

**Multijurisdictional Watershed Management in Virginia:  
Experiences and Lessons Learned**

by

Matthew Criblez

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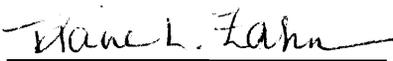
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Environmental Planning

Approved:

  
\_\_\_\_\_  
John Randolph, Chairman

  
\_\_\_\_\_  
William Cox

  
\_\_\_\_\_  
Diane Zahn

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**Keywords:** Watershed Management; Watershed Protection Approach; Institutional Framework and Planning; Stakeholder Involvement; Local Implementation Strategies; Monitoring.

# **MULTIJURISDICTIONAL WATERSHED MANAGEMENT IN VIRGINIA: EXPERIENCES AND LESSONS LEARNED**

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Dr. John Randolph, Chairman

Department of Urban Affairs and Planning

## **(ABSTRACT)**

Multijurisdictional agreements among local and regional authorities have emerged as an effective way to manage Virginia's watersheds. These agreements generally result in the development of goals and objectives for the watershed environment, and the implementation of various strategies designed to achieve these goals. Successful agreements often result in stabilized or improved water quality in the region.

The Environmental Protection Agency has developed the Watershed Protection Approach and recommended it to manage water quality. While accepted, the Approach has not been well demonstrated in practice. Ten Virginia case studies are conducted to determine (1) if the Approach is represented in the program components and (2) if the components are effective in achieving program objectives. The case studies were developed through document review and interviews with program personnel, including local and regional agencies and nongovernmental organizations. Critical components of these multijurisdictional approaches are identified and compiled to assist other regions and localities in their watershed management programs.

The EPA Approach identifies four relevant watershed management features; however, these are general and do not describe nor clarify its potential implementation. This thesis four categories corresponding to critical components of watershed management programs identified in the case studies, which illustrate and expand on EPA's Approach, particularly its implementation: institutional framework and planning, stakeholder involvement, implementation strategies, and monitoring. These case studies demonstrate that regional policies and plans provide the necessary institutional

framework; that participation of key stakeholders, especially those involved in implementation is critical in plan development; that local implementation land use strategies including both regulatory and non-regulatory land use measures, and structural and non-structural land practices, are most effective in achieving regional watershed management objectives; and that monitoring is needed to measure effectiveness and can effectively engage non-governmental groups and citizen volunteers.

## **Dedication**

To Ringo, you were a great inspiration and a great friend. Although gone, your memory will always live through your family and friends. Your impact on our lives and my life and my beliefs in particular has been immense. You convinced me to see the world without blinders and to be a considerate and good person. I will always try to be more like you.

## **Acknowledgments**

Thanks go to Vinh Nguyen, who helped me get through the last two years of grief and headaches and who was also there to share the fun times. I so enjoyed our critical discussions about this experience. One day I'm sure we will sit back and laugh.

I would also like to thank Mom, Pop, Roger, Cathy, Jeff, Greg, and their respective families for their continuous support and patience. All of you have contributed to who I am today and to my desire to succeed at everything I set out to do.

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## **I. Introduction**

The most effective way to control the quality and flow characteristics of a waterbody is to manage the land area that constitutes its watershed. A watershed is the drainage basin or land area draining to a waterbody and is separated from other watersheds by a ridge or drainage divide. For watersheds that extend across political boundaries, land use and water practices in one jurisdiction affect others in the watershed. Therefore, effective management of the entire watershed requires collaboration among jurisdictions. Multijurisdictional programs for watershed management have been implemented in several areas. In addition, beginning in the early 1990s, the Environmental Protection Agency (EPA) advanced a management framework for a multijurisdictional approach based on what it calls the Watershed Protection Approach (WPA). However, neither the Watershed Protection Approach nor recent experiences in watershed management have been fully assessed in practice.

### **Purpose**

The purpose of this thesis is to identify the specific institutional characteristics and components of selected Virginia watershed management programs in practice and to assess their relative effectiveness in achieving watershed management objectives. The thesis will determine the extent to which EPA's Watershed Protection Approach is represented in the experiences of these watershed management programs in Virginia. Finally, the thesis will extract and formulate the lessons from these selected watershed management programs that may be useful to other regions and jurisdictions lessons in developing their programs and that contribute to the clarification and implementation of the Watershed Protection Approach.

## **Background**

Historically, management of waterbodies has occurred at the primary river or lake and usually has not extended into the watershed and other tributaries. A watershed is most often defined as “a geographic area from which water, sediments, and dissolved materials drain to a common outlet, which may be a point on a larger stream, a lake, or an estuary” (Randolph, 1991:1). Because watersheds do not conform to jurisdictional boundaries, runoff and water pollution do not cease at local, regional, and national borders, nor can they be solved by any one organization.

As a result, the watershed is becoming more accepted as the appropriate geographic unit for water quality and quantity management. However, to accommodate this shift to watershed wide management, various institutional changes are necessary. The spectrum of changes “range from informal interagency consultations to radical overhaul of existing natural resources legislation and administrative agencies” (Cortner et.al., 1994: 172). A complete overhaul of existing natural resources legislation and institutions is unlikely due to political, financial, and other concerns. Development of informal interagency consultations has occurred in many regions, although this has often not been sufficient for achieving watershed wide objectives. The appropriate management framework for a specific region may lie between these ends of the spectrum, or some combination of the two.

Several regions are coordinating local management policies, institutional arrangements, and management strategies to accommodate this change. An integrated institutional approach has been used by a number of regions which includes regional coordination and planning and local implementation strategies at the subwatershed level.

Regional planning and coordination is required because multiple jurisdictions contribute to the problem and affect one another. The interdependence among these affected parties requires innovative organizational arrangements to develop and implement effective policy and management actions. Because many of the reservoirs located throughout Virginia are primary drinking water sources, development of effective management strategies is particularly important for public health and economic

development as well as environmental quality. These local strategies generally include land use controls and practices deemed important to control watershed runoff quality and quantity in order to maintain and improve the water quality of a receiving lake or river.

Nonpoint source pollution, especially nutrients and sediments, is a major contributor to regional and localized water quality problems in Virginia's rivers and lakes and in the Chesapeake Bay as well (Cox et.al., 1987: 1; NSCBP, 1995: 2). While agricultural practices are the primary contributors through erosion, sedimentation, and chemical and organic runoff, urban development and forestry activities have also resulted in significant nonpoint source loads (NSCBP, 1995: 2).

In ultra-urban areas, such as Northern Virginia, nonpoint source pollution comes primarily from urban development as a result of increased stormwater runoff volumes and subsequent increased rates of erosion and sedimentation (Northern Virginia Planning District Commission (NVPDC) et.al. 1992: 2-3). Impacts from nonpoint source pollution (urban development and agricultural and forestal practices), therefore, have resulted in the impairment of drinking water sources and supplies (Cox et.al., 1987: 1). In Virginia, the Occoquan basin and the Hampton Roads region have experienced these particular problems and have attempted several strategies to protect the watershed and the water quality of reservoirs and tributaries.

State and federal water quality programs in Virginia have focused on four distinct areas in developing more comprehensive approaches. First, water quality standards have been established as a basis for monitoring and regulation. Second, a strong emphasis on wastewater discharge management has brought a semblance of control over point source pollution. Third, an increased emphasis on nonpoint source pollution has occurred. Virginia, however, has been strongly criticized because its program is not directly related to established water quality standards and does not address watersheds as a whole. Fourth, the Virginia Chesapeake Bay Preservation Act has focused attention on land use and the importance of tributaries the quality of the Bay (City of Fredricksburg, 1994).

### ***Chesapeake Bay Preservation Act***

While many local watershed management programs have concentrated on the protection of drinking water supplies and tributaries, many of their efforts are governed by a more comprehensive approach, which focuses on the Chesapeake Bay. Protection and improvement of the Bay is the primary focus of federal and state agencies and various citizen organizations and has become the guiding framework for many watershed management plans and policies in the region.

In 1983, the states of Pennsylvania, Maryland, and Virginia, and the District of Columbia signed the Chesapeake Bay Agreement, which established a unique multi-state partnership for the restoration of the Bay. The Agreement was complemented by the 1987 Agreement, the 1992 Amendments, and the 1993 and 1994 Directives of the Chesapeake Executive Council. The initial Agreement recognized three primary factors: (1) the economic, environmental, and social importance of the Bay, (2) the impacts associated with point and uncontrolled nonpoint source pollution, and (3) specific mandates to mitigate these impacts. The 1987 Agreement continued to identify nonpoint source pollution as a serious threat to the Bay's water quality and subsequently set a goal to reduce nitrogen and phosphorous by 40% by the year 2000. The 1992 and 1994 Amendments were designed to continue this reduction and establish watershed wide nutrient reduction targets at the Bay's 10 major tributaries throughout the states and District (Chesapeake Bay Program, 1995).

Virginia enacted the Chesapeake Bay Preservation Act (CBPA) in 1989 to partially fulfill the intent of the interstate Chesapeake Bay Agreement. Virginia's CBPA "establishes a more specific relationship between water quality protection and local land use authority" (CBLAD, 1989: iv). This Act and the previous interstate Agreement are the result of the need for a regional perspective in addressing local land use management concerns (Hirschman et.al., 1992: 86).

All localities included in the CBPA region are required to adopt the Act's provisions and implement various policies and strategies to protect the state's water quality. Figure 1.1 identifies the jurisdictions falling within the CBPA region. While

many localities have enacted more stringent policies and strategies to protect water quality, this Act is a minimal requirement for all jurisdictions in the region in implementing watershed management practices.

The Chesapeake Bay Preservation Act provides the regional framework for water quality protection, although smaller regions and localities must adopt and build this into their plans, land use regulations, and other site-specific watershed protection strategies. According to the EPA (1995: 1-4), both statewide and local watershed approaches can be effective and compatible when designed appropriately. For example, the development of local watershed projects provides for the implementation of a larger statewide approach. In contrast, the establishment of the “statewide approach may be more suitable and may help build a case for local action at the watershed level” (EPA, 1995: 1-4).

### ***Environmental Protection Agency: Watershed Protection Approach***

The purpose of the Watershed Protection Approach developed by EPA, is to refocus watershed management programs in a more comprehensive manner. This federally sponsored approach suggests that states and localities target threatened watersheds and address their problems. The approach is decentralized recognizing that regulations and protection techniques established by the federal government at the individual watershed level would not be financially feasible or politically acceptable: they not only would require considerable financial and technical resources, but also would encroach on traditional state and local objectives. The Watershed Approach, therefore, provides the framework for an integrated comprehensive approach in protecting local or regional water quality. The Approach is based on four key components. These components are illustrated in Figure 1.2 and are briefly described below.



**Figure 1.1: Tidewater, Virginia**

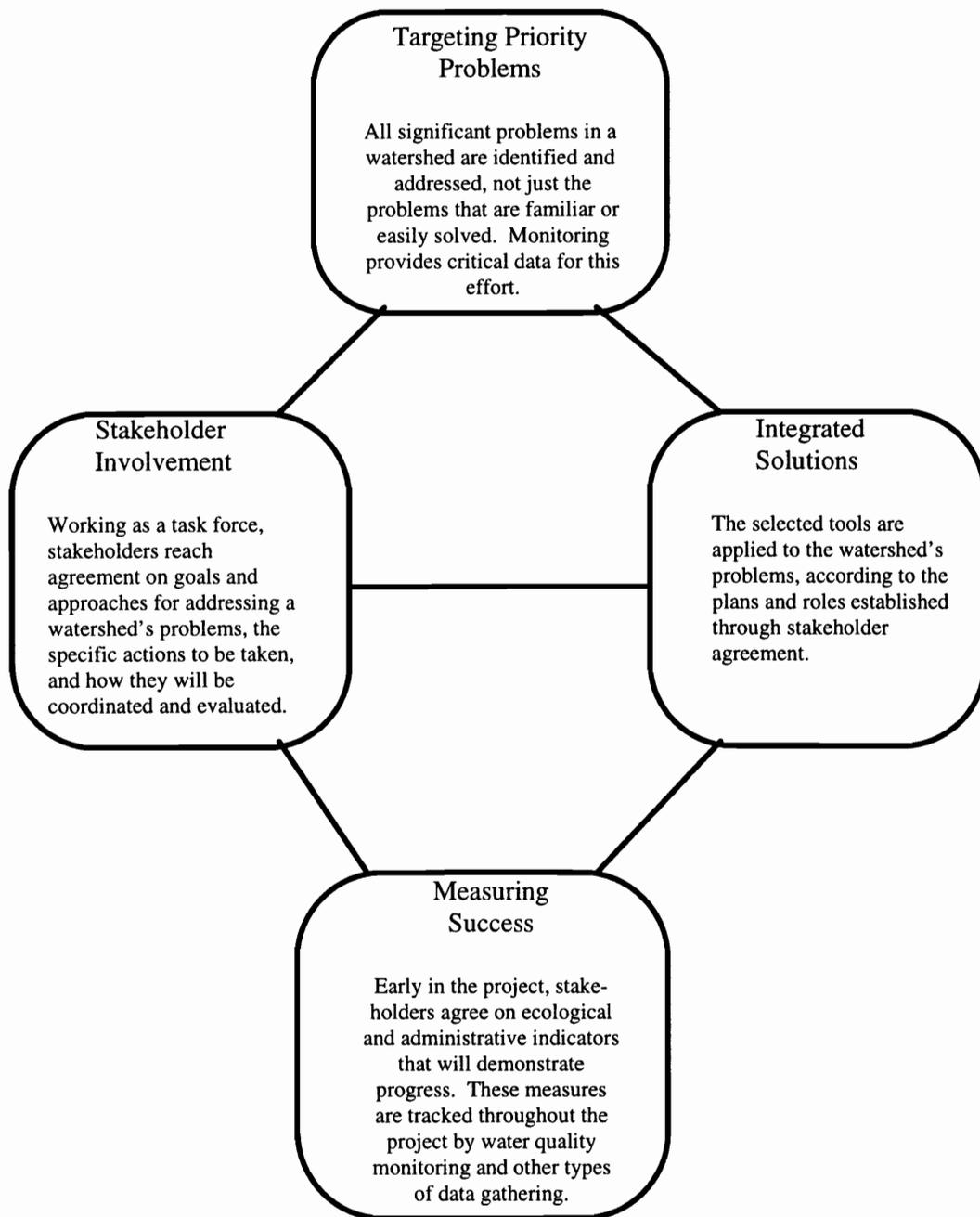
Note: Albemarle and Culpeper counties are not included in Tidewater, but they have adopted the Chesapeake Bay Act regulations.

Source Chesapeake Bay Local Assistance Department, 1989.

- ♦ *Targeting Priority Problems:* All problems within the defined watershed should be identified and prioritized. High priority problems should be addressed first.
  - ♦ *Stakeholder Involvement:* All relevant stakeholders (e.g. landowners, citizen organizations, public agencies) should be involved in problem identification, solution formulation, and implementation.
  - ♦ *Integrated Solutions:* A variety of institutional, regulatory, non-regulatory, economic, and engineering strategies should be considered in formulating integrated and coordinated watershed management policies and implementing programs.
  - ♦ *Measuring Success:* Measures of success should be identified and agreed upon by all stakeholders and should be used to monitor the effectiveness of programs. (EPA, 1995: 1-1,2,3)

The Watershed Protection Approach intends for regions to develop multijurisdictional water quality programs based on four guidelines. First, this Approach requires that watersheds are to be the basic management unit and that all nonpoint and point sources of pollution within the watershed be addressed. EPA, among others, has stated that the effectiveness of a watershed management framework is related to the identification of a common concern or issue held by all interested stakeholders. Jurisdictions and individuals are much more likely to become concerned about an issue, such as water quality degradation, when it directly impacts them. On the other hand broad frameworks, such as the CBPA and tributary strategy, do not identify a critical concern held by all the localities, especially those jurisdictions furthest from the Bay.

A watershed management program is often established to provide protection of a regional drinking water supply. Drinking water throughout Virginia is derived to a large extent from surface water sources. Feeder tributaries, as well as many reservoirs and distribution systems, cross jurisdictional boundaries and, are therefore, impacted, utilized,



**Figure 1.2: Features of the EPA Watershed Protection Approach**  
Source: USEPA, 1995: 1-2.

and managed by a number of localities. These water supplies, critical to public health and economic development, are often the common concern identified among various jurisdictions.

Second, goals and objectives are to be clearly defined by involving all stakeholders during the program. Many stakeholders in a region including localities, regional organizations, citizen groups, and individual landowners make use of federal and state financial and technical assistance programs. Perhaps more significantly, use of these assistance programs illustrate the necessity of creating moderate and small watershed projects. By focusing on a particular lake or reservoir, local interest of localized water quality problems will increase. Large multiwatershed programs, such as the CBPA, are essential in providing a regional framework for watershed protection. However, the establishment of the WPA at a regional level in conjunction with the smaller subwatershed management actions can provide regional coordination and site specific solutions, therefore, contributing to the attainment of regional watershed goals and objectives.

Third, resources and expertise of all participating agencies are used to expand the scope of the program to avoid reliance on one agency or jurisdiction. According to the EPA, the appropriate size of a watershed program under the Approach should be based on five factors.

- ♦ *Nature and extent of the water quality problem*
- ♦ *Existing administrative boundaries (e.g. counties)*
- ♦ *National watershed delineations (US Geological Survey, Natural Resources Conservation Service)*
- ♦ *Ecoregion boundaries, reflecting homogeneous ecological systems, derived from analysis of topography, land use, potential natural vegetation, and soils*
- ♦ *Water quality model limitations (EPA, 1995: 2-3,2-4).*

This Approach can complement other environmental and natural resource management activities. Local and regional groups interested in protecting their watersheds and water quality have implemented the WPA with other federal assistance

programs. Three programs are commonly used by these organizations and agencies for water supply evaluation and protection.

- The Clean Water Act (CWA) section 319 provides federal grants to localities for small nonpoint source watershed demonstration projects.
- The CWA section 314, the Clean Lakes Protection/Restoration Program provides technical and financial assistance to develop holistic watershed management projects, focusing on small lakes and reservoirs and emphasizing grassroots stakeholder involvement.
- The PL-566 Watershed Protection and Flood Prevention Program (Small Watershed Program) provides federal assistance to small watershed projects. This Program is aimed at identifying and implementing appropriate land treatment practices and is developed collaboratively by the NRCS and individual landowners.

Finally, monitoring provides data on the implementation of management strategies and resulting water quality changes and can be used to determine the effectiveness of watershed management projects. Various indicators have been suggested by the EPA to monitor the success of programs using the Watershed Protection Approach. Some examples include

- water quality improvements and changes, e.g. nutrients, phytoplankton, clarity.
- fish populations
- number of stream miles monitored
- number of facilities installing BMPs
- number of municipalities enacting zoning ordinances.

These indicators provide general measures of success for Watershed Protection Approach projects and can be adapted to analyze other types of watershed management programs.

## **Objectives and Methods**

### ***Research Approach***

The research uses case studies of selected watershed management programs in Virginia to assess critically EPA's WPA and to identify lessons useful to other regions and localities interested in developing watershed management programs.

### ***Objectives***

*Objective 1:* Identify case study candidates based on data collected through surveys of local governments and regional PDCs (Randolph 1990). (See Appendix 1 for list of all candidates).

*Objective 2:* Select successful programs for case studies.

*Objective 3:* Develop case studies of the selected multijurisdictional approaches in Virginia.

*Objective 4:* Identify the specific institutional characteristics and program components from the selected watershed management programs and assess the relative effectiveness of these components in achieving watershed management objectives.

*Objective 5:* Determine the extent to which EPA's WPA is represented in the experiences of the selected watershed management programs in Virginia.

*Objective 6:* Formulate lessons learned from the selected watershed management programs that

- (a) may be useful to other jurisdictions in developing and implementing their own watershed management programs, and
- (b) contribute to the clarification and implementation of EPA's WPA.

### ***Methods***

- ♦ Measures of success used to select case studies are based on three criteria derived from the Watershed Protection Approach (Objective 2).

1. Improved water quality in river, stream, lake, or reservoir.
  2. Development of and consistency with watershed wide objectives.
  3. Institutional change: indicated by increases in the number of water quality projects by localities and the region.
- ♦ Project and program documents of selected case studies are reviewed (Objective 3).
  - ♦ Conduct interviews with relevant agency and organizational representatives throughout the identified watersheds. Relevant representatives are those who have developed the project and/or are responsible for its implementation. Local agencies (planning, public works, utilities, and park authorities), regional agencies (planning district commissions, regional boards and agencies), and local environmental citizen groups were interviewed (Objective 3).
  - ♦ Primary components from each program are identified and those essential to the watershed management planning process are extracted (Objective 4).
  - ♦ Components are assessed according to the following criteria to determine how well they represent the WPA (Objective 5).
    - Identification of regional problems (e.g. water quality)
    - Involvement of relevant stakeholders
    - Development of regional plans
    - Establishment of monitoring projects to assess project success

## **Procedures**

Preliminary case study candidates were identified and evaluated from three primary sources: surveys, conducted by Randolph (1990), all Virginia Water Resource Conference abstracts, and various 319 projects provided a. Surveys were conducted of local jurisdictions and Planning District Commissions to identify conflicts and accomplishments at both levels. From these surveys 35 multijurisdictional watershed management programs were identified as possible case studies. (See Appendix 1 for a complete list). Most of the programs exhibited some of the selection criteria: water quality improvements, watershed wide objectives, and institutional changes. However, a

total of 11 case studies were selected, which were deemed to meet the criteria to the largest extent. In addition, these 11 programs also provide lessons of various innovative policies and techniques that may be potentially useful to other localities.

Table 1.1 identifies the 11 programs and illustrates how each meet the preliminary criteria. Four of the programs became detailed primary case studies: the Occoquan watershed, the Hampton Roads region, the Albemarle-Charlottesville region, and the Upper Rappahannock watershed. These four met the specified criteria and were, therefore, considered successful multijurisdictional approaches.

Water quality at the Occoquan and Albemarle-Charlottesville reservoirs have stabilized since the inception of watershed management programs. Comprehensive water quality at Hampton Roads cannot be determined due to the large number of rivers and reservoirs located there. The upper Rappahannock is a slightly different case in which water quality at the River has remained relatively high.

Watershed wide objectives have been developed and implemented by all of these regions. Regional objectives and plans have been developed at both the Occoquan and South Fork Rivanna watersheds. Due to the numerous waterbodies in Hampton Roads, there are no regional plans, although a number of subwatershed agreements exist. The upper Rappahannock region has not adopted regional objectives or a regional plan, although informal agreements and objectives do exist and are implemented.

All of the programs are experiencing problems and conflicts that are common to several other regions throughout Virginia. The four regions are developing policies and strategies that are not site-specific and may be implemented by other jurisdictions. Finally, the jurisdictions within each of the regions have adopted various institutional and programmatic changes to incorporate the regional approach.

The other six programs selected are examples of multijurisdictional experiences which have developed specific innovative policies and/or management strategies. Most of these programs have resulted in water quality improvements, except at Smith Mountain Lake where water quality continues to decline.

**Table 1.1: Case Studies Selection Process**

<b>Region</b>	<b>Water Quality</b>	<b># Stream Miles Monitored</b>	<b>Use of BMPs</b>	<b>Policy Measures</b>	<b>Sources of Data</b>
<b>Occoquan</b>	↔	↑	↑	↑	OWML, DEQ, NVPDC, local comprehensive plans
<b>Hampton Roads</b>	N/A	↑	↑	↑	HRPDC, local comprehensive plans
<b>Albemarle-Charlottesville</b>	↔	↑	↑	↑	TJPDC, RWSA, local comprehensive plans
<b>Upper Rappahannock</b>	N/A	↑	↑	↑	local comprehensive plans
<b>Chesapeake Bay</b>	N/A	↑	N/A	N/A	Alliance
<b>Copper Creek</b>	N/A	N/A	↑	N/A	VWRRC
<b>Moccasin Creek</b>	N/A	↑	N/A	N/A	CBLAD
<b>Polecat Creek</b>	↑	N/A	↑	↑	Peninsula PDC
<b>Dragon Run</b>	↓(?)	↑	↑	↑	Ferrum College, SMLA, SMLPAB
<b>Smith Mountain Lake</b>	N/A	N/A	↑	↑	EPA
<b>Floyd County</b>	N/A	↑	↑	↑	EPA
<b>Lake Barcroft</b>	N/A	↑	↑	↑	EPA

## **Organization of Thesis**

The next four chapters are in-depth studies of Occoquan, Hampton Roads, Albemarle-Charlottesville, and upper Rappahannock watershed management programs, respectively. Each chapter provides an overview of the region and the conflicts faced and describes the solutions developed to mitigate the problems. Chapter 6 explores and assesses six other programs, which have demonstrated a specific institutional characteristic or program component relative to the WPA. Chapter 7 then synthesizes specific lessons from each of the programs and assesses them for their contribution to and clarification of EPA's Watershed Protection Approach.

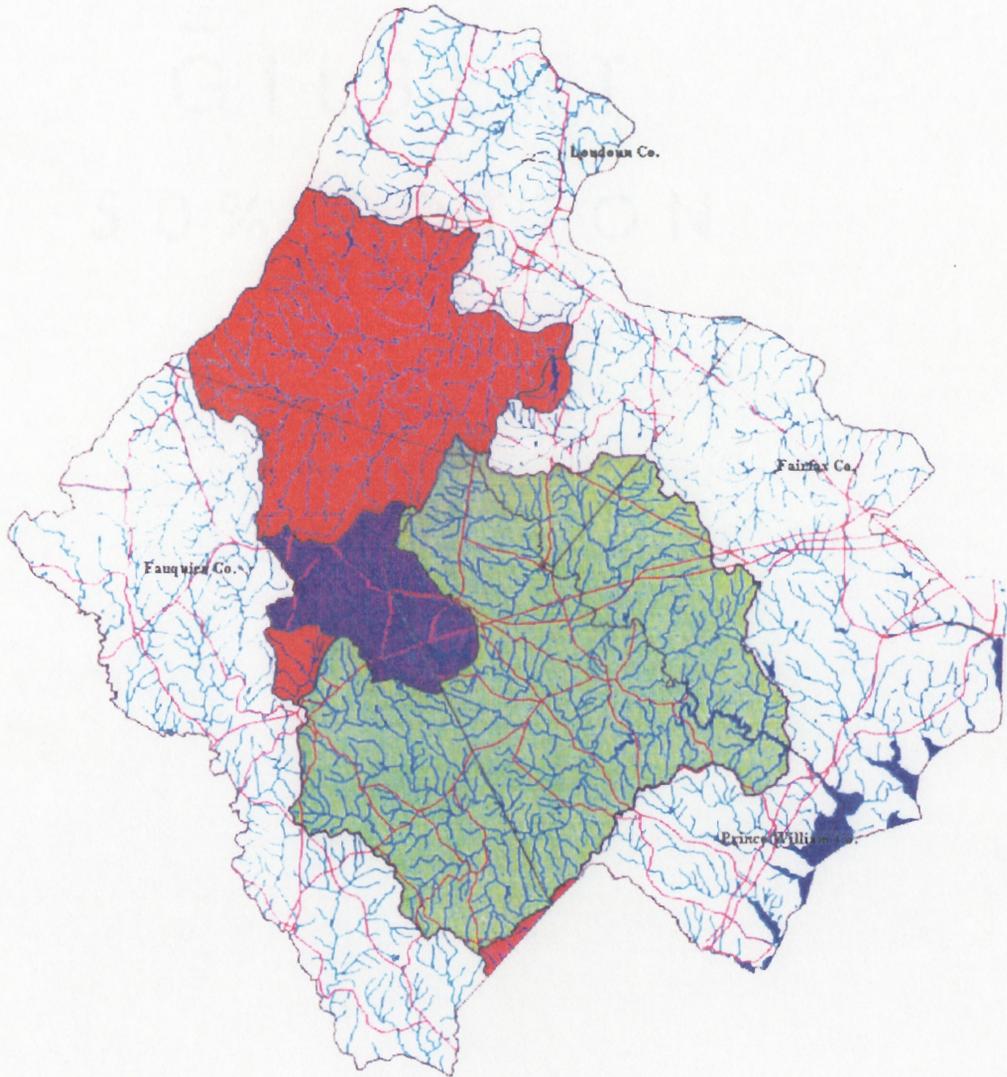
## **II. Multijurisdictional Watershed Management and Water Quality Monitoring in Northern Virginia**

This case study investigates the Occoquan watershed and related watersheds of Northern Virginia. It identifies plans, institutional frameworks, strategies, and monitoring techniques developed by various agencies and organizations. Lessons are then gleaned from this case study, which may be useful for other watershed management programs in Virginia.

The study begins with an overview of the political and geographic extent of the watersheds. It then briefly describes the history of watershed evaluation and assessment in the region and evaluates the processes used to formulate goals and watershed management policies. The study also analyzes the watershed program relative to the WPA and formulates lessons from the experience that may be useful to other localities in developing their own watershed management program.

### **Background**

Northern Virginia is the southern portion of the Washington DC metropolitan area and is governed by a number of county and municipal jurisdictions. The Occoquan Watershed, a sub-watershed of the Potomac, is an area in Northern Virginia defined by the Occoquan Reservoir and the streams draining into the Reservoir (See Figure 2.1). The Reservoir has a watershed encompassing 570 square miles, extends into four counties and two municipalities, and supplies water to well over 800,000 people (Fauquier Co., 1994: 2-11). Bull Run and Occoquan Creek are the primary feeders of the Occoquan Reservoir and watershed, while Pope's Head Creek, Wolf Run, Cub Run, and Sandy River, also drain into the Reservoir. The Occoquan Creek is formed by the confluence of Broad Run and Cedar Run, and lies above and supplies the Lake Jackson impoundment. The subwatershed of Broad Run also drains into Lake Manassas, which is the principal water supply for the cities of Manassas and Manassas Park.



**Figure 2.1: Water Supply Watersheds in Northern Virginia**

- Goose Creek
- Beaver Creek
- Occoquan Watershed
- Lake Manassas Reservoir
- Aquia Creek Reservoir
- Warrenton Reservoir

Source: Derived from Information Support Systems Lab, Virginia Tech

Portions of the Potomac are included in this discussion because the Occoquan is a subwatershed of the Potomac and, additionally because of the influence and transference of the Occoquan's organization and jurisdictional controls to the Potomac watershed. Previously attempted management and monitoring strategies in the Occoquan have influenced local authorities in developing management strategies at the Potomac.

As with the Occoquan, portions of the Potomac watershed are also managed in a multijurisdictional fashion, including three of the Occoquan management localities: Loudoun, Fairfax, and Prince William counties (See Figure 2.1). Subsequently, with information derived from the Occoquan projects and studies, these jurisdictions have been able to develop management and monitoring strategies in the Potomac and other subwatersheds.

During construction of the Occoquan Reservoir, the basin was primarily rural and it was believed that this condition would preserve the quality of the reservoir waters (OWML, draft report). What was not expected were the high levels of development and the rapid population growth in the region, nor the resulting increases in wastewater discharge and stormwater runoff in the developed areas. Poorly controlled development and inadequate planning resulted in the placement of several wastewater discharges just above the Reservoir's intake. Furthermore, agricultural activity throughout the watershed resulted in increases of other nonpoint source pollutants and higher levels of soil erosion impacting the Reservoir.

Beginning in the 1960's, the Reservoir experienced degradation of water quality due to these point and nonpoint sources of pollution (Cox et.al., 1987). The reservoir showed signs of advanced eutrophication due primarily to the increased pollution loads. As a result, the Reservoir experienced massive algal blooms, shortened filter runs, periodic episodes of taste and odor problems, and periodic fish kills due to low levels of dissolved oxygen. To eliminate these problems, the State Water Control Board (now the Department of Environmental Quality (DEQ) and the Department of Health collaborated to establish the Occoquan Policy in 1971. Table 2.1 outlines the history of water quality concerns at the Occoquan Reservoir.

## Multijurisdictional Management of the Northern Virginia Watersheds

### *Occoquan Policy*

The 1971 Occoquan Policy recognized the extraordinary measures needed to protect public health where re-use of treated wastewater would become the operational norm in the watershed (NVPDC, 1994:7). This Policy included strict wastewater treatment standards and required the construction of a single regional advanced water treatment (AWT) plant to replace all the secondary treatment plants. The Policy further required the adoption of land use regulations restricting development activities in the basin. While the Occoquan Policy focused primarily on specific practices and measures to protect water quality, it also provided for extensive and continued water quality monitoring. The Occoquan Policy established the region's water quality monitoring framework by mandating the creation of the Upper Occoquan Sewage Authority (UOSA) and the Occoquan Watershed Monitoring Program (OWMP). Subsequent to the introduction of the single point pollutant loads have decreased and the Occoquan's water quality has actually improved (NVPDC, 1994).

**Table 2.1: Timeline of Events at the Occoquan Reservoir**

1957	Occoquan Reservoir constructed.
1960s	Eutrophication of the Reservoir occurred.
1971	Occoquan Policy created.
1972	Occoquan Watershed Monitoring Lab created.
1976	208 Areawide Plan conducted.
1978	UOSA AWT plant placed in service, replacing 11 secondary treatment plants.
1978	Occoquan Policy Board established.
1982	Occoquan Basin Nonpoint Pollution Management Program developed.
1982	Occoquan Basin Study conducted.
1985	Downzoning in Fairfax County upheld by courts.
1994	OWML began Phase II of the USEPA Clean Lakes Program Diagnostic-Feasibility Study of the Occoquan Reservoir.

Source: Derived from: NVPDC, 1994; Mohan(a), 1995; and Godrej, 1996.

Poorly treated sewage was generally believed to be the primary source of the algae and nutrients found in the Reservoir and that nonpoint source pollution did not significantly contribute to the eutrophication of the Reservoir. Reservoir quality did improve. However, nonpoint sources were more significant than previously believed and it was determined that serious impacts on water quality would occur given unchecked urban growth. With this information, the NVPDC, in collaboration with the Occoquan Watershed Monitoring Laboratory (OWML), developed a 1976 “208” areawide plan for the basin to mitigate urban and agricultural impacts on the water quality. The plan identified and recommended a number of Best Management Practices (BMP) to alleviate the nonpoint source impacts.

### ***Occoquan Policy Board***

To implement the plan, the Occoquan Policy Board was established in 1978. The Board, which is still in effect today, was a major stakeholder in the development of the region’s multijurisdictional approach to watershed management. The Policy Board is comprised of representatives from all affected jurisdictions, as well as representatives from the City of Alexandria, the local Soil and Water Conservation Districts (SWCD), the Fairfax County Water Authority, the Virginia-American Water Company, and the NVPDC. According to the NVPDC (1994: 222), the Board is unique because it receives financial support from all local jurisdictions, including Manassas and Manassas Park which do not draw water from the Reservoir.

The Board evaluates pollution control techniques throughout the watershed and develops watershed wide policies to protect regional water quality. The NVPDC under the supervision of a Technical Advisory Committee conducts various technical investigations. The studies, subsequently, assist the Policy Board in assessing the progress of nonpoint source pollution controls. Representatives from local planning, public works, and environmental departments, NVPDC staff, and a citizen representative from each participating jurisdiction all sit on the Committee.

While the local jurisdictions implement various strategies to protect the Occoquan reservoir watershed, their collaboration through the Policy Board is a key component. According to the Environmental Protection Agency (EPA), in reference to watersheds in general, “the best chance for noticeable improvements is comprehensive assessment of all pollution sources in the watershed and a coordinated plan to control the sources and attain water quality goals” (Perciasepe, 1995). This assessment came with the development of the 208 areawide plan and the subsequent Occoquan Basin Nonpoint Pollution Management Program.

### ***Occoquan Basin Nonpoint Pollution Management Program***

A major force in developing a comprehensive plan for all activities in the Occoquan basin occurred with the enactment of the Occoquan Basin Nonpoint Pollution Management Program. The NVPDC created the Program in 1982 as part of the Occoquan Policy and the EPA’s National Urban Runoff Program. The Occoquan Program monitored water quality at “12 urban test watershed sites to correlate the effectiveness of urban land use and nonpoint pollution loadings and to evaluate the effectiveness of BMPs” (NVPDC, 1994:1). The Program’s provisions are outlined and briefly described in Table 2.2.

The Program coordinated local jurisdictions’ land use controls, policies, and management strategies. Furthermore, the Program assisted localities in revising and amending comprehensive plans, zoning ordinances, subdivision ordinances, stormwater management regulations, erosion and sediment control ordinances, and promotes the use of structural and nonstructural BMPs (Hirschman et.al., 1991: 19). The Occoquan Program, which is still in effect, serves as an advisory tool only, not a regulatory program imposed on the local agencies. However, all the localities throughout the watershed have adopted the Program.

The Program was originally developed to provide localities with information on the use of specific structural on-site BMPs, such as dry ponds, and outlines appropriate implementation techniques. The Occoquan Program also encouraged jurisdictions to

require creation of BMPs by local developers. However, these BMPs were designed with the intent of controlling water quantity, with little regard for water quality issues. Recently, the Occoquan Lab and local jurisdictions have started retrofitting dry ponds and other BMPs in an attempt to address water quality as well.

**Table 2.2: The Occoquan Basin Nonpoint Pollution Management Program**

<ul style="list-style-type: none"> <li>♦ Program <u>developed by NVPDC and local jurisdictions</u> in 1982.</li> <li>♦ Developed due to the identification of <u>nonpoint source pollution as a major contributor of water quality decline</u> in Occoquan and tributaries.</li> <li>♦ <u>Works with local agencies</u> to: <ul style="list-style-type: none"> <li>♦ revise comprehensive plans;</li> <li>♦ amend zoning, subdivision, site review, erosion and sedimentation, and</li> <li>♦ stormwater management ordinances; and</li> <li>♦ promote structural and nonstructural BMPs.</li> </ul> </li> <li>♦ <u>SWCDs work with local agencies and resident landowners in developing site plans</u> to bring land into compliance with Program.</li> <li>♦ A <u>voluntary program serving as an advisory tool</u>, not a regulatory project.</li> <li>♦ Established <u>NVPDC as a major player</u> in the watershed.</li> <li>♦ Instrumental in developing <u>multijurisdictional approach</u> in the watershed.</li> <li>♦ <u>OWML</u> in collaboration with local agencies is currently <u>reevaluating recommendations in original Program</u>.</li> </ul> <p>Source: Derived from: NVPDC, 1994; Mohan(a), 1995, Godrej, 1996.</p>
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The local Soil and Water Conservation Districts (SWCD) located within the basin have also been instrumental in designing and carrying out this Management Program. The Districts inform landowners about the Program’s objectives and work in collaboration with residents to design and implement site-specific projects. This collaborative effort allows local residents to bring their land into compliance with the Management Plan’s objectives and the equivalent jurisdictional standards. As a result of the Plan’s requirements, a number of these BMPs have been incorporated into developers site plans.

A number of problems are associated with the Program, and therefore, it has not been as effective as originally hoped. Perhaps the most significant problem is that specific types, designs, and implementation strategies promoted by the Program are not

monitored for effectiveness and efficiency. For example, dry ponds were designed in the Occoquan Lab and not tested prior to implementation. According to Godrej (1996), these measures are being mandated by government agencies and are being implemented throughout various parts of the world, although effectiveness is not yet known.

A second problem associated with this Program is the original focus on water quantity. Dry ponds, culverts, and other stormwater management measures were developed to control storm flows with a frequency of two years or less. As the water quality in the Occoquan and tributaries continued to decline, it became apparent that the BMPs should control water quality as well as quantity. Subsequently, the BMPs have been redesigned and are being retrofitted when financially feasible. Dry ponds, which are ineffective water quality controls, are being retrofitted as wet ponds, while culverts are also being retrofitted to better maintain water quality.

Retrofitting, however, is an expensive and time consuming procedure and has created doubts among agency officials about the actual effectiveness of the BMPs. Furthermore, many on-site BMPs have structural failures and can no longer be retrofitted. As a result, localities and developers alike, concerned about the efficiency and cost effectiveness of retrofitting, are not eager to construct BMPs. Localities are becoming reluctant to require development of these measures due to inadequate attention to water quality concerns. In many cases local agencies have assumed responsibility for BMP maintenance and, are therefore, responsible for the retrofitting. Jurisdictions, compelled to require and develop these BMPs, are now attempting to shift the responsibility to state and federal authorities by requesting financial assistance for retrofitting.

While this Nonpoint Pollution Program does have a number of problems, it has been a major step toward a multijurisdictional approach. The Program encouraged the involvement of all relevant jurisdictions, including local, regional, and state agencies in the planning and management of the Occoquan watershed. In addition, it has required that local agencies work in collaboration with other jurisdictions and agencies to achieve both watershed wide and individual objectives.

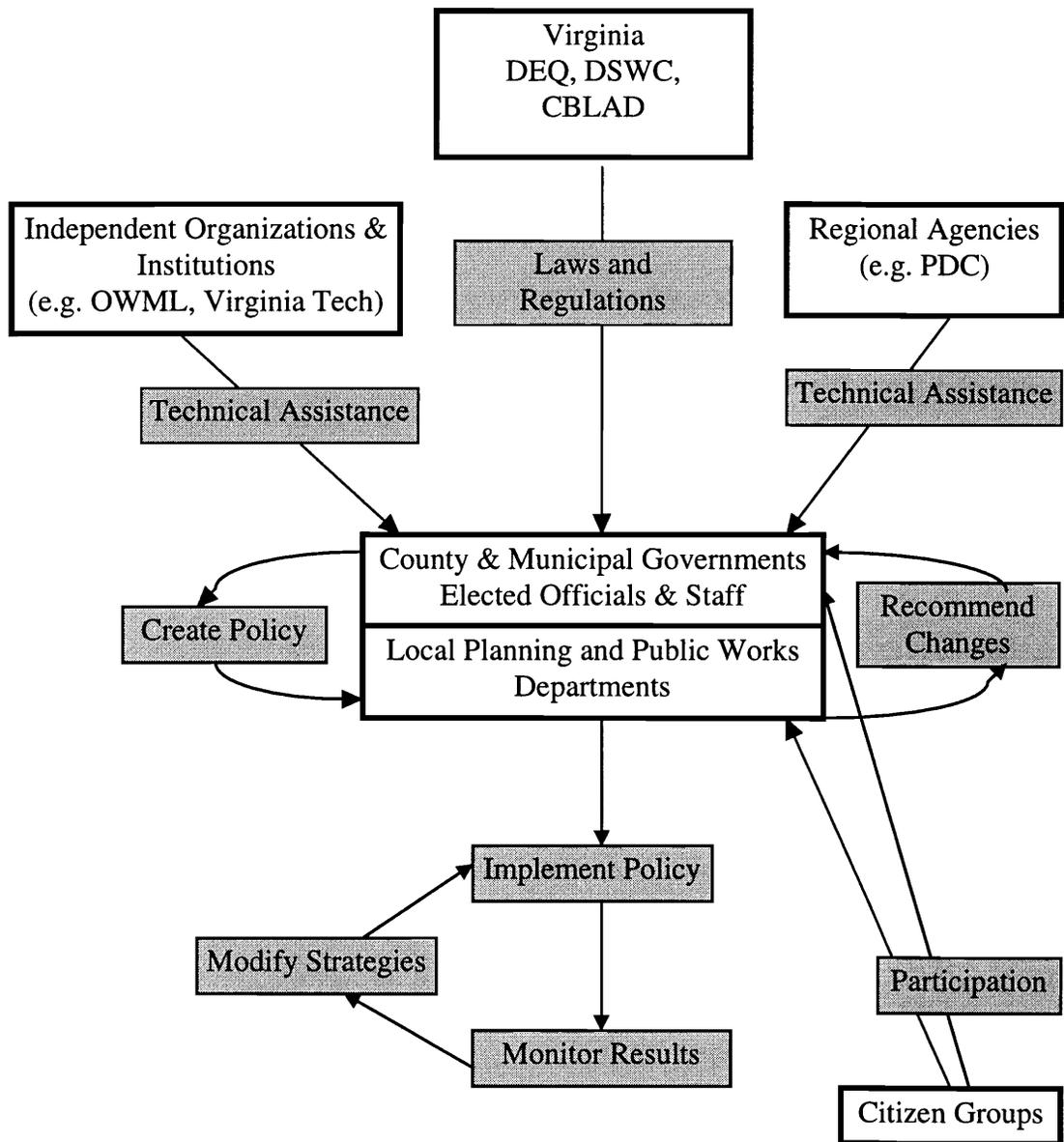
### ***Role of Regional and Sub-watershed and Local Agencies***

Development of the Program was significant for the NVPDC because it established the PDC's role as lead agency in the region. The NVPDC is an instrumental agency in the region, acting as a catalyst for watershed and water quality protection. The PDC has developed a number of management guidelines and handbooks for agencies and residents to maintain and enhance regional water quality. Furthermore, it works with the Fairfax County Water Authority in designing monitoring strategies to evaluate various land use management techniques.

Similar to the PDC, the SWCDs are also an advisory agency without regulatory authority, although they do assist local governments and the PDC in developing management strategies. The SWCDs provide technical assistance to individual landowners required to abide by the management strategies and recommendations mandated by the localities and the NVPDC. As illustrated in Figure 2.2, a number of agencies hold responsibility for management and planning decisions around the Reservoir.

Several other agencies play a vital role in management of the Occoquan Reservoir and tributaries. The most prominent of these are the planning departments of each jurisdiction. These departments develop comprehensive strategies for the entire locality and target sensitive areas, such as the Occoquan watershed, for particular management techniques. The planning departments also work closely with the NVPDC to coordinate regional planning objectives to protect the watershed.

Other local agencies are responsible for the implementation of these objectives. These include the public works departments, the Fairfax County Park Authority (FCPA), and the Northern Virginia Soil and Water Conservation District (NVSWCD). The public works departments are responsible for actually carrying out the Plan recommendations by developing site-specific management plans and implement water quality monitoring strategies.



**Figure 2.2: Institutional Arrangements Of Water Resources Management And Planning In Northern Virginia**

The Prince William Public Works Department has been very active and is relied upon by other localities for developing and coordinating monitoring activities throughout the watershed. Several Occoquan localities, such as the City of Fairfax, are using the Prince William Department to monitor local water quality and to design proper watershed protection measures. The Fairfax County Public Works, also instrumental in the region, develops coordinated management techniques with the County Park Authority (FCPA) and the NVPDC. The NVSWCD provides technical assistance to individual landowners within the watershed, many of which are very near to the Reservoir.

While a good relationship exists among many of the local, state, and regional agencies, two cities are relatively absent from this interjurisdictional approach. Both Manassas and Manassas Park have remained quite independent of the other jurisdictions and the NVPDC. These localities are not included under the provisions of the Chesapeake Bay Preservation Act and have taken an alternative approach to water quality protection. The two localities do not participate extensively with regional projects or programs, primarily due to a lack of staff. According to a Manassas planner, the cities do not consider these uncoordinated efforts as detrimental; instead they provide opportunities for locality-specific planning and management (Snyder, 1996).

The City of Manassas lies at the top of several subwatersheds and has not experienced any serious water quality problems. Water quality testing at Lake Manassas, the City's primary drinking water source, indicates that the Lake's water quality has stabilized and perhaps improved. Snyder (1996) suggested that this stabilization is a result of the City's ability to act independently of the NVPDC and other jurisdictions. Excluded from the CBPA requirements, both cities see this as an opportunity to employ innovative policies and to develop strategies which are most useful to them. Fauquier and Loudoun counties, likewise, are not included in the CBPA; however, in contrast they have attempted to coordinate their management and planning actions with other regional localities. While the two cities are not extensively involved with the other jurisdictions, the cities have adopted the Occoquan Basin Nonpoint Pollution Management Program.

## **Management Strategies at the Local Level**

An initial step to watershed wide management of the Reservoir came with the adoption of the Occoquan Basin Nonpoint Pollution Management Program. This Program established a minimum level of management and protection to be maintained throughout the region. While the Program developed a regional framework, little would have been accomplished without local implementation of the Program's objectives.

Local governments in the Occoquan region have implemented various management strategies to be consistent with the regional watershed wide plan and objectives. These include stream buffers, overlay districts, density controls, and Best Management Practices. Table 2.3, defines the common management strategies used throughout Virginia, which is followed by Table 2.4 , an overview of the strategies employed by the Occoquan jurisdictions to incorporate the multijurisdictional approach.

### ***Stream Corridor Protection***

Stream corridors or buffers have been used by various agencies, citizen groups, and regional commissions to provide water quality protection for streams and rivers. Properly designed buffers are effective and cost-efficient methods to reduce nonpoint source pollution from entering the stream. This has been documented by a number of institutions, including EPA, which found that riparian buffer systems are effective in a number of situation. While most often used in forestry practices around the Chesapeake Bay, these are also useful tools to mitigate urban and agricultural impacts (NSCBP, 1995).

A unique type of buffer is the Environmental Quality Corridors (EQC), which are buffer areas along stream corridors, "to provide an integrated network of ecologically valuable land and surface waters for present and future residents of Fairfax County" (Fairfax Co., 1990: 91). The EQCs are primarily located at stream corridors to protect the floodplains, steep slopes, and wetlands, which ultimately enhances wildlife habitat

**Table 2.3: Definitions of Management Strategies**

<i>Stream Corridors</i>	These are protected areas surrounding reservoirs and lakes or within the valley of rivers and streams. Buffers are designed to provide water quality protection to the waterbody by mitigating erosion and thereby reducing loadings of sediments and nutrients. Buffers may be public lands, although they are often private lands which are bound by a conservation easement. These are commonly established in the 100 year floodplain of stream valleys and extend inland a specific distance, which is dependent upon the local land use policies.
<i>Overlay Districts</i>	These are policy areas in which development and land disturbing activities are severely restricted. Many jurisdictions have created these to specifically protect drinking water supplies. Overlay districts often surround a reservoir, such as those in Fairfax County around the Occoquan reservoir, while others are located throughout the watershed to protect feeder tributaries.
<i>Density Controls</i>	These are policies designed to restrict development in environmentally sensitive areas, such as water supply watersheds. Cluster development is one type of density control which deters growth in “critical areas” and redirects this growth to “growth areas”. Downzoning is another method to control development by restricting development density in a critical area. Besides restricting urban development to provide watershed protection, this policy is also used to preserve agricultural lands in retaining the rural character of the region.
<i>BMPs</i>	BMPs are structural and nonstructural techniques to mitigate water quality impacts from agricultural, urban, and forestal activities.

Source: Derived from Various Literature.

quality and water quality by mitigating nonpoint source pollution. These Corridors provide protection for the Reservoir and help to fulfill the regional objectives outlined in the Nonpoint Pollution Management Program. They are implemented through rezoning and other public hearings. Furthermore, the County Park Authority is developing a Greenways plan which will link the EQCs and establish a comprehensive network of open space and corridors with the EQCs as the centerpiece. A set of standards will be established for the greenway, which will be more stringent than the requirements established for the EQCs (Douglas, 1995).

**Table 2.4: Overview of Management Strategies at the Local Level**

	Stream Corridors	Overlay Districts	Density Controls	BMPs	OBNPMP*
Fairfax County	EQCs	Reservoir Water Supply	Downzoning, Cluster Devel.	Extensive Use	Yes
Prince William County	Stream Buffers	Special Public Interest Dist., Reservoir	Cluster Devel., Impact Assess.	Extensive Use	Yes
Loudoun County	Creek Valley Buffer	N/A	N/A	N/A	Yes
Fauquier County	N/A	Agric/Cons Dist.	Cluster Devel.	Extensive Use	Yes
City of Fairfax	Stream Buffers	N/A	N/A	Extensive Use	Yes
City of Manassas	N/A	Buffer around Lake Manassas	Limited Use	Move to Regional	Yes
City of Manassas Park	N/A	None	Limited Use	On-site	Yes

\*OBNPMP = Occoquan Basin Nonpoint Pollution Management Program

Source: Fairfax Co., 1990; Prince William Co., 1991; Loudoun Co., 1991; Fauquier Co., 1994; City of Fairfax, 1988; City of Manassas, 1994; Douglas, 1995; Snyder, 1996.

The EQCs are located along streams and, are therefore, found on both public and private lands. Fairfax County has implemented a density transfer program to move development away from the EQC sites to less sensitive areas in order to offset the Corridor restrictions imposed private landowners. The maximum density of the area is determined according to a mathematical expression, which is based upon the ratio of EQC land to total land. The development at the receiving site is to be compatible with the surrounding area’s existing or proposed use plans.

The City of Fairfax and Prince William have similar buffer requirements, which restrict development from areas 100 feet adjacent to a stream or tributary. Fairfax, however, allows a minimum 50 foot buffer, provided a BMP is located inland to account for the lost buffer area. An innovative approach taken by Fairfax is the implementation of a “Water Quality Impact Assessment.” This Assessment is required for all site plans

located within the RMAs or RPAs, including impacts, pollution estimates, and the measures proposed to mitigate the impacts (City of Fairfax, 1988: 385).

A major force in the adoption of Loudoun County's stream buffer plan came from the citizens of Loudoun County. Concern among citizens and the local government about the encroaching development surrounding the County's waterways, resulted in the development of the "Creek Valley Districts". The Districts were originally designed as a buffer for land within 300 feet of the stream banks draining more than one square mile.

In 1993 after major changes in the membership of the Board of Supervisors, a move occurred to reduce or eliminate the buffers. Citizens reacted by creating a symposium to foster support for the buffers. The buffers were accepted by the Board, although scaled down from 300 feet to 150 and 250 feet from the stream bank. The buffers may be further reduced by up to 100 feet if the landowners employ certain measures, such as structural BMPs or nonstructural techniques to stabilize the stream bank. The buffer standards apply only to new subdivisions, while land owned within the buffer zones prior to the statute are able to build single family homes (Blankenship, 1995: 3). As with the EQCs, developers may transfer development density to another area if negatively impacted by the buffer zone requirements.

### ***Overlay Districts***

Overlay Districts are used throughout the Occoquan watershed as a land use regulatory mechanism to mitigate point and nonpoint sources of pollution. In 1982 the Fairfax County Board of Supervisors created a Water Supply Overlay District. All County land within the Occoquan Watershed was designated as part of this District. The District also required the use of site or subdivision plans for new developments. The CBPA requirements for new development were fairly similar, although not as stringent as those imposed by the Occoquan Policy or the reservoir overlay criteria (Douglas, 1995).

Prince William County has recently adopted a Special Public Interest District to establish land use requirements and provide water quality protection in overlay districts in the Occoquan and Lake Manassas watersheds. The District is based on a three tier

approach ranging from basic prohibitions in the first tier to far reaching restrictions in the third tier closest to the waterbodies. All pollutants are to be 100% contained on-site, while the third tier also requires that post-development discharges do not exceed 50% of the pre-development sedimentation (NVPDC, 1994: 232).

### *Downzoning/Density Control Measures*

As a result of water quality model predictions, Fairfax County decided to evaluate land use controls and other measures in an effort to reduce nonpoint source pollution from urban growth. Water quality impacts from various land use scenarios within the Fairfax County portion of the watershed were also evaluated as part of the study. In 1982 Fairfax completed the Occoquan Basin Study, which recommended various watershed management measures.

One of these measures included the downzoning in 1982 of about 60 square miles from one acre to five acre minimum lot sizes. The downzoning was challenged in court by the Homebuilders Association, but was upheld by the courts in 1985. The successful legal defense of downzoning supports the local jurisdiction's ability to choose the regulatory controls they feel are necessary to protect quality of water supplies. The Northern Virginia Soil and Water Conservation District was also originally involved in the downzoning design and assisted the County in the passage of the statute (Kohnke, 1995). During this concern over water quality protection there was also a movement to preserve existing rural land in the county. These factors increased public support and contributed to the approval of the downzoning proposal.

To ensure a high quality of public drinking water sources, Prince William has encouraged minimum density around the shores of Lake Manassas and the Occoquan Reservoir and has conducted a study to determine the appropriate land densities in these areas. The zoning ordinance of the City of Manassas included cluster development to protect the subwatersheds (Manassas, 1994). This ordinance was repealed in March of 1994, and leaves the City without cluster development, although density control measures are still being used in certain areas (Snyder, 1996). The City is now using low density

development, of one unit per acre around water resources with significant need for protection, such as floodplains and fragile environmental areas. The City of Manassas Park has adopted cluster development, although it is seldom required. The use of cluster development in Manassas Park, however, is used to control development and is not necessarily implemented in regards to water quality protection.

Fauquier County also uses density control measures in the watershed, by requiring cluster development in the Agriculture and Conservation Districts. According to County maps (Fauquier Co., 1994: 8-8, 8-9), these Agriculture and Conservation Districts cover nearly the entire Fauquier portion of the Occoquan watershed. The County has also recommended the use of Transferable Development Rights (TDR) for resource protection. The TDRs would be used to encourage cluster development and more effectively protect the Agricultural and Conservation Districts (Fauquier Co., 1994: 8-24). However, the Virginia General Assembly has not granted authority to localities in using TDRs.

Fauquier instituted a Special Land Preservation Assessment Taxation (land use assessment) for landowners to protect the environment and preserve the County's rural way of life. Interested private landowners have the opportunity to place their land in a forestal or agricultural district or may place the land in an open space easement. This assessment taxation is essentially a tax break for landowners who place their land in one of the programs consistent with the County's Land Use Plan. These programs run on an eight year cycle and must be renewed at the end of each term. The County has widely implemented these programs and as of 1993 nearly 15% of all Fauquier County parcels were within one of these land use control programs (Fauquier Co., 1994:4-18).

### ***Best Management Practices***

A measure recommended in the 1982 Occoquan Basin Study was to strengthen requirements for urban runoff structural BMPs. Since that Study, Fairfax and Prince William counties have researched and implemented a number of regional BMPs to meet this objective throughout the Occoquan watershed. This has been well documented in

various literature sources including *Case Studies of Local Water Resources Management in Virginia* (Hirschman et.al., 1991: 26,27).

Fairfax County's overlay district requires a subdivision to implement runoff control measures, such as BMPs, to mitigate phosphorous runoff. Fauquier County requires BMPs for all new development within the Basin, established through subdivision and site plan review ordinances. In addition, "State of Nature" easements are also employed by Fauquier County, which are required buffers of 100 to 200 feet within the floodplains. Prince William County requires BMPs in the watershed and other parts of the county through conditional zoning and development proffers and has mandated agricultural BMPs on agricultural land located within the Occoquan and Lake Manassas watersheds.

The City of Fairfax has required that private landowners develop with respect to three measures in controlling rainfall runoff to preserve natural creek channels. First, the development must not exceed September, 1974 runoff usage levels. Second, if it is at least 15% greater than the 1974 levels, then the landowner must provide on-site detention drainage or retention facilities. Third, natural drainage channels and on-site drainage facilities must be maintained by the owner.

### **The Role of Monitoring in a Multijurisdictional Approach**

Monitoring is an integral part in designing and implementing management strategies to effectively protect the Occoquan Reservoir and watershed. Water quality data is being collected by the OWML and is disseminated to local jurisdictions in developing appropriate watershed management and monitoring strategies. While water quality monitoring is necessary, this data loses relevance if not used to develop and evaluate appropriate management techniques. To facilitate the relationship between monitoring and management of a watershed, the EPA instituted the Clean Lakes Program in accordance with Section 314 of the Clean Water Act. The primary goal of the 314 program is to continue the development and implementation of strategies to enhance water quality and protect waterbodies in a simple economical manner.

The NVPDC is responsible for organizing and coordinating water quality protection programs around the Reservoir and the tributaries and is instrumental in locating partial funding for the Occoquan Laboratory. The Laboratory works closely with managing jurisdictions and other institutions to conduct comprehensive studies of receiving and discharging waters of the Occoquan Reservoir.

The OWML receives half of the program costs from the local jurisdictions and the remainder from the Fairfax County Water Authority, resulting in close collaboration among these entities. Interplay exists between the Authority and state agencies, (DEQ, and the Department of Health) as it relates to providing data and working with and commenting on regulations. The Authority also partially funds the Cooperative Water Supply Operations (CO-OP) as part of the Interstate Commission on the Potomac River Basin (ICPRB). The CO-OP was created to serve as the central cooperative technical center to coordinate the operation of the region's major water supply systems. The Authority has monitoring programs at the Reservoir and the Potomac river and has multijurisdictional relations, including governmental, that fosters the establishment of policies, agreements, and Boards.

The ICPRB was established by an act of Congress in 1940 and is comprised of representatives from Maryland, Pennsylvania, Virginia, West Virginia, the District of Columbia, and the federal government. The Commission is designed as a fact finding and coordinating agency for the Potomac basin and has no regulatory authority. ICPRB's primary objective is to coordinate interstate and basin wide efforts, which is reflected in the statement "local, state, and federal agencies can best develop a river basin through cooperative efforts, providing there is some coordinating body for the basin" (ICPRB, 1990:2). The Commission, therefore, assists agencies by monitoring water quality basin wide and disseminating the results to governmental and non-governmental organizations.

### ***Water Quality Monitoring Approaches***

Within Virginia water quality monitoring is carried out at three basic stages.

1. Regional agencies, such as the OWML, have conducted detailed and precise water quality studies throughout the watershed.
2. County and municipal agencies have also implemented a number of monitoring strategies, although these are often standard monitoring techniques and do not vary significantly from one agency to the next. Monitoring at this level often entails benthic macroinvertebrate studies, water quality data collection, and stream flow studies.
3. Citizen groups have implemented a number of basic water quality tests. These studies are primarily based on the protocol created by The Chesapeake Bay Foundation and The Izaak Walton League for citizen groups: “Save Our Streams”.

### ***Regional Monitoring***

Over the past 20 years the OWML has determined the suitability of discharges, extensions, and alternative treatment practices at the AWT plant and has provided data on nonpoint source pollution controls in the basin (OWML, undated). The lab conducts monitoring at the Reservoir and tributaries to assess the water quality impacts of the AWT and nonpoint sources of pollution. Originally, the OWML established a network of stream monitoring stations on each of the major tributaries and began regular stream sampling of the basin AWT plant’s performance.

Besides standard testing, the Lab is also responsible for developing the Clean Lakes Assessment required by the EPA. The OWML has recently completed the *Clean Lakes Phase I Diagnostic-Feasibility Study of the Occoquan Reservoir* to evaluate the water quality of the Reservoir and the basin. The lab summarizes these monitoring results in an annual report, which is distributed to all of the local jurisdictions involved in the management of the Occoquan watershed. The localities are then able to make informed management decisions based on the current water quality of the Reservoir and tributaries.

In Virginia, the DEQ is the responsible agency for prioritizing the public lakes and reservoirs and acts as the administrator of the 314 grants. DEQ’s Office of

Environmental Research and Standards updates this list every two years and submits it to the EPA. During the 1994 reporting process the Occoquan Reservoir was granted Phase II funding to advance the wastewater treatment practices to protect the public health (Va. DEQ, 1994: 64). As with Phase I, this project phase is also being carried out by OWML.

This study monitors and evaluates the wastewater treatment practices at several locations throughout the basin to assist local jurisdictions in determining their impacts on the watershed and identifying the best alternatives for future courses of action. The lab also assesses nonpoint sources in the basin and began monitoring stream water quality, including an assessment of ambient water quality based on nonpoint source pollution loads transported through stormwater runoff. Various tests are conducted by the lab including temperature, dissolved oxygen, hydrogen ion, conductance and total dissolved solids, suspended solids, nitrogen, phosphorous, degradable organic matter, and synthetic organic chemicals. The stream monitoring network runs throughout the basin and have been placed to properly quantify the type and amount of nonpoint source pollutant loads (OWML, 1995) Baseflow and stormwater runoff sampling is performed at 20 stations and are located at various inflow and outflow points of the reservoir.

The Department of Biological Systems Engineering at Virginia Tech has made significant contributions to water quality monitoring in the Occoquan. They have acted as consultants to the OWML by designing and installing monitoring stations throughout the watershed (McClellan, 1995). They have also designed and conducted their own monitoring stations at Owl Run and Nomini Creek, both Prince William watersheds.

### ***Localities Monitoring Initiatives***

The County of Fairfax has emphasized the need for a standardized monitoring system and are, therefore, encouraging a centralized environmental planning and monitoring function. This system would be responsible for designing and implementing all water quality functions in the watershed (Fairfax Co., 1994: 94). While there is no formal policy establishing this type of system, the Public Works Department in Prince William County has been contracted to monitor water quality in several jurisdictions,

including the cities of Fairfax and Manassas. Much of the water quality testing in the sub-watersheds is conducted by the Public Works Department in Prince William County resulting in high levels of cooperation between these jurisdictions.

### ***Citizen Monitoring***

The Fairfax County Park Authority (FCPA) developed a stewardship program to involve citizens in monitoring and, thereby, improve the quality of the stream valleys and the Chesapeake Bay. A project plan was developed that concentrates on interpretation and education, which are the principle factors in protecting and managing the water quality and watershed of the stream valleys (FCPA, 1993). The FCPA is also actively seeking cooperative ventures with other County-wide agencies, nonprofit organizations, schools, and the general public to improve the effectiveness of the stewardship program. This initiative is designed to involve the citizens to monitor and evaluate basic water quality, and therefore, advance natural resource protection through quick identification of problems and their remedies.

### **Regional Projects in Other Northern Virginia Watersheds: Prince William County 319 Program**

Management in the Occoquan basin has been designed and implemented in a multijurisdictional fashion with participation by all the local jurisdictions. These same local authorities realizing the success of the project have begun using the Occoquan as a framework for other management and monitoring strategies in various sub-watersheds of the Potomac.

Prince William County, in particular, has developed watershed and stormwater management programs outside the Occoquan watershed. The County is currently involved in two particular projects, which include a number of other agencies and institutions in managing and monitoring water quality in three County watersheds. These projects are designed similarly to other programs which exist at the Occoquan, although instead focusing on developing strategies to protect the environmental integrity of the

watersheds. First it is developing a comprehensive plan for managing stormwater in the County. The second is essentially an extension of the first, in which a Geographic Information System (GIS) is designed to estimate pollutant loads and then to target environmentally sensitive areas. The goal of this EPA/Prince William County program is “to develop an innovative stormwater management plan and demonstration project in Prince William Co. that takes a watershed approach to environmentally sensitive decision making” (Pasquel et.al. 1991:2).

This project began in 1991 and received a 319 grant in 1994 to develop a comprehensive approach to stormwater management based on watershed-wide planning. It integrates traditional water quality analyses with data on watershed resources and environmentally sensitive stormwater management facilities. The program is a study of three watersheds at different levels of development to compare watershed impacts before and after development. The program uses the Quantico Creek Watershed, an undeveloped watershed as the baseline, and the Neabsco Creek Watershed, which is highly developed, as the post-development reference. The study then focuses on the Powells Creek Watershed, where development is beginning, to determine how stormwater management facilities will impact the watershed.

Several site-specific stormwater management facilities have been constructed in the Neabsco and Powells Creek watersheds according to two guidelines: the watershed’s stage of development and the existing technology at the time of implementation. These facilities were not designed with respect to their impacts or how they are affected by the regional watershed processes, and therefore, are not as effective as originally envisioned (Mohan(b), 1995:2). However, these different stages of growth and types of facilities permit a proper and relatively easy comparison as to the impacts of various stormwater management facilities on a watershed (Mohan(a), 1995).

This program is measuring spatial changes and evaluating impacts on land use, slopes, habitat, and water quality. Land use and nonpoint source pollution controls are monitored to determine their impacts on water quality and stormwater management facilities. This information, in conjunction with water quantity, water quality, and land

use characteristics, will provide the necessary data to determine the beneficial impacts on the “environmental integrity” of the watershed. EPA has funded this project in the hopes that this will serve as a pilot project and result in the creation of beneficial stormwater management facilities throughout EPA’s Mid-Atlantic region.

Six subcommittees have been created to implement this project to effectively involve relevant agencies and organizations and to coordinate the objectives and activities of the individual organizations. The committees are comprised of representatives from participating federal, state, and local agencies and academic institutions involved with the multi-agency and interdisciplinary nature of watershed management in the region.

***Management Strategies in the Comprehensive Stormwater Management 319 Program***

Three main projects are to be constructed and monitored by the Prince William Public Works Department, while several other secondary stormwater projects are also to be conducted by various agencies and organizations (See Table 2.5). Constructed wetlands and shallow marshes are being used for biological update and also for the removal of nitrogen and phosphorous. A second project is a bioretention site to allow water to pond and, subsequently, filter out nutrients. Third, Prince William is designing a stream restoration project with assistance from the USFWS to recreate meandering streams by stabilizing slopes and dechannelizing streams.

**Table 2.5: Individual Watershed Management Projects in the Comprehensive Stormwater Management Planning 319 Program**

- ♦ Neabsco and Powells creeks site-specific facilities, including wetlands and bioretention sites
- ♦ Cow Branch habitat restoration project by USFWS to recreate stream meanders.
- ♦ Neabsco regional stormwater management facility constructed and monitored for its impact on land use through a pre-development and post-development inventory.
- ♦ Neabsco Creek riparian restoration project to recreate stream meanders.
- ♦ A culvert retrofit BMP project by Prince William to monitor and replace culverts.

Source: Derived from Mohan (b), 1995.

### ***Monitoring Strategies in the Comprehensive Stormwater Management 319 Program***

A number of monitoring strategies are also being developed for this program (See Table 2.6 below). Similar to the management strategies, monitoring projects will be conducted by various agencies throughout the watersheds. The County is currently conducting a number of studies to identify the resource base and determine the current condition of the watersheds. The County, in collaboration with the other agencies, is gathering data for three projects: an advanced wetland study; a bioassessment of macroinvertebrates and fish using the rapid bioassessment protocol (RBP); and comparison of the results upstream and downstream of the regional stormwater facility. The RBP was originally completed by George Mason, although Fairfax County has become interested in the Project and has started conducting the bioassessment study.

Limited research on the environmental impacts of Stormwater Management Ponds (SWM) has been conducted in the past and usually “negative” impacts of SWM ponds are inferred from larger and older reservoirs, or based on extrapolations of limited data collected from short-term case studies (Pasquel et.al. 1991). Data is, therefore, being collected at a number of existing and proposed SWM pond facilities to better analyze and make more sound and rational management decisions based on this information. Data is also being collected at stream reaches above and below the SWM facilities and at “integrator” sites for each watershed.

**Table 2.6: Watershed Monitoring in the Comprehensive Stormwater Management 319 Program**

- ♦ Riparian buffers and constructed wetlands will be monitored for water quantity and quality impacts upstream and downstream of stormwater management facilities.
- ♦ Water quality and stream flow will be monitored upstream and downstream of USFWS restoration project.
- ♦ An environmental resources inventory will be conducted in all three watersheds.
- ♦ A bioassessment of nonpoint source impacts will be conducted in the three watersheds.
- ♦ Stormwater Management Ponds will be monitored and evaluated.
- ♦ Field surveys of bottom sediment deposition will assess absorbed pollutants.
- ♦ GIS applications will model hydrologic and hydraulic parameters and compute pollutant loads.
- ♦ GIS developed to provide a link between watershed characteristics (land use) and types and amounts of pollutants and sediments delivered to the regional pond.
- ♦ A comparison made between GIS computed nonpoint source loads and actual data from monitoring stations.

Source: Derived from Mohan (b), 1995

***Use of GIS in the Prince William Multijurisdictional Stormwater Management Program***

A GIS is being developed as part of the 319 grant by the County to monitor water quality and land use changes at the watershed and to provide the region with a decision-making tool for comprehensive watershed management planning. GIS is being used to identify acceptable nonpoint source pollutant loads and to incorporate these results into the management strategies. The GIS will evaluate nonpoint source activities and will assess the efficiency of various BMPs and other options for managing the nonpoint source loads. The results of the GIS analyses from the differing land uses will be compared with existing data from monitoring stations. The data will then be displayed on an overlay, enabling planners to target environmentally sensitive areas and to develop appropriate management strategies at the watershed level.

A Watershed Management Strategy manual will be developed to identify environmentally sensitive areas and watershed-wide management options and facilitate the application to other GIS systems. The Manual will detail the steps in the design of a

stormwater management facility and compare various facilities, such as second generation BMPs. Furthermore, the Manual will develop guidelines on how to transfer these techniques to other watersheds. The results of this study will be used to improve the County's Watershed Management Program and to comply with nonpoint source and stormwater related regulations.

## **Conclusions and Lessons Learned for Watershed Management in Virginia**

### ***Effectiveness in Achieving Watershed Management Objectives***

Water quality at the Occoquan has stabilized over the past twenty years. Problems at the Reservoir during the 1960s and the early 1970s, such as algal blooms, fish kills, and taste and odor problems, have been corrected. These improvements have resulted from the regional watershed management approach and local implementation.

### ***Institutional Characteristics and Program Components***

The approach taken by the jurisdictions at the Occoquan watershed can be characterized by a number of components used to manage the Reservoir and watershed in a multijurisdictional manner (See Table 2.7). The components are divided into four basic categories: institutional framework and planning, stakeholder involvement, implementation strategies, and monitoring. These four categories characterize the regional approach, which incorporate and coordinate the local jurisdictions' efforts. "Institutional framework and planning" involves the formation of overseeing regional organizations and authorities and development of regional plans and programs which drive the multijurisdictional strategies. "Stakeholder involvement" is the role of relevant jurisdictions, organizations, and citizens which participate throughout the process. "Implementation strategies" and "monitoring" are measures employed by the various stakeholders to enact and evaluate the plan.

The Occoquan Policy established a regional framework by creating regional agencies and coordinating jurisdictional policies and management techniques. A watershed wide program, the Occoquan Basin Nonpoint Pollution Management Program,

was established to develop and implement water quality monitoring. This Program allowed the jurisdictions to confirm assumptions about point and nonpoint source loadings in the Occoquan Basin. A number of innovative management strategies were then implemented by local jurisdictions to mitigate nonpoint source runoff in the tributaries in accordance with the Occoquan Nonpoint Pollution Program.

**Table 2.7: Institutional Characteristics from Occoquan Program**

Institutional Framework & Planning	Occoquan Policy and Occoquan Nonpoint Pollution Management Program provided a regional framework and established watershed wide objectives. Regional agencies (e.g. Occoquan Policy Board, OWML) have developed regional plans and policies and a regional program assessment. Subregional and local agencies have developed strategies to implement the plans. Non-governmental agencies and private landowners have provided data and encouraged governmental action.
Stakeholder Involvement	Each stakeholder has played a particular role in program development and implementation. Regional agencies have developed the plans, while subregional and local governments are responsible for their implementation.
Implementation Strategies	Stream buffers have been established by many of the localities (e.g. Environmental Quality Corridors in Fairfax County). Overlay districts have been implemented by Fairfax and Prince William counties specifically to protect water supply watersheds. Density controls are being used by many of the localities to restrict development in critical watersheds. Regional BMPs are being developed by most localities in accordance with the Nonpoint Pollution Management Program.
Monitoring	A regional agency, OWML, was developed to monitor water quality at the Reservoir and tributaries. Monitoring projects analyze water quality trends and BMP effectiveness and evaluate program effectiveness.

*Institutional Framework and Planning*

- ♦ The regional institutional framework consists primarily of the Occoquan Policy Board, the OWML, and the NVPDC.
- ♦ The Occoquan Policy established the foundation for multijurisdictional watershed management by identifying conflicts and common concerns and developing watershed wide objectives and strategies. The Policy provided the coordination and oversight

for the implementation of strict point and nonpoint source controls throughout the watershed. It also provided for extensive and continued water quality monitoring at the Reservoir and tributaries.

- The Occoquan Basin Nonpoint Pollution Management Program is a detailed advisory mechanism adopted by all localities. It was designed to coordinate local jurisdictions' land use controls, policies, and management strategies. It provides localities with specific information on BMP usage and development.

### *Stakeholder Involvement*

- All relevant jurisdictions have been involved in the planning and management phases of watershed protection through the Policy Board and the OWML. This permitted the development of regional objectives and policies, which were acceptable to all parties.
  - The PDC in conjunction with the Occoquan Policy Board has created regional policies and encouraged their adoption at the local level.
  - The OWML advises regional and local agencies on appropriate policies and management techniques to mitigate water quality impacts.
- Subregional agencies have developed a number of management and monitoring techniques to implement the Occoquan Policy and the Management Program. For example, SWCDs assist landowners in developing soil and water quality control plans to attain the programs' requirements.
- Localities, primarily Fairfax and Prince William, driven by the regional Policy and Program, have implemented site specific subwatershed plans and projects. For example, Prince William has developed a comprehensive stormwater management plan to integrate and coordinate various agencies activities. The stormwater management program is evaluating and comparing the effectiveness of different BMPs and land use controls at three subwatersheds. These jurisdictions have also collected subwatershed data to complement the OWML's studies. With these data the departments advise other local and regional decisions-makers in developing policies to mitigate water quality impacts.

- While state and federal agencies have provided technical and financial assistance, local and regional agencies are responsible for developing and implementing the watershed project. This has resulted in a bottom-up approach, allowing local and regional jurisdictions to develop plans and policies which are most effective for the region. For example, Prince William County initiated an effective subwatershed project, although a number of agencies have been involved in the design and implementation of the project.
- Citizens are important stakeholders in a watershed and provide valuable information throughout the plan design, implementation, and monitoring stages. For example, Loudoun County residents concerned about tributary water quality protection initiated a stream buffer plan. After attempts by the local government to eliminate the buffers, citizens created a task force to educate landowners and administrators about the necessity of the buffers. The citizen group has continued to encourage more extensive stream buffers and are monitoring water quality to illustrate the positive impacts associated with the buffers.

### *Implementation Strategies*

- All localities have developed a diverse set of appropriate strategies and techniques to comply with the Policy and Program. The use and coordination of a number of management strategies throughout the watershed improved the effectiveness of the Occoquan Policy and the Nonpoint Pollution Management Program.
- Stream buffers, such as the EQCs in Fairfax County, appear to be cost effective measures in protecting tributary water quality by limiting the amount of nonpoint pollution entering streams and the Reservoir.
- Overlay districts are policies used by localities to restrict the types of development occurring in a designated “sensitive” area. These have been used by several jurisdictions to restrict development in the Occoquan watershed, and thereby, provide water quality protection for the Reservoir.

- ♦ For example, Fairfax County has enacted a Water Supply Overlay District around the Reservoir, which severely restricts the type of development that can occur. Furthermore, this District requires the use of BMPs and the establishment of site plans prior to development.
- ♦ Prince William County has also enacted a Special Public Interest District which protects the Occoquan and the Lake Manassas watersheds. This is a three tier process, ranging from minimal standards at the first tier to the most stringent standards in the third tier.
- ♦ Density controls, such as downzoning and cluster development, have been used by nearly all of the localities to restrict development in the Occoquan watershed. This measure then decreases the type and amount of nonpoint source loads discharging into the Reservoir and tributaries.
- ♦ Regional BMPs as compared to on-site BMPs are more effective in mitigating nonpoint source pollution over the long term. According to the Occoquan Nonpoint Pollution Management Program, regional BMPs are more financially feasible due to decreased monitoring and maintenance costs and, as a result, actually decrease nonpoint source pollutants entering the waterbody.

### *Monitoring*

- ♦ Regional coordination and technical assistance have been coupled with local projects and citizen monitoring programs to monitor water quality and measure the success of the regional program.
- ♦ The OWML was developed to conduct water quality monitoring at the Reservoirs and tributaries and to coordinate localized water quality efforts.
- ♦ The OWML disseminates the data to advise regional and local agencies of appropriate policies and management techniques to mitigate water quality impacts.
- ♦ Monitoring projects, developed by the Lab and Prince William County, analyze BMPs and land use management strategies as to their effectiveness, and thereby, evaluate water quality changes over the long term. These monitoring projects then provided

the local and regional agencies with appropriate information for the decision-making process.

- ♦ The development of a regional GIS evaluated on-site BMPs and monitored local water quality providing more extensive and useful data for the planning process.

### ***Representation of the Watershed Protection Approach in the Occoquan Program***

The Occoquan's multijurisdictional watershed management approach corresponds with, and therefore, supports the validity of the Watershed Protection Approach. The Occoquan incorporates the four basic features of the EPA Approach: targeting problems, involving stakeholders, applying integrated solutions, and measuring success through monitoring. As a result of the watershed management efforts, water quality has stabilized at the Reservoir. While EPA's Approach may be a useful model in developing a general watershed management program, it does not specifically define implementation characteristics. The Northern Virginia experience provides useful information on watershed management in practice that can help clarify what is needed for effective implementation of the Approach.

The problem of water quality deterioration at the Reservoir was readily identified and targeted by all stakeholders. Through the establishment of a regional authority (Policy Board) the problems were prioritized and then targeted by regional agencies and local governments. Furthermore, water quality and land use conflicts are continually being identified and prioritized by the stakeholders, reflecting the iterative nature of problem targeting.

The stakeholders participated in the analysis of the problem and in the development of possible solutions. Soon after a problem was identified, stakeholders at all levels were involved. State, regional, and local agencies contributed to the formation of the Policy Board and to the creation of regional objectives. These agencies in conjunction with federal agencies have also developed programs (Occoquan Basin Nonpoint Pollution Management Program) and management techniques (overlay districts, BMPs, etc.) at the regional, subregional, and local levels.

Efforts at the Occoquan have also concentrated on integrated solutions to water quality protection. A regional framework was developed with the establishment of the Occoquan Policy and the Nonpoint Pollution Management Program. A wide variety of local policies and management techniques have also been integrated into a coordinated multi-organizational effort, thereby, implementing the regional framework Policy and Program.

Measuring success has been an important component in the planning and management of the Reservoir and watershed. The Occoquan Watershed Monitoring Lab was created by the Policy Board to monitor water quality and provide water quality data to regional and local agencies in the implementation of appropriate policies and management techniques. The Lab is significant since it is supported by all localities and several regional agencies to track ecological indicators, and thereby, demonstrate the success or failure of policies and projects. Many local agencies are also monitoring water quality and analyzing land use controls to determine the effectiveness of regional and local plans.

### ***Lessons Learned for the WPA and Other Watershed Management Programs***

The Occoquan program has included the four features of the WPA and offers lessons about the implementation of the WPA, which can contribute to program effectiveness. In addition, lessons are drawn from this program, which may also assist other regions in developing their own watershed management program (See Table 2.8).

Problem identification has been an on-going process in the Occoquan watershed. While point sources were initially targeted, it was found that nonpoint sources were also contributing to water quality degradation. Recently, problem identification has expanded to include failing nonpoint source pollution controls, namely on-site BMPs. The planning process at the Occoquan watershed, therefore, has gone full circle. Monitoring results of the implemented management techniques confirm the ineffectiveness of on-site BMPs and are now being treated as part of the problem.

Local jurisdictions became involved early in the planning process, although their participation in regional agencies was key. The establishment of the Occoquan Policy Board and the Occoquan Watershed Monitoring Lab permitted all jurisdictions to be involved and allowed them to contribute to the policies and planning strategies for the entire watershed. Through these regional agencies, a watershed wide policy and plan were developed, which were adopted by all jurisdictions. Localities then created and implemented specific management techniques in accord with the regional framework and consistent with the other jurisdictions.

Measuring success has been a critical component of the Occoquan program and over the years has changed the type and implementation of specific management techniques. The Occoquan program incorporates specific methods of water quality monitoring at three levels (regional, local, and non-governmental) and program evaluation primarily at the local level. All three levels have a unique and important role in the monitoring and evaluation process. At the regional level, the OWML monitors

**Table 2.8: Lessons Learned for WPA and Other Watershed Management Programs**

Problem Identification	A common problem was targeted by all localities, which directly impacts them (e.g. drinking water source degradation). Is an <i>on-going process as the watershed is developed and more data becomes available.</i>
Stakeholder Involvement	All localities became involved since they were directly impacted by and contributed to the water quality problem. However, the <i>localities participate primarily through regional agencies, to which they contribute: funding, expertise, information, and recommendations.</i>
Integrated Solutions (Regional)	<i>Regional agencies, such as the Occoquan Policy Board and the OWML, are established to develop watershed wide objectives and to direct the management of the watershed. Regional plans and policies establish the framework and direct the course of local implementation.</i>
Integrated Solutions (Local)	<i>Development and implementation of specific management techniques occurs at the local level, although directed by the regional framework.</i>
Measuring Success	<i>Monitoring occurs at three levels: regional (OWML), local (public works departments), and non-governmental (citizen groups). The results from each are included in regional water quality changes and in the assessment of program success.</i>

water quality of the Reservoir and to some extent local tributaries. In addition, the Lab assists the local agencies in developing and implementing consistent and complimentary monitoring programs.

Local jurisdictions also monitor local management strategies to evaluate technical and program effectiveness. Non-governmental or citizen groups also monitor water quality which is accepted and included into local, regional, state, and even federal water quality evaluation documents. Citizen groups are collaborating with local agencies to implement monitoring projects throughout tributaries, which may cross political boundaries.

This study suggests that while the four features of the WPA do exist, stakeholder involvement and integrated solutions are subdivided into planning and implementation. In addition, regional frameworks, such as agencies and plans, provide a foundation on which to build local implementation techniques and strategies.

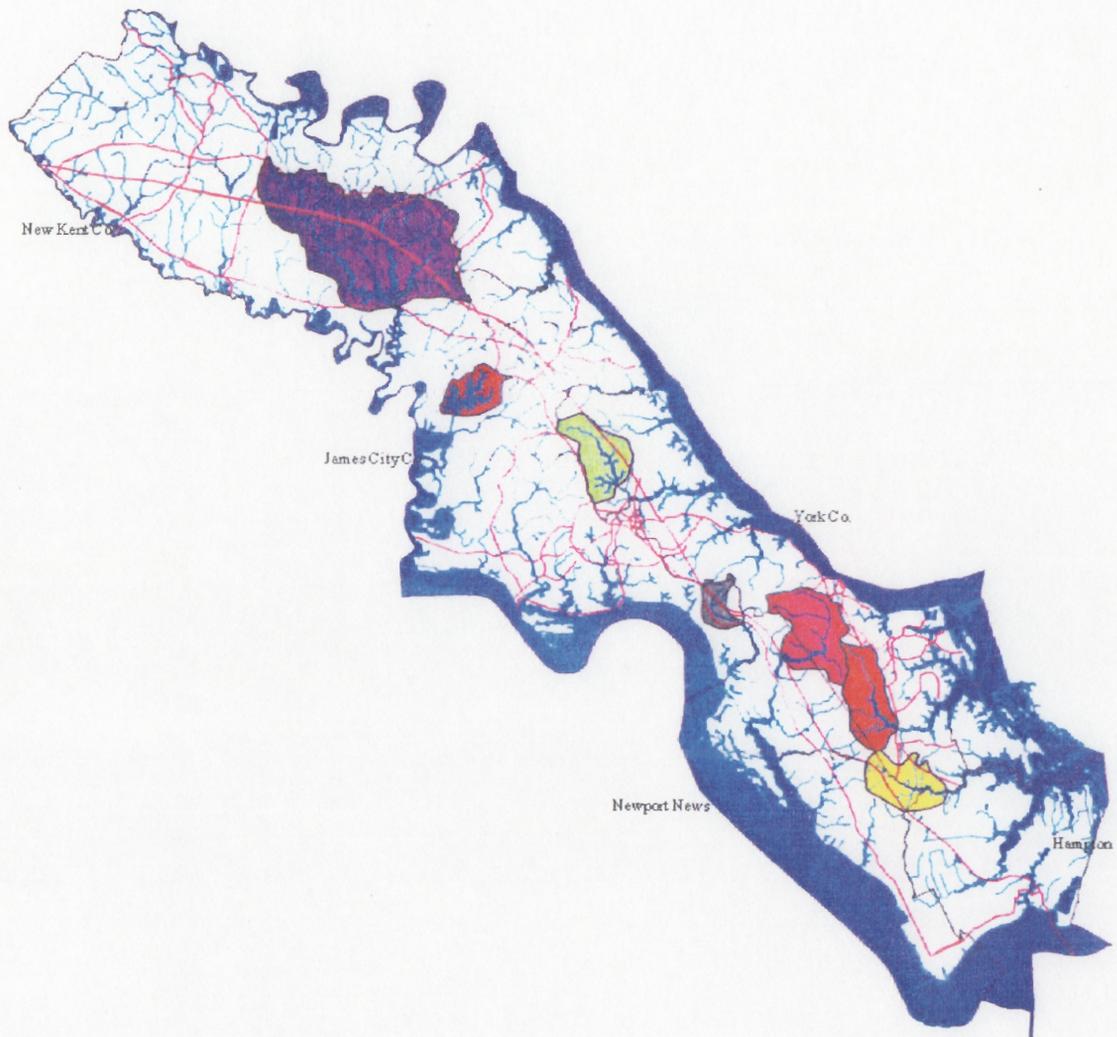
### **III. Multijurisdictional Watershed Management in the Hampton Roads Region**

This case study investigates the Hampton Roads region, which includes the James River watershed and several subwatersheds. It identifies plans, institutional frameworks, strategies, and monitoring techniques developed by various agencies and organizations. Lessons are then gleaned from this case study, which may be useful for other watershed management programs in Virginia.

Hampton Roads is being studied due to the unique multijurisdictional framework established by the local and regional agencies. This case study examines the Hampton Roads region including its prevalent water quantity and quality issues and assesses the interjurisdictional approach taken in this region. The study identifies the various individual management strategies used by the local agencies in protecting the James and York rivers' watersheds, reservoirs' subwatersheds, and also the Chesapeake Bay watershed. Finally, the study assesses the process used to formulate goals and objectives and evaluates the watershed management program relative to the Watershed Protection Approach.

#### **Background**

The Hampton Roads region is defined as that area from James City County east to the Chesapeake Bay and from the York River south to North Carolina. (See Figure 3.1: the Northern Peninsula). The region is governed by several local authorities including the counties of James City, York, Southampton, and Isle of Wight. A number of cities are also located in this region including the cities of Virginia Beach, Chesapeake, Norfolk, Portsmouth, Suffolk, Newport News, Hampton, Williamsburg, and Poquoson. While each of these has employed various management techniques, they have attempted to coordinate activities with other jurisdictions as well as the Hampton Roads Planning District Commission (HRPDC, previously the Southeastern Virginia PDC and the Peninsula PDC).



**Figure 3.1: Water Supply Watersheds of Northern Peninsula, Hampton Roads**

- Big Bethel Reservoir
- Diascund Creek Reservoir
- Harwood Mill Reservoir
- Lee Hall Reservoir
- Little Creek Reservoir
- Skiffes Creek Reservoir
- Waller Mill Creek Reservoir

Source: Derived from Information Support System Lab, Virginia Tech

Hampton Roads is the site of a number of innovative management approaches to protect the watersheds of reservoirs, streams, and the Chesapeake Bay. These strategies have occurred as a result of the need to protect water supply reservoirs and the Bay on the one hand, and rapid development in the area and subsequent pressures on the water quality of receiving waters on the other. The innovative approaches are the result of interjurisdictional agreements among these localities.

According to the surveys (Randolph et.al., 1990) completed by the two PDCs (SVPDC and the Peninsula PDC), many of the jurisdictions in the region are experiencing some type of water quality or quantity problem. The surveys identified four major problems at the jurisdictional level (See Table 3.1).

**Table 3.1: Survey Results for Hampton Roads Region**

<p>Problems Identified by PDCs</p> <ul style="list-style-type: none"> <li>◆ Insufficient water supplies</li> <li>◆ Water supply infrastructure is not being provided for at the same pace as development</li> <li>◆ Nonpoint source pollution is a major concern in both urban and rural areas Environmentally critical aquatic areas are being encroached upon and threatened</li> </ul> <p>Actions Identified to Mitigate Problems</p> <ul style="list-style-type: none"> <li>◆ Improved land use controls</li> <li>◆ Resolution of legal challenges among jurisdictions</li> <li>◆ Improved financial assistance</li> </ul> <p>Source: Derived from Randolph, 1990.</p>
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These problems still exist throughout the region, although a number of policies and management strategies have been developed to control them. Improved land use controls were cited most often as critical measures recommended for local jurisdictions. Similarly, the PDCs suggested that legal challenges need to be resolved. These two actions suggest that the problems can only be rectified through agreement on common goals and objectives by all the jurisdictions and that the localities must work in collaboration with one another to achieve these objectives.

## **Regional Conflicts**

The Hampton Roads area is characterized by major urbanized municipalities along the Chesapeake Bay and the Atlantic Ocean. While the primary emphasis of the localities' management efforts is protection of the Bay and public drinking water supply reservoirs, they have also included watershed management strategies to protect the tributaries.

Cities in the Hampton Roads region are experiencing extreme deficiencies of potable water in the area due primarily to rapid population growth and also to inadequate watershed management. The City of Virginia Beach, in response to the water crises, is currently developing options to buy water from other neighboring jurisdictions and even from as far away as Lake Gaston in south central Virginia. At the time of this report, the City of Virginia Beach began construction of a pipeline to transport water from Lake Gaston, in spite of opposition from southside Virginia residents and the state of North Carolina.

Norfolk is also working with neighboring jurisdictions, such as Newport News to obtain water from the Lower Peninsula. In addition, the City of Norfolk is once again proposing the construction of a reservoir, which would be placed in Newport News. Norfolk's previous attempts to construct a reservoir failed due to unacceptable adverse environmental impacts resulting from the proposed development. The construction of a new reservoir is also being proposed by the City of Newport News, which would draw water from the Mattaponi River. In response to these water quantity issues, the Hampton Roads area is in the process of developing a multijurisdictional approach by coordinating the regional water resources management activities.

### ***Response to Regional Conflicts: Shared Watershed Institutional Process***

The first step in the multijurisdictional approach came in 1991. The Hampton Roads Planning District Commission, with state funding, developed a BMP tracking system and Shared Watershed Institutional Process (SHIP) to develop an interjurisdictional approach to manage the watersheds crossing jurisdictional boundaries

(HRPDC, 1992: 2). The Hampton Roads PDC has begun assisting localities and coordinating the jurisdictions in their watershed strategies in order to develop a consistent approach to stormwater and river basin management. This is essential since several local governments frequently share management activities at these sub-watersheds.

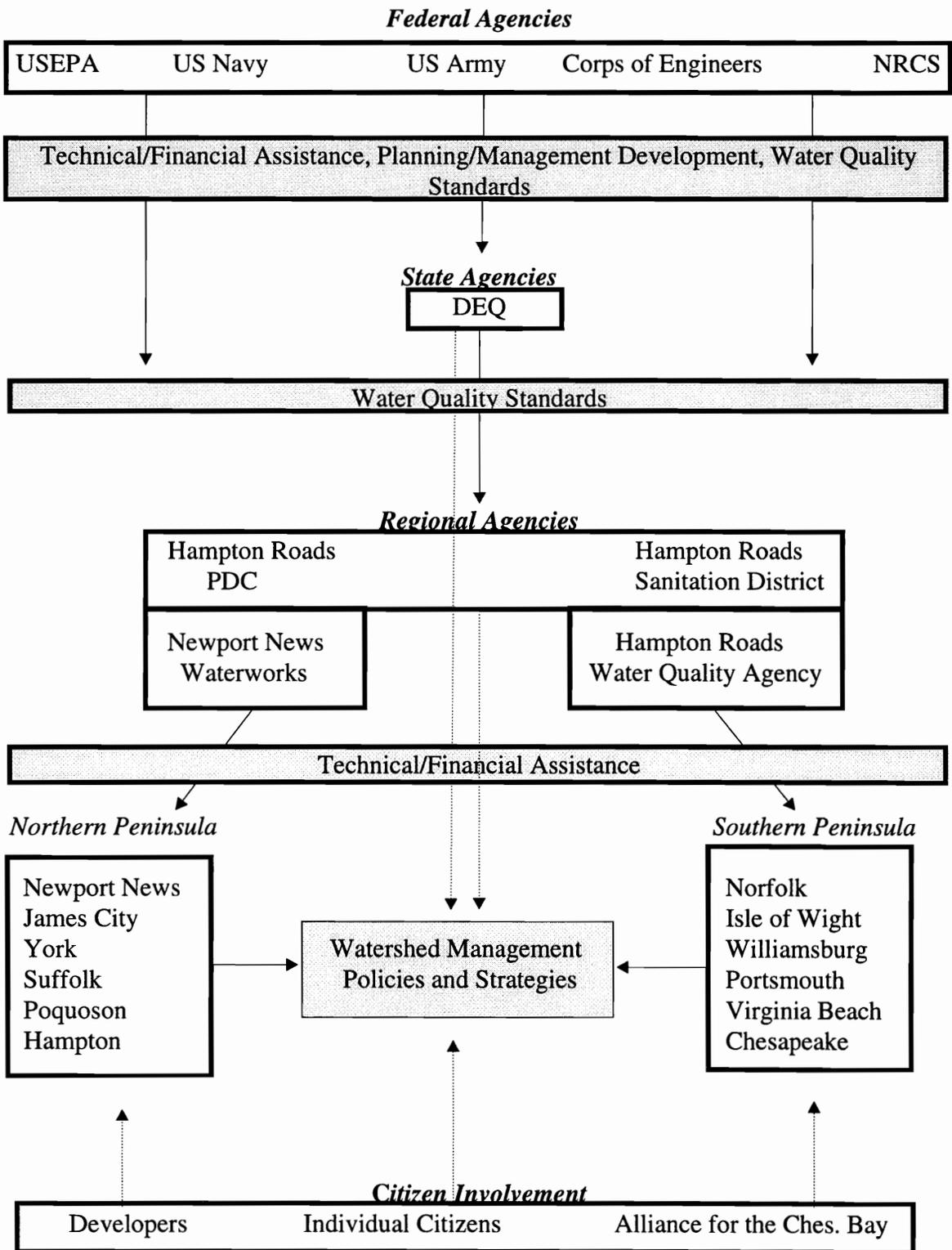
The region is, therefore, attempting to establish a multijurisdictional approach for managing nonpoint source pollution and stormwater within the watersheds. Although local jurisdictions are the major stakeholders, other organizations are involved in the watershed planning process, including the Corps of Engineers, the Hampton Roads Water Quality Agency, the Newport News Waterworks, the Hampton Roads Sanitation District, and local environmental citizen groups. As can be seen in Figure 3.2 below, a number of localities and state and federal agencies involved in the management and planning of regional water resources.

### **Why Multijurisdictional Watershed Management?**

Rapid population growth has put a great deal of pressure on water quality and water quantity at all the reservoirs. Furthermore, localities must concentrate on the reservoirs' management due to the complex nature of ownership and management which exists at the reservoirs. In an effort to curb these pressures, local governments and the PDC have concentrated management efforts on the region's public drinking water supply reservoirs.

### ***Upper Hampton Roads***

Water for the upper Hampton Roads region, the peninsula, is supplied primarily through a number of water supply reservoirs located throughout the region. The Newport News Waterworks is a municipally owned utility and the largest water purveyor on the peninsula. The Waterworks supplies water to nearly 350,000 people located in the City of Newport News and neighboring communities, including York County, James City County, and the cities of Williamsburg, and Poquoson (James City Co., 1994: 39).



**Figure 3.2: Major Stakeholders in the Hampton Roads Region**

The Waterworks provides the majority of the service to the region, although there are separate water supply systems owned by James City County, York County, Williamsburg, the US Army, and the US Navy. The Waterworks supply system consists of five reservoirs, a water intake on the Chickahominy River, and two water treatment plants. Above the Chickahominy intake the River has a drainage area of approximately 300 square miles draining portions of five counties and a number of cities. Approximately 75% of the Waterworks supply comes from the River intake, to directly supply residents and also to fill the reservoirs.

Table 3.2, below, identifies the location and ownership of each reservoir and the jurisdiction(s) responsible for their management. Table 3.2 also identifies those localities with bilateral interjurisdictional agreements to protect the reservoirs' water quality. While Newport News owns the water in many reservoirs and supplies water to the largest number of people, the City has little control or authority over actual land use decisions around many of the reservoirs.

Three of the Newport News Waterworks reservoirs are located entirely or partially in James City County, while the other two are in York County. Little Creek lies completely within the boundaries of James City; Diascund Creek is located at the eastern border of James City and New Kent County; Skiffe's Creek is at the boundaries of James City and Newport News; and Harwoods Mill and Lee Hall Reservoirs are located in the City of Newport News and York County. The reservoirs are designed in an interconnected way so that water can be pumped from the intake and "primary" reservoirs to the secondary or terminal reservoirs. This complex type of pumping structure has created difficulties in determining the causes or general locations of water quality problems. As a result, nonpoint and point source pollution have impacted regional water quality. Furthermore, pollution controls and regulations have been difficult to develop and enforce without the ability to identify the sources and types of pollution.

**Table 3.2: Reservoir Ownership**

<b>Reservoir/ Watershed</b>	<b>Location</b>	<b>Reservoir Ownership</b>	<b>Land Use Controls</b>	<b>Water Quality Responsibility</b>	<b>MultiJuris Agreement</b>
<b>Little Creek</b>	James City	Newport News	Shared	Newport News	Yes
<b>Diascund Creek</b>	James City/ New Kent	Newport News	Shared	Newport News	Yes
<b>Skiffe's Creek</b>	James City/ Newport News	Newport News	Shared	Newport News	Yes
<b>Harwoods Mill</b>	York	Newport News	Shared	Newport News	Yes
<b>Lee Hall</b>	Newport News/ York	Newport News	Shared	Newport News	Yes
<b>Speights Run</b>	Suffolk	Portsmouth	Suffolk	Portsmouth	N/A
<b>Lake Kilby</b>	Suffolk	Portsmouth	Suffolk	Portsmouth	No
<b>Lake Cohon</b>	Suffolk	Portsmouth	Suffolk	Portsmouth	No
<b>Lake Meade</b>	Suffolk	Portsmouth	Suffolk	Portsmouth	No
<b>Lake Prince</b>	Suffolk	Norfolk	Suffolk	Norfolk	No
<b>Burnt Mills</b>	Suffolk	Norfolk	Suffolk	Norfolk	No
<b>Western Branch</b>	Suffolk	Norfolk	Suffolk	Norfolk	No
<b>Lake Lawson</b>	Va. Beach	Norfolk	Shared	Norfolk	Yes
<b>Lake Smith</b>	Va. Beach	Norfolk	Shared	Norfolk	Yes

Source: Derived from: Newport News, 1992; James City Co., 1994; Walburg, 1996; Rosenthal, 1996; Umphlette, 1996

Waterworks ownership of the watersheds varies from none on the Chickahominy, to approximately two-thirds in the Little Creek Reservoir, and it cannot enforce policy decisions or management strategies on any of the other jurisdictions. It does, however, have a land management strategy to identify possible threats to the watershed or to water quality from existing or proposed land uses. The Waterworks then proposes recommendations to the relevant authority in order to rectify the problem.

Newport News has suggested two primary measures to create and ensure a comprehensive approach to watershed management and regional water quality protection. First, it proposed a regional utility to manage stormwater in much the same way that the Hampton Roads Sanitation District has been structured. This utility is a realistic consideration for administrative and political purposes (Newport News, 1992: 12.12). Second, the City has encouraged the use of a regional approach to implement this utility. However, the local jurisdictions have not adopted this regional utility and probable never will due to political and financial concerns (Walburg, 1996).

### ***Lower Hampton Roads***

Seven lakes surrounding the Nansemond River watershed are public water supply sources for the lower Hampton Roads region. Lake Prince, Lake Burnt Mills, and the Western Branch Reservoir are used and managed by the City of Norfolk, although located in the City of Suffolk. All of the lakes are classified as eutrophic, except for Lake Burnt Mills which is mesotrophic. The lakes have all been impacted primarily from urban nonpoint sources of pollution and municipal and industrial point sources (VWCB, 1992: 6.2-90-91).

Speights Run Lake, Lake Kilby, Lake Cohoon, and Lake Meade are owned and operated as drinking water sources by the City of Portsmouth, although again located entirely within the boundaries of the City of Suffolk. The City of Portsmouth is in a similar predicament as Newport News. All four of Portsmouth's reservoirs are within Suffolk and have very limited ownership or responsibility for the land around the reservoirs.

The regional water authority, which owned the reservoirs until the early 1980s when it was eliminated, offered to sell the reservoirs to both Portsmouth and Suffolk. While Suffolk declined to buy, Portsmouth bought the water supplies and began supplying water to Portsmouth and began selling water to the cities of Suffolk and Chesapeake. This arrangement lasted until 1982, when Suffolk developed a separate water supply and discontinued buying water from Portsmouth. The City of Chesapeake

continues to buy water from Portsmouth and will begin buying more in the near future (Umphlette, 1996).

Water quality at the Portsmouth reservoirs remains relatively high primarily because Suffolk is relatively rural and has not experienced nonpoint sources of pollution as severe as those found in urbanized areas. The City of Portsmouth has no authority over land use activities around the reservoirs and owns little land around these waterbodies. Portsmouth owns as little as 2 feet above the high water mark in many of these areas, although it owns several hundred acres of buffer zones in certain areas. These areas are primarily designated as forest districts under Suffolk regulations.

While land use controls are outside the authority of Portsmouth, it does have the ability to monitor land and water resource activities in the area. Portsmouth can then recommend or request specific controls for Suffolk to implement. Suffolk has designated the seven reservoirs into the Chesapeake Bay Preservation system as Resource Protection Areas. Incorporating reservoirs into a City's designation as Chesapeake Bay Resource Protection Areas is a common method used by many of the jurisdictions in Hampton Roads to protect local and regional water supplies and watersheds.

Portsmouth has developed a number of educational programs and projects for Suffolk landowners to consider water quality when designing development proposals. This voluntary approach has not been readily accepted by Suffolk residents and is, therefore, rather ineffective (Umphlette, 1996). Although Portsmouth has made a number of recommendations, there is little cooperation between the cities and the requests have never been implemented. Umphlette (1996) has suggested that the residents of Suffolk view this as a move by another jurisdiction to control and step on individuals' property rights and are reluctant to adopt the recommendations.

Portsmouth has taken an essential first step in identifying potential hazards and protecting reservoir water quality by creating the position of watershed manager. In late 1994, Portsmouth concerned over the future of water quality hired the City's first watershed manager to identify problems and attempt to eventually open a more productive dialogue with Suffolk. This concern has risen primarily due to increased

developmental pressures around the reservoir, which will likely result in water quality problems and degradation. Rapid development around the Nansemond River is likely with the recent construction of the bridge connecting Newport News and Suffolk. According to Walburg (1996), these relatively rural areas of Suffolk and Isle of Wight County will likely see rapid development due to this new linkage.

### ***Nansemond River Corps of Engineers Watershed Management Strategy***

The Corps of Engineers is studying the Nansemond River watershed to create a watershed management strategy that could eliminate or minimize adverse impacts of uncontrolled or unregulated growth in the area. The Corps became involved as a result of increased regulatory permit requests to develop around the River and the water supply reservoirs in the watershed. The Corps, therefore, is attempting to develop a regional watershed plan while simultaneously implementing “traditional” Corps’ projects, such as flood control and navigation. The Corps intends “to develop a comprehensive watershed planning and management plan that will identify water resource problems and management solutions throughout the Nansemond River watershed focusing on the interrelated problems and needs of water conservation, water control, water resources development, wetlands protection, and environmental restoration” (Corps of Engineers, 1995).

This project has only started and is still in the reconnaissance or problem identification stage. The Corps is working with Suffolk and Isle of Wight, as well as other interested stakeholders in the region to identify common problems, such as water quantity and water quality issues. The Corps expects to release the reconnaissance study results to the public in late 1997 and begin the second feasibility stage shortly thereafter. The feasibility stage will require further data collection and detailed designs and cost estimates. The Corps, with support from the local jurisdictions, will identify the most acceptable alternative and also create the watershed management plan.

### ***Role of the Hampton Roads Planning District Commission***

The Hampton Roads PDC is currently taking a more active role in watershed management activities in the region by targeting critical waterbodies and developing cooperative agreements among relevant local, state, and federal agencies. The PDC is attempting to coordinate the water-related ordinances and develop a multijurisdictional arrangement among all the localities, through the formulation of a Memorandum of Agreement (MOA). The PDC received a 319 grant to develop the MOA and create a manual to identify and describe necessary policy and management changes. As part of the grant, the PDC is meeting and working with local jurisdictions' public works and planning departments and utility directors to identify problems and possible solutions.

While still tentative and on-going, the meetings with individual jurisdictions and joint meetings with local officials and utility directors have been rather successful in identifying common issues and strategies to deal with them (Walburg, 1996). Table 3.3 below outlines the MOA, the meetings' results, and also reveals how this Agreement is to be used. The PDC is attempting to develop this MOA as a first step in coordinating interjurisdictional policies and strategies.

As noted in the table, these meetings have thus far identified five main concerns. Various individuals and agencies foresee a rapid growth in population in Suffolk and Isle of Wight. While growth is not considered unacceptable, a number of the region's drinking water supply reservoirs are located in these localities and require protection. Furthermore, with the construction of the Lake Gaston pipeline a new holding reservoir will most likely be constructed in Isle of Wight. Therefore, interjurisdictional agreements and effective land use controls need to be considered and created prior to development. Growth in other localities is also increasing, thereby, putting more pressure on the quantity and quality of all drinking water supply reservoirs.

The CBPA and tributaries strategy mandated stricter water quality standards and subsequently impacted the jurisdictional policies and management strategies. Because of these changes, the public works and planning departments as well as the utilities have recognized the necessity for multijurisdictional and regional agreements. The 319 EPA

grant stipulates that BMPs are to be evaluated and a manual developed to identify and describe the most effective watershed management strategies in the region. Similar to the Northern Virginia grant, as described in Chapter 2, this will evaluate various BMPs and develop recommendations on methods to improve effectiveness.

**Table 3.3: Memorandum of Agreement**

<ul style="list-style-type: none"> <li>♦ Meeting with planning and public works departments and water supply utilities.</li> <li>♦ Identify water quality and water quantity problems <ul style="list-style-type: none"> <li>Rapid population growth</li> <li>Inadequate watershed protection</li> <li>Insufficient water supply to keep up with increased demand</li> <li>Inadequate interjurisdictional relations</li> <li>Potential problems with growth in Isle of Wight and Suffolk</li> </ul> </li> <li>♦ Identify solutions to mitigate these problems <ul style="list-style-type: none"> <li>Improved multijurisdictional cooperation</li> <li>Improved technology and implementation of BMPs</li> <li>More effective land use controls</li> </ul> </li> <li>♦ Use of MOA <ul style="list-style-type: none"> <li>Develop a manual describing regulatory framework, specifically recent changes in water quality standards affecting utilities actions</li> <li>Assess and evaluate effectiveness of on-site and regional BMPs</li> <li>Develop and expand use of computerized tools, such as GIS, in decision-making process</li> <li>Coordinate interjurisdictional policies</li> </ul> </li> </ul> <p>Source: Derived from Walburg (3/14/96 and 3/26/96).</p>
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This project is also being used to expand the use of GIS and other computerized tools to improve the decision making process. According to the survey (Randolph, 1990), most of the agencies already have GIS technology; however, the systems are designed individually and there is little collaboration or information exchange between the jurisdictions. This project will allow localities to develop a GIS in accordance with other jurisdictions and provide for a more holistic and regional decision-making approach. During a scoping meeting (1996), several jurisdictions recognized the necessity of a regional GIS, which could identify critical sites and assist in the development of more effective land use and water quality controls.

The MOA and the manual are being developed to improve the relations between the jurisdictions and subsequently permit improved and organized watershed management decisions. The MOA will organize watershed management of individual jurisdictions throughout the region, although it is still unclear what the Agreement will actually contain (Walburg, 1996). In addition to the regional MOA, the HRPDC is also attempting to coordinate policies and strategies between select localities.

Recently, the HRPDC assisted the City of Virginia Beach at two small water supplies within the City: Lake Smith and Lake Lawson. The Planning Commission is working in collaboration with Virginia Beach, state agencies and institutions, federal agencies such as the NRCS, and citizen groups and individual residents. Interest in this region has occurred primarily because of the initial interest and involvement by local citizens. Citizens have been rather instrumental in bringing these lakes into the spotlight, which has resulted in local agencies and utilities taking more interest in the management and planning of the lakes.

### **Tiered Approach to Multijurisdictional Watershed Management**

Through these various programs, three levels of approaches to multijurisdictional watershed management are becoming apparent: regional, bilateral, and local. The levels or tiers reveal different scales of interjurisdictional agreements and arrangements developed among jurisdictions, utilities, and the PDC. Figure 3.3 graphically illustrates the geographical and conceptual differences among the three tiers. The dotted lines, representing the political boundaries, are bisected by a river and reservoir, illustrating the geographical context of the problem. In this scenario, a regional plan would establish water quality objectives for several jurisdictions, although the management of the river would still occur at the local level. The bilateral agreement, although consistent with the regional plan, is developed between two jurisdictions for the sole purpose of protecting a water supply reservoir. The bilateral approach then requires the development of a multijurisdictional plan, establishment of management controls, and plan implementation.

As illustrated here, the three approaches exist simultaneously, requiring the involvement of many localities at all three levels.

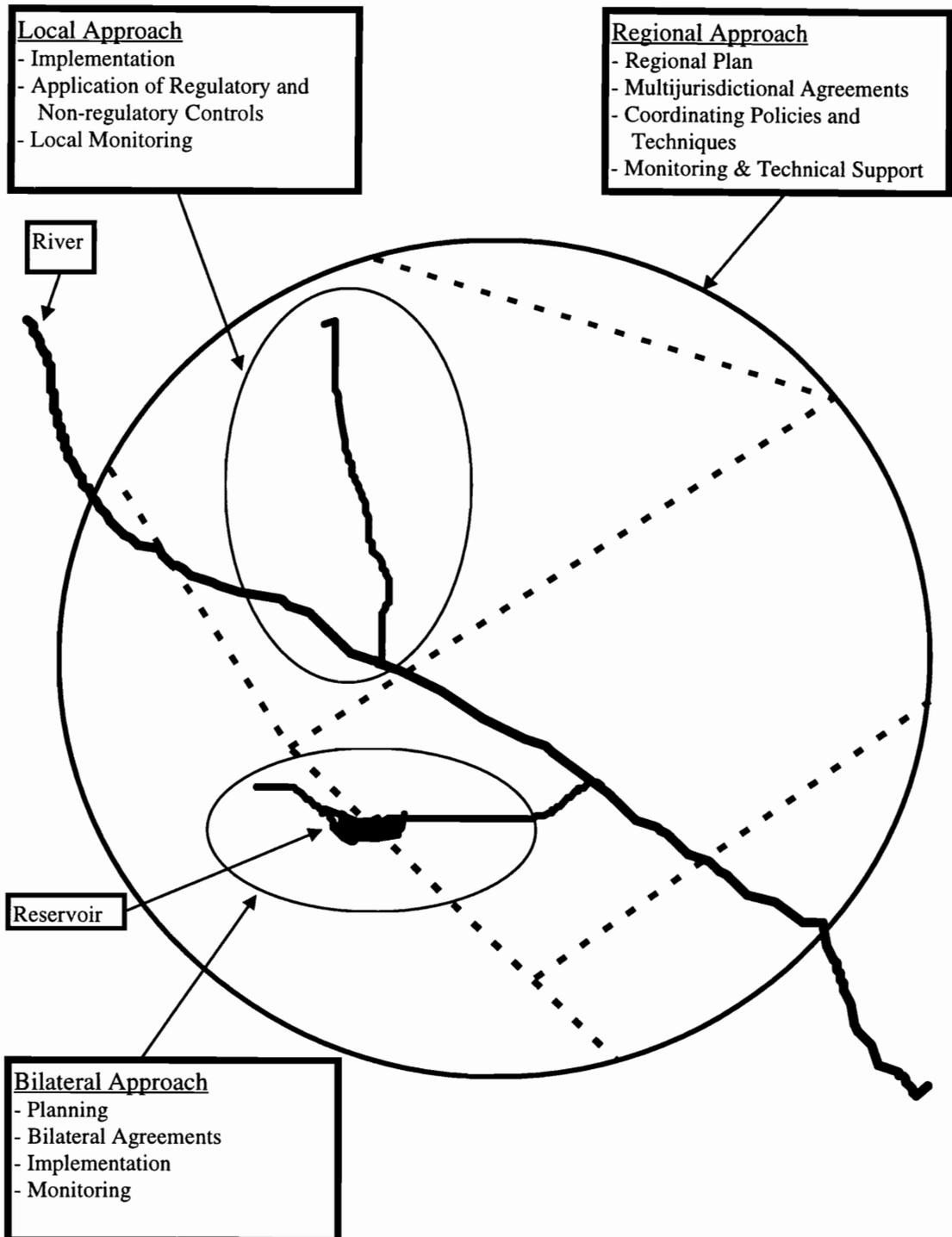
The most basic and geographically confined strategy is the local approach. It is characterized by plan implementation and localized water quality monitoring. The bilateral approach, a combination of the local and regional strategies, is developed between two jurisdictions identifying a common concern. Both jurisdictions then collaborate in developing and implementing policies and management techniques to rectify or mitigate this problem. For example, Newport News has developed various agreements to protect water quality at reservoirs located in other jurisdictions. Other agreements have been reached involving the cities of Suffolk and Portsmouth and Norfolk to protect their reservoirs' water quality.

The most comprehensive is the regional approach, which requires the input of a number of jurisdictions, agencies, and organizations. Regionalization includes the development of regional plans and agencies, although their implementation is conducted at the local level. For example, the current project being developed by the PDC identifies common concerns of the region; subsequently, agreements on overall water quality goals and objectives are reached.

### **Multijurisdictional Management of Sub-watersheds**

#### ***A Local Approach: Lake Smith and Lake Lawson, Virginia Beach***

A group of local homeowners, citizens, and Virginia Beach officials created an organization in response to concerns about algae blooms and general declines in water quality at Lake Smith and Lake Lawson. The lakes have a combined watershed of approximately 3,100 acres and are surrounded by single family residences and other urban land uses. The lakes lie entirely within Virginia Beach, although owned and operated by



**Figure 3.3: A Tiered Approach to Multijurisdictional Watershed Management**

Norfolk as water supplies. This organization, established in mid 1995, has developed a strategic plan of action to improve water quality through education and example (VASWCD, 1996:8). The group is developing and disseminating educational material to local residents, which describes nonpoint source impacts and techniques to mitigate impacts.

The HRPDC has become involved as a result of citizen involvement and influence and has created a project at Lake Smith and Lake Lawson to educate local citizens about water quality protection. The PDC project includes City officials and agency representatives and is developed with assistance by local, state, and federal agencies. A technical committee, comprised of representatives from all relevant agencies, meets monthly to generate ideas and strategies for these lakes. The Committee is beginning to work with residents through workshops and community meetings to distribute flyers and pamphlets on goals and objectives of the Committee for the lakes.

In the past, the HRPDC targeted management of water resources primarily at the coastal shoreline and at the Chesapeake Bay, with little effort inland at the water supply watershed level. The PDC has realized the need for watershed protection and is now attempting to concentrate on projects inland at this level (Rosenthal, 1996).

While this example serves as a “local approach” to watershed protection, it is also an example of a bilateral and a regional approach. Norfolk is also interested in the project due to its role as water purveyor for the region. Therefore, a bilateral approach exists, although Norfolk is not an active participant in this particular project. Furthermore, a regional approach exists since the lakes are water supply sources for a number of localities. While other agencies and organizations have a stake in the program, primary action and technical support has occurred within Virginia Beach.

#### ***A Bilateral Approach: Southern Watershed Area Management Program (SWAMP)***

The Hampton Roads PDC is coordinating a joint project between two localities known as the Southern Watershed Area Management Program or SWAMP. The PDC, in conjunction with the cities of Virginia Beach and Chesapeake, is developing a

coordinated watershed management plan for this subwatershed. This plan incorporates the southern watershed area, consisting of the watersheds of the Back Bay, the Northwest River, and the North Landing River (Little, 1995: 1). The Program was created approximately two years ago with the formation of an advisory committee. Table 3.4 summarizes the components of this program.

**Table 3.4: Components of SWAMP**

<ul style="list-style-type: none"><li>◆ Project between the cities of Virginia Beach, Chesapeake, and the HRPDC.</li><li>◆ HRPDC served as an <u>advisory regional agency</u> and link between this project and various projects throughout the region.</li><li>◆ <u>Local Government Advisory Committee</u> comprised of technical personnel from both local governments and one representative from the Virginia Dare SWCD.</li><li>◆ Critical watershed <u>problems and priorities</u> were identified.</li><li>◆ Current data was assessed to determine current state of watersheds.</li><li>◆ Problems and solutions with current management strategies were identified.</li><li>◆ <u>Goals, objectives and a coordinated management approach</u> for the future were developed.</li><li>◆ 5 goals identified as necessary to protect water quality for these water supplies.</li><li>◆ <u>Future needs</u> in terms of technical studies, research, and data were identified.</li><li>◆ Draft <u>Memorandum of Agreement</u> currently under review by both cities.</li><li>◆ Future step is to <u>implement</u> project.</li></ul> <p>Source: HRPDC Internet Homepage, 1995.</p>
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The Local Government Advisory Committee, formed in early 1994, was comprised of technical personnel from both Virginia Beach and Chesapeake, as well as a representative from the Virginia Dare SWCD. Although responsible for the development of the committee, the PDC serves only in an advisory capacity and does not have a representative on the committee. The Committee met several times over the course of a year to reach agreement on identifying watershed and water quality issues and concerns in this area.

The Committee acted as a risk assessment team to identify problems, prioritize these concerns, and then develop a plan to resolve them. The team began by assessing the current condition of the area's watersheds, through an examination of past and current

technical data and reports. The most critical watersheds, in terms of use and degradation, were identified and prioritized. The committee identified a number of future studies to accurately assess the watersheds and to fill in gaps in data.

Management issues, problems, and strategies were reviewed and prioritized in order to evaluate the progress and effectiveness of the local jurisdictions. Common goals and objectives were identified as the highest priority in the region. The prioritization also recognized that management strategies, including use and protection, must be coordinated among the localities. Finally, it was agreed upon that this type of open dialogue needs to continue due to the number of agencies and interests in the area.

Goals, objectives, and a coordinated management approach were then agreed upon and developed by the Committee. Five goals were identified as essential in protecting the watersheds and water quality in this region. These goals are:

1. Protect water quality at water supplies and enhance natural resources conservation;
2. Preserve open lands to help protect and enhance water quality;
3. Ensure compatibility of recreational activities and commerce with natural resource protection;
4. Preserve the rural character of the Southern Watershed while providing for rural residential development; and
5. Sustain and encourage agricultural and forestry activities in the Southern Watershed (Little, 1995: 2-4).

Through the prioritization and goal formulation processes the Committee realized the need for future data collection and follow-up studies. Current data, according to the Committee, was sufficient for identifying critical watersheds and developing broad goals; however, more precise data were necessary to target specific watersheds and identify refined management strategies. Furthermore, this information will improve local government management of these watershed areas.

A final task of the Committee was to create a draft Memorandum of Agreement (MOA) between the two localities. The MOA, developed as an administrative framework provides broad comprehensive goals for the Southern Watershed Area and coordinates the localities' management strategies for consistency with the regional goals. Both

localities are currently reviewing the draft MOA, which is critical for the implementation of this project.

The implementation of this project is the next step to be taken by both localities in the very near future. To implement the project requires a great deal of public education and development of public support for the project. Public support is expected to occur through the assistance of a volunteer water quality monitoring strategy as an essential component of the overall project.

### ***A Regional Approach: The Elizabeth River Basin Environmental Management Program***

In 1986 the Hampton Roads Water Quality Agency and the then SVPDC (HRPDC) developed the *Comprehensive Elizabeth River Water Quality Management Plan: Preliminary Management Recommendations (CERWQMP: PMR)*. This Plan was designed to develop a watershed management approach for the Elizabeth River basin. A second project, the Elizabeth River Watershed Special Assistance Project, reevaluates the original recommendations and evaluates the effectiveness of the management strategies proposed in the CERWQMP: PMR. In particular, the project's objectives were to "protect critical aquatic habitat, provide pollution control alternatives for developers and citizens, develop a comprehensive regional stormwater management plan for the River in coordination with the remainder of the HRPDC region, and to integrate other land uses with local jurisdictions and the River" (SVPDC and Hampton Roads Water Quality Agency, 1989: iv).

While the Project evaluated and analyzed the River basin, no management or implementation strategies were developed. The Elizabeth River Basin Environmental Management Program was produced by the SVPDC and is the direct product of the project. This Environmental Program integrates the studies with the recommendations and determines the optimal comprehensive implementation strategy to improve the water quality.

A number of studies were conducted during the Project phase and integrated during the Program phase. These consisted of: reviewing the original recommendations; analyzing the goals of the River basin; analyzing the regulatory and institutional components; reviewing other relevant state and local programs; evaluating the proposed Elizabeth River Critical Management Area; developing a stormwater management strategy for the basin; reviewing shoreline planning requirements; identifying hazardous waste sites in the basin; and identifying data and resource needs for implementation (SVPDC and HRWQA, 1989: iv-v). This Program identifies and regulates a number of point source pollutants; however, it does not include sufficient management measures to control and reduce nonpoint sources.

According to the HRPDC (SVPDC, 1989), the River's water quality has improved as a result of the Program being implemented by local and state governments, as well as, the private sector. The HRPDC recognizes that if these strategies are to be successful there must be strong institutional cooperation among the relevant parties. Furthermore, it has been noted that the local levels of government have been particularly critical in the implementation stage. Local agencies have primary authority over land use controls and should continue this progress to further protect the River's water quality. State and local levels of government have assisted the region in developing comprehensive strategies, such that uniform water quality monitoring and management strategies can be carried out by all jurisdictions. This permits local, state, and regional authorities to enact various land use or monitoring programs in accordance with other jurisdictions in the watershed.

This management document outlines a number of recommendations, which are to be carried out by the local governments. One of the most critical is to modify the institutional structure of the region. This will result in coordination of individual agencies' objectives, the development of enabling legislation, and the facilitation of financing and regulations for local land use controls. A second recommendation is to develop a watershed-wide environmental management program focused on those areas and land uses which pose the greatest threat to the environment. Thirdly, the document recommends that nonpoint source pollution and waterfront developments are managed in

accordance with state and federal regulations and that BMPs are established for all development in the watershed.

The Elizabeth River Basin Management Plan is a first step in developing and implementing management strategies to protect the Basin's water quality. A number of localities have conducted further studies to evaluate water quality and associated land use problems in the River basin. These studies have provided the local authorities with vital information in designing the optimum management plan for the region and in developing recommendations for further study. With these results the HRPDC and the local agencies will be able to develop management plans for other regional tributaries.

Through SHIP the local authorities and the PDC designed a guide to sub-watershed management, a *Regional Stormwater Management Strategy for Southeastern Virginia* (1989). The Strategy was created to develop a consistent stormwater management program for those drainage streams crossing jurisdictional boundaries. A second study conducted by the PDC and the Water Quality Agency, the *Elizabeth River Basin Environmental Management Program*, outlined the appropriate approach to local goals, objectives, and development policies for consistency with regional water quality objectives.

A number of studies have been completed in accord with the recommendations developed by the Hampton Roads PDC. These include three studies and documents to guide development of BMPs for agencies and individual land owners. In addition, the PDC has developed a *Citizen's Guide to Nonpoint Source Pollution* (1992), which is essentially a primer for homeowners on steps they can take to protect the water resources, especially the Bay. To further implement the recommendations of these studies the local governments and the PDC created the Pagan River program as a pilot project for the entire region (HRPDC, 1992). This study was designed to develop an institutional process for cooperative management of stormwater and nonpoint sources in sub-watersheds throughout Hampton Roads.

The Elizabeth River Basin Environmental Management Program recommended several interjurisdictional activities to assist local governments in creating stormwater

management programs and other environmental projects to meet the requirements of the NPDES and the CBPA. Some of the recommendations included design standards for stormwater management, cooperative water quality sampling, and public education. Due to the restructuring of the PDCs regional coverage, this program was extended to the Hampton Roads and Lower Peninsula regions.

### **Implementation of Watershed Management Strategies**

The Hampton Roads region is a unique situation involving reservoir ownership and surrounding land use controls. This situation has resulted in the need for innovative and effective management strategies at the local level to provide protection for reservoirs and feeder tributaries. Many of these strategies are developed and implemented by a jurisdiction to protect its own water supply, while others are developed to protect the water supplies of another locality. Ordinances and management strategies, therefore, have often been developed as a coordinated effort by multiple jurisdictions. For example, Newport News has worked in conjunction with several localities in developing land use controls around its reservoirs, although located entirely within another jurisdiction.

The following index, Table 3.5, gives an overview of existing projects and strategies by the local governments in the Hampton Roads region. Listed and described are the most common and often used projects in the region. Listed below are the four categories; overlay districts, stream corridors, density controls, and Best Management Practices (BMPs). Also included into this matrix is the category “multijurisdictional agreement”. This category identifies those localities with a multijurisdictional arrangement and the locality or localities for which it is in effect. Reservoirs are not found in all jurisdictions; therefore, certain localities are not relevant for this discussion and have been excluded from the matrix.

### ***Reservoir Protection Overlays and Ordinances***

In 1987 the city of Newport News passed a reservoir protection ordinance that takes a basin wide approach to protect portions of the three reservoirs lying within their

jurisdiction. The Reservoir Protection Ordinance contains several provisions to protect water quality at the reservoirs. These provisions include: required runoff control permits and structural BMPs for all new development; 200 foot buffers around reservoirs and perennial streams; 100 foot buffers around intermittent streams; and no new septic systems in the watersheds except under certain conditions (Newport News, 1992: 234).

The buffers, however, may be reduced to as little as 50 feet if BMPs are employed. The buffers may be further reduced to 25 feet if compliance represents a significant hardship to the owner. Through enactment of the Reservoir Protection Ordinance the City of Newport News has the authority to purchase land within the buffer zones. As of 1989, the City had purchased 30 acres of private land within these buffer zones. The Newport News Reservoir Protection Ordinance was a significant first step in protecting the water quality of the basin and has encouraged other local jurisdictions to develop similar plans and strategies.

The City of Newport News has taken the lead in protecting the water supply for the region and has encouraged other jurisdictions, primarily York and James City Counties, in protection of the reservoirs and the Chickahominy River. Both York and James City counties have adopted reservoir protection ordinances throughout their respective jurisdictions, as a result of Newport News involvement. The purpose of the Overlay District in James City County is to protect the water quality of James City County's existing and proposed public drinking water supply reservoirs as a result of runoff causing pollution and sedimentation. The District attempts to protect each of the public drinking water supply reservoirs and the tributary streams through a variety of regulatory measures by establishing special requirements in addition to the zoning district standards governing the reservoirs.

**Table 3.5: Management Strategies at the Local Level: A Quick Index**

<b>Jurisdiction</b>	<b>Overlay District</b>	<b>Stream Corridors</b>	<b>Density Controls</b>	<b>BMPs</b>	<b>Bilateral Agreements</b>
James City	Reservoir	Limited Use	Ag/For Districts	N/A	Newport News
York Co.	Reservoir	N/A	N/A	N/A	Newport News
Isle of Wight	Reservoir	N/A	Growth Areas	N/A	Portsmouth, Norfolk
Newport News	Reservoir	Park System	Cluster Devel.	*Regional	York, James City, New Kent
Norfolk	Reservoir	N/A	N/A	*On-site Regional	Suffolk, Isle of Wight
Virginia Beach	Rural	N/A	N/A	N/A	Chesapeake (SWAMP)
Portsmouth	Zoning Dist	N/A	N/A	N/A	Suffolk
Suffolk	Zoning Dist	N/A	No	N/A	Portsmouth, Isle of Wight
Chesapeake	Rural	N/A	N/A	N/A	Va. Beach (SWAMP)
Hampton	Reservoir	N/A	N/A	N/A	Newport News
Williamsburg	Reservoir	Around Reservoir	N/A	N/A	Newport News
Poquoson	Reservoir	N/A	N/A	N/A	Newport News

Source: Derived from: Newport News, 1992; James City Co., 1994; Walburg, 1996; Rosenthal, 1996; Umphlette, 1996

\* Extensive use of BMPs. Other localities use BMPs, but to a lesser degree.

N/A Not applicable for this discussion, but does not imply that techniques do not exist or are inadequate.

Developers must conduct a Runoff Analysis to meet the County's performance standards prior to development of subdivisions and large lot residential units. However, proposed commercial or industrial developments of less than 5,000 square feet of impervious surface do not require the calculation of a Runoff Analysis. The Analysis describes the project including the location, extent of proposed impervious surface, anticipated land use, and a description of existing site conditions. It describes natural characteristics of runoff at the site including rate and composition of existing runoff conditions and potential runoff with the proposed project. Furthermore, the analysis identifies and describes measures which reduce the rate of runoff and pollutant loading

from the project both before and after construction. Criteria are then proposed to reduce suspended solids and phosphorous by 75% and to retain runoff from impervious surface to mitigate runoff impacts and to subsequently protect the reservoir.

Williamsburg, according to Walburg (1996), has an extensive water supply protection overlay district. Although the City has jurisdiction over little land around Wallers Mill Reservoir, it has required a 300 foot buffer in that particular area. A 300 foot buffer is considerably larger than requirements set by other jurisdictions or those mandated by the CBPA. Throughout Hampton Roads, local jurisdictions, such as James City County, are only implementing 100 foot buffers, which are the minimal requirements of the CBPA.

Norfolk has developed a reservoir protection overlay district within the City for in-town lakes. While this was essential, the in-town lakes only account for approximately 10% of the City's drinking water supplies while the remainder comes from reservoirs within other jurisdictions. Portsmouth is in much the same situation. Both of these cities have a number of reservoirs located within Suffolk and Isle of Wight. While Suffolk and Isle of Wight own the land around the reservoirs, Portsmouth and Norfolk are responsible for the water quality at their respective reservoirs.

Both Norfolk and Portsmouth have encouraged Suffolk and Isle of Wight to implement land use controls, although without a great deal of success. Portsmouth and Norfolk recently drafted Reservoir Protection Overlay Districts and are working with Suffolk and Isle of Wight to adopt them. Suffolk has now incorporated the reservoirs into Resource Protection Areas, according to the CBPA. Isle of Wight has also adopted overlay districts around the reservoirs to promote appropriate land use controls and thereby protect water quality. However as previously described, rapid development in the area will apply significant pressure on water quality at the reservoirs.

### ***Stream Corridors/Buffers***

The City of Newport News has created a park system to protect the stream corridors, reservoirs, and watersheds. The City has preserved 8,000 acres of watershed

property around the Newport News Reservoir through land acquisition and donations. Newport News has also developed parks around Lake Mahey and small parklands along Deep Creek and Warwick River. Furthermore, natural areas and open space have been dedicated around all of the corridors of the remaining rivers, streams, and stream segments. In accordance with the open space objectives to protect water quality, the City has implemented greenways along tributaries of the Warwick River, Stoney Run, and Lucas Creek. While the park system and the open space/greenway system have covered all of the tributaries and reservoirs, both systems have excluded the James River.

Throughout most of the jurisdictions the use of stream buffers is quite common. Newport News, however, is one of the few that have actually acquired large tracts of land around the reservoirs and tributary streams. This type of land use management strategy while effective in this area to mitigate water quality impacts is rarely financially or politically feasible for other localities. Many of the other localities are unable to acquire large tracts of land and instead are implementing zoning restrictions and conservation easements around the tributaries to protect water quality. James City County has been reluctant to employ stream buffers due to public opinion. According to the Comprehensive Plan (James City Co., 1994), the local residents have stated that stream buffers are not appropriate for the County. The residents suggested that buffers are not effective since the watersheds are extremely developed and have already been compromised. This viewpoint, however, does not seem to be common throughout the region where localities often employ stream buffers.

### ***Density Controls and BMPs***

The City of Newport News has also implemented a number of other land use management strategies, such as cluster development and development design requirements. The City has enacted cluster development as a mechanism to keep development away from the James River. The City has also required the use of design standards and innovative construction techniques by developers to reduce runoff. Most of these requirements are in the form of on-site BMPs such as grassy swales and stormwater

detention ponds. Other BMP and innovative technological measures are also utilized by the City and developers throughout the region to control runoff and to decrease nonpoint source pollution.

James City County has developed land use controls to protect water resources, although cluster development is not common throughout the County. The County is, instead, using agricultural and forestal districts to direct growth away from water supplies. The County encourages the use of these districts specifically in identified critical watersheds. Growth, both suburban and urban, is then encouraged in specified areas. While agricultural and forestal related sources of pollution still occur, these are mitigated and more importantly urban runoff is minimized.

### **Monitoring**

Point and nonpoint sources of pollution are common in the reservoirs as well as in the tributary rivers supplying the Newport News Waterworks. The nonpoint sources of pollution are attributed primarily to urban and agricultural runoff. The reservoirs' watersheds are comprised primarily of forests and swamps and undeveloped federal land. The reservoirs have, however, experienced persistent algae blooms and other water quality concerns. Due to the increased levels of urban growth and water quality impacts, the Waterworks began studying and taking action to protect the reservoirs' watersheds.

The Waterworks department conducted a study to analyze structural and nonstructural controls to determine the effects and possible solutions of the water quality problems. Furthermore, they established a stream monitoring system at the reservoirs and created a reservoir protection ordinance. The stream monitoring system, established in 1986 by the Waterworks and Virginia Tech, evaluates and assesses the level of pollutants entering the reservoirs. The study made a number of recommendations to mitigate water quality hazards, which included urban runoff controls and advanced water quality monitoring on the tributaries.

## **Conclusions and Lessons Learned for Watershed Management in Virginia**

### ***Effectiveness in Achieving Watershed Management Objectives***

The Hampton Roads region cannot easily be assessed for effectiveness (e.g. water quality improvements) due to the vast number of waterbodies and jurisdictions. However, water quality at many of the reservoirs has been maintained at relatively high levels. This is due primarily to the interjurisdictional nature of reservoir and river ownership and the subsequent agreements developed between the localities.

### ***Institutional Characteristics and Program Components***

The Hampton Roads region is a unique situation in which several institutional arrangements have been developed to manage the rivers and reservoirs throughout the area. They range from broad programs, such as the Chesapeake Bay Preservation Act, which impact all the Hampton Roads jurisdictions, to local or bilateral agreements, such as memoranda of agreement between a few localities. Table 3.6 outlines the specific institutional characteristics and the program components which have contributed to the effectiveness of the Hampton Roads watershed management program.

#### ***Institutional Framework and Planning***

- ♦ The Hampton Roads region has a large number of jurisdictions with diverse perspectives and this has impeded development of region wide plans or policies. Instead of a grand regional agency, subwatershed plans and bilateral agreements have provided the multijurisdictional approach.
- ♦ Three types of agreements are identified in this case study and together they constitute a tiered multijurisdictional approach: regional, bilateral, and local. A tiered approach to watershed management provides opportunities for all jurisdictions and organizations to identify common issues and develop multijurisdictional solutions appropriate to the problems.

**Table 3.6: Watershed Management Characteristics from Hampton Roads Program**

Institutional Framework and Planning	Three tiered approach evident: regional, bilateral, local Regional and bilateral plans Bilateral and local implementation
Stakeholder Involvement	Regional agencies (e.g. HRPDC) assist with coordination of problem identification and with development of regional policy which guides local and bilateral programs. Local jurisdictions identify, prioritize, and target problems, and develop and implement programs.
Implementation Strategies	Extensive use of stream and reservoir buffers through local implementation.
Monitoring	Consistent monitoring of water quality and program effectiveness by localities and citizen groups

- Regional plans and policies are developed through the involvement of several jurisdictions and may include regional agencies, such as the HRPDC or a managing or monitoring agency.
- Local jurisdictions are then responsible for implementation of the plan. Localities have also developed and implemented specific programs to monitor the effectiveness of the implementation strategies and the regional program.
- Bilateral arrangements are a combination of the two approaches, incorporating multijurisdictional agreements and plans between two jurisdictions and localized implementation.
- Memoranda of Agreement (MOA) are becoming increasingly used by the PDC and local jurisdictions in an attempt to develop appropriate watershed management policies and strategies throughout the region. These MOAs are an essential first step in developing a regional approach and provide a regulatory framework for the region. Use of MOAs is encouraging and reveals that the region as a whole is concerned with the water quality and water quantity issue. These Agreements enhance the regional regulatory and jurisdictional framework and serve as a policy guide for individual jurisdictions. While MOAs are a positive step, they do not provide the necessary foundation to guide regional objectives and local strategies.

### *Stakeholder Involvement*

- The Hampton Roads Planning District Commission is assuming a relatively passive role in the region, thereby, permitting local governments to identify particular concerns and initiate specific projects to address these issues. This type of approach may allow localities to develop multijurisdictional agreements and establish projects and policies on a subwatershed scale. For example, many localities in the Southern Peninsula have developed interjurisdictional agreements and management strategies to protect water quality at a number of reservoirs. However, without a well developed regional framework, local management strategies may not be coordinated with other localities or consistent with the regional objectives. In contrast to the Occoquan, Hampton Roads lacks a strong regional coordinating body, such as a regional policy or planning authority.
- However, multijurisdictional approaches to watershed management are being developed in the region through the creation of three basic programs: Southern Watershed Area Management Program (SWAMP), the Elizabeth River Basin Project, and the Pagan River Watershed Project. SWAMP, a project initiated by the PDC and localities, provides a framework for future management strategies in the Virginia Beach and Chesapeake area. While this type of agreement could be expanded to include other jurisdictions, perhaps more importantly, the PDC could use the framework in developing other initiatives around the region. Bilateral agreements, such as SWAMP, established throughout the region may be the building blocks for a regional institutional framework, or may exist in place of a strong regional approach.
- The Elizabeth River Basin Project is a unique situation, in which residents have forced local governments to take action to protect the quality of the river and surrounding watershed. This type of “citizen rebellion” reveals the need for and benefits of public involvement in the identification and assessment of problems and also in the planning and implementation processes. The local governments have begun working closely with citizens to mitigate and rectify these problems.

### *Implementation Strategies and Monitoring*

- ♦ Specific management strategies and monitoring programs have been used by the localities to mitigate water quality impacts. Monitoring of water quality, management strategies, and plan implementation has provided the region and localities with data on project effectiveness. With regional and bilateral agreements in place, local governments have been able to develop implementation strategies consistent with other local and regional objectives. In addition, program success has been measured primarily through water quality monitoring conducted by local governments and regional citizen groups.

### ***Representation of the Watershed Protection Approach in the Hampton Roads Program***

The Hampton Roads watershed management program includes the four features of the WPA and therefore follows the EPA Approach. However, this program also has specific implementation characteristics that can be used to clarify the practice of WPA.

In general it has been recognized that water quantity deficiencies and water quality degradation are the major problems confronting all the localities. However, problem prioritization and targeting has been more difficult due to the complex nature of reservoir ownership and water quality protection responsibility.

To deal with these problems, Hampton Roads localities formed institutional frameworks, primarily bilateral agreements. While lacking a grand regional focus, localities have taken the initiative and targeted a specific and relative problem. In many cases, such as the Elizabeth River, citizen groups and landowners have identified the problem and initiated the program. Due to the bilateral nature of many area programs, a subwatershed plan is developed among two jurisdictions. The program is then implemented through specific local management strategies. Therefore in relation to the WPA, integrated solutions are weak regional or subregional frameworks with implementation at the local level.

### ***Lessons Learned for the WPA and Other Watershed Management Programs***

This program and the lessons drawn may be useful to other similar regions in developing their own watershed management program and in clarifying the WPA (See Table 3.7). Due to the number of jurisdictions and diverse interests and viewpoints in Hampton Roads, a grand regional approach was not employed. In this context, the tiered approach has been very useful in developing an effective watershed management program and have facilitated the involvement of the key stakeholders into the planning and management processes.

**Table 3.7: Lessons for the WPA and other Watershed Management Programs**

Problem Identification	No single regional problem exists to unite and coordinate all localities. Instead many site specific problems are identified.
Tiered Approach to Stakeholder Involvement and Integrated Solutions	Allows for institutional framework appropriate to the problem.
Regional	Development of regional agreements and plans.
Bilateral	Collaboration among two jurisdictions to identify a common problem (e.g. water quality degradation), develop integrated solutions at a regional level, and implement the solutions at the local level.
Local	Development of specific strategies to implement regional plans and policies.

The tiered approach is driven by the involvement of the key stakeholders and in turn drives the type and level(s) of integrated solutions. For example, the Elizabeth River Basin Management Plan identified a problem which involved several jurisdictions, thereby, requiring subregional planning and local implementation to mitigate the impacts. Alternatively, SWAMP involved two jurisdictions, Virginia Beach and Chesapeake, in problem identification, plan development, and local implementation. This bilateral agreement permitted the localities to develop watershed wide objectives and also site specific techniques to mitigate water quality impacts.

The tiered approach then permits stakeholders to identify and develop solutions for a common problem. While the WPA requires the involvement of all stakeholders,

this program reveals that key stakeholders (those impacted and/or contributing to problem) are to be involved. In addition, these stakeholders will also be responsible for developing regional objectives and plans (regional and bilateral tier) and creating local management techniques (local and bilateral) to implement the plan.

## **IV. The Albemarle-Charlottesville Multijurisdictional Approach to Watershed Protection**

This case study investigates the South Fork Rivanna Reservoir watershed and the institutional framework established between Albemarle, Charlottesville, and regional agencies. This chapter outlines the historical events which have shaped the regional approach to protect the Reservoir's water quality. It identifies plans, policies, strategies, and monitoring techniques developed by these three governing bodies. Lessons are then identified from this study which may be useful to other watershed management programs in Virginia and also provides lessons relating to the Watershed Protection Approach.

### **Background**

Albemarle County and the City of Charlottesville have implemented a multijurisdictional approach to watershed protection at the South Fork Rivanna River Reservoir. This approach, however, is slightly different from those undertaken in Northern Virginia and Hampton Roads. Albemarle and Charlottesville became involved in this management strategy in the early 1970s due to pressure from the Virginia Water Control Board (now the DEQ) to improve water quality. These pressures resulted in the formation of the Rivanna Water and Sewer Authority, which became responsible for maintaining and financing water supply facilities at the reservoir.

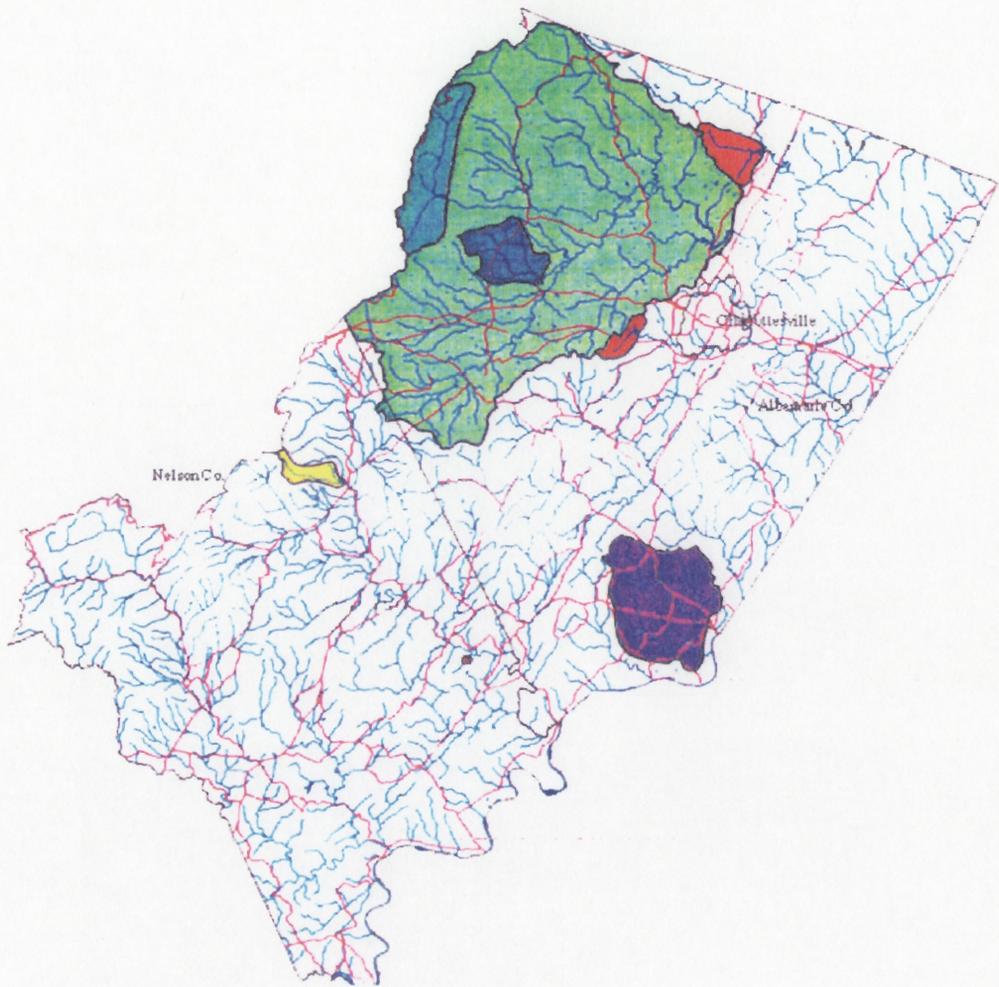
Albemarle County contributes to three primary river drainage basins, while the entire County is part of the greater Chesapeake Bay watershed drainage area. The three river basins, the Middle James, the Rappahannock, and the York, are then divided into eight watershed divisions. The Middle James River basin has six divisions, while there is only one division each within the Rappahannock and the York River basins. Management occurs at the divisional level and not according to political boundaries. Approximately two-thirds of the County drains into the Rivanna, which eventually flows to the James River. The James River, which has the most prevalent water quality problems of the Chesapeake Bay tributaries provides, a watershed for the southern edge

of Albemarle County (Albemarle Co., 1989: 58). The remaining one-third drains into the York and Rappahannock Rivers.

Six reservoirs are located throughout Albemarle and they supply water to Charlottesville and other localities around the County. The South Fork Rivanna Reservoir, Beaver Creek Reservoir, and Sugar Hollow Reservoir are located in the South Fork Rivanna River Watershed, while the Ragged Mountain Reservoir is in the Rivanna River Watershed. The Totier Creek Reservoir is found in the James River Watershed and a river in-take structure is located in the North Fork Rivanna River. All of these reservoirs supply water to localities throughout the County and are managed and regulated primarily by the County. Management and administration at the South Fork Rivanna Reservoir, however, is unique and provides an insight into the multijurisdictional approach. Figure 4.1 below, identifies the local jurisdictions and the placement of the South Fork Rivanna Reservoir.

### **Early Multijurisdictional Watershed Management Efforts**

Constructed in the mid 1960s, the South Fork Rivanna Reservoir, fed by the South Fork Rivanna River, supplies water only to the City of Charlottesville. Concerns about water quality existed prior to completion of the Reservoir resulting from growth and development in the watershed and they were substantiated almost immediately after completion. Point and nonpoint sources of pollution, such as excess chemicals from agricultural and urban areas, seriously compromised the water quality. While there were many complaints of taste and odor, the most noticeable problems were a result of oxygen deficiencies, which accounted for numerous fish kills throughout the Reservoir (Owens, 1991: 7). Urban and suburban growth within the watershed increased resulting in increased nonpoint source pollution loads. Furthermore, during the 1960s and early 1970s agricultural lands also contributed larger loads of nonpoint source pollutants due to the increased use of pesticides and fertilizers and also due to the limited use of soil conservation techniques. Table 4.1 reveals the events that led up to the multijurisdictional approach in the region.



**Figure 4.1: Watersheds of Water Supply Reservoirs in Albemarle-Charlottesville Region**

- South Fork Rivanna Reservoir
- Sugar Hollow Reservoir (also part of So. Fork Rivanna Watershed)
- Beaver Creek Reservoir (also part of So. Fork Rivanna Watershed)
- Totier Creek Reservoir
- Chris Green Reservoir
- Ragged Mountain Reservoir
- Lake Monacan Watershed

Source: Derived from Information Support Systems Lab, Virginia Tech

**Table 4.1: Timeline of Events Prior to 1980**

1960s	South Fork Rivanna Reservoir constructed in Albemarle County.
1972	Rivanna Water and Sewer Authority created to administer Upper Rivanna River Basin.
1975	Initial study by the Authority to identify and assess pollution problems.
1977	314 EPA Clean Lakes Phase I grant awarded to Rivanna Water and Sewer Authority to perform Rivanna Reservoir Restoration Project.
1977	Water Quality Management Study of the South Fork Rivanna Reservoir completed with the following recommendations. 1977 Runoff Control Ordinance was adopted, becoming the first major step toward a watershed wide management plan. 1979 Creation of Watershed Management Planning Committee. 1979 Creation of a Watershed Management Plan for Albemarle County.
1977	Alternative Water Supply Study completed.
1978	Rezoning in Rivanna watershed to a conservation district.
1979	South Rivanna Reservoir Watershed Management Plan completed with the following recommendations. 1979 Creation of Watershed Management Official in Albemarle County. Elimination of point source discharge in the watershed. Integrate watershed management goals.
Source: Derived from: Owens, 1991; Albemarle, 1989; Hirschman, 1996.	

Charlottesville, responsible for water quality protection, perceived the problem to be insufficient watershed protection. The City only acquired a 10 foot buffer around the Reservoir, although it claimed that Albemarle had not enacted and implemented proper land use ordinances to provide adequate protection for the Reservoir's water quality. Because the Reservoir was located in the County, Albemarle held responsibility for land use around the Reservoir and for the management and maintenance of the Reservoir itself. There was considerable disagreement between these two jurisdictions about the extent to which the County was responsible for protecting the Reservoir and water quality. The City claimed that although the Reservoir was used and operated by the City, the County had a responsibility to enact land use regulations, and thereby, protect the water quality. Neither jurisdiction took responsibility for the water quality problems and allowed the decline to continue.

During this time period both the County and City were attempting to expand water and wastewater capacity and requested funding from the Virginia Water Control Board. The Board cited the lack of cooperative management efforts in the Rivanna watershed, and subsequently, denied funding to both parties until a regional agency was created, that would be responsible for the administration of the Upper Rivanna River basin (Owens, 1991: 7).

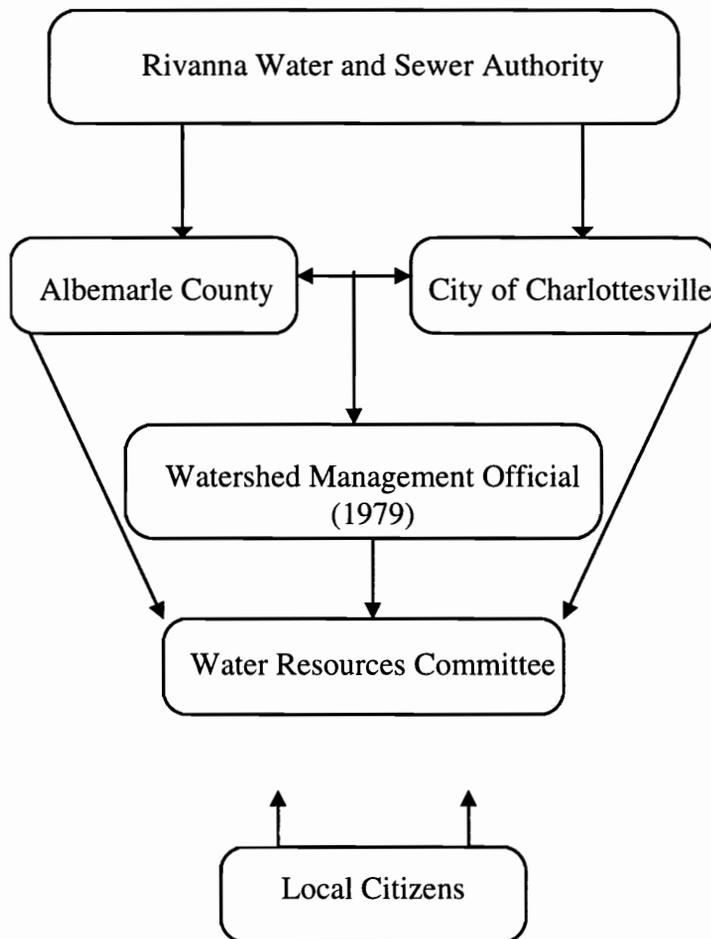
### ***Rivanna Water and Sewer Authority***

The Rivanna Water and Sewer Authority was created in 1972 as a joint resolution by the City and County to accomplish this objective. As can be seen in Figure 4.2, the Rivanna Water and Sewer Authority was very significant in bringing the two localities together and developing a multijurisdictional approach in the region. With the creation of the Authority, the City and County realized the need to develop and coordinate their management efforts (see Figure 4.3). The Authority was granted the power to acquire, maintain, and finance water supply facilities, while the County retained sole authority in land use matters.

Shortly after its inception, the Authority appointed a committee to study the pollution problems and concerns at the Reservoir. The committee conducted a study in 1975, which made a number of recommendations to mitigate the pollution problems. In 1977 the USEPA awarded a 314 Clean Lakes Phase I grant to the Rivanna Water and Sewer Authority to perform the Rivanna Reservoir Restoration Project. This demonstration project, one of the first Clean Lakes Program awards in the United States, was developed to “[evaluate] the effectiveness of reservoir aeration, agricultural grass waterways, and sedimentation ponds in reducing the eutrophication of the reservoir” (Browne et.al. 1993: 1).



**Figure 4.2: Stakeholders at South Fork Rivanna Reservoir Prior to 1972.**  
 The main stakeholders in region are Albemarle and Charlottesville due to problems at the South Fork Rivanna Reservoir. Little cooperation existed between the localities and no regional agencies or plans were in existence.



**Figure 4.3: Stakeholders at South Fork Rivanna Reservoir 1972-1980.**  
 Water quality problems at the Reservoir resulted in the formation of the Rivanna Water and Sewer Authority and forced cooperation between the two jurisdictions.

### ***Water Quality Management Study of the South Rivanna Reservoir and Tributary Area***

During this same year, the Water Quality Management Study of the South Rivanna Reservoir and Tributary Area was completed, recommending future measures to provide water supply protection in the watershed. The study recommended the implementation of a comprehensive watershed management plan, water treatment modifications, and various land use controls to mitigate impacts on the Reservoir (Albemarle, 1989: 63). A first step towards realization of these recommendations came with the enactment of the Runoff Control Ordinance in 1977. The purpose of the Ordinance was to minimize nonpoint source pollution impacts and eutrophication resulting from new development in the watershed.

### ***Report on Alternative Water Supply Sources***

In response to rapid development in the watershed and the Reservoir's water quality declines, a study was conducted to identify possible water supply alternatives to the South Fork Rivanna Reservoir. An initial proposal was made to abandon it, although it was not accepted. This Report on Alternative Water Supply Sources was developed by Albemarle to study water quantity issues in conjunction with water quality concerns. The Report, created and published in 1977, identified three alternatives to water supply expansion and water quality protection in the region. These three were (1) the expansion of the South Fork Rivanna Reservoir, (2) development of the Buck Mountain System, (3) development of the James River and abandonment of the South Fork Reservoir. The Report ultimately found that the Reservoir should not be abandoned and reaffirmed the importance of protecting the South Fork Rivanna Watershed.

### ***South Rivanna Reservoir Watershed Management Plan***

A second study was completed in 1979: the South Rivanna Reservoir Watershed Management Plan. The Plan outlined the basic guidelines required for future actions to provide water supply protection for the watershed. A primary recommendation of the Report was to create the position of a Watershed Management Official to oversee all

water resource related issues and was funded through a joint effort by both Charlottesville and Albemarle. This position, now the Water Resources Manager, has since been modified to include all water related planning and management issues including groundwater as well as surface water. The funding for the water resources manager has also changed. While in the past this position was funded through a joint venture by both jurisdictions, it is now funded by the Rivanna Water and Sewer Authority, although the manager is still under the County's jurisdictions.

The management plan also recommended the elimination of all major point source discharges within the watershed. Furthermore the Plan recommended that the Virginia Department of Transportation mitigate urban nonpoint source pollution by installing and maintaining erosion and sedimentation control measures. Finally, recommendations were made to integrate watershed management goals into agricultural, technical, and financial assistance programs. Major provisions of the plan are outlined and described below in Table 4.2.

**Table 4.2: Major Provisions of 1979 Watershed Management Plan.**

- ◆ Creation of Watershed Management Official to oversee all water related issues.
- ◆ Construction of the Lickinghole Creek Sedimentation Basin to mitigate nonpoint source discharge from Crozet community.
- ◆ Construction of Crozet community interceptor to reduce point source discharge in Rivanna River.
- ◆ Construction and maintenance of erosion and sedimentation control measures to mitigate urban nonpoint source pollution.
- ◆ Integration watershed management goals into agricultural, technical, and financial assistance programs through rural areas, downzoning, and conservation plans.

Source: Albemarle, 1989 and Hirschman, 1996.

A water resource committee, a watershed management official, and a subsequent management plan were developed jointly by Albemarle and Charlottesville beginning in 1979. The Water Resource Committee is composed of County and City staff, the water resources manager, a River Water and Sewer Authority representative, and is open to the public with citizen input encouraged. The Committee reviews a number of documents,

including the comprehensive plan, water supply protection ordinances and the current Watershed Management Plan in order to identify the best way to coordinate and develop water resource standards for the County. Currently, local matters of water resource protection are primarily handled by the area's Watershed Management Official and the Rivanna Water and Sewer Authority.

During the late 1970s, the County Board of Supervisors began implementing these land use recommendations. Development of a runoff control ordinance was the first step taken by the County to mitigate pollution and eutrophication of the reservoir. Subsequently, the County exercised its land use control authority by denying a planned unit development near the Reservoir. According to County administrators, this development was found to be inconsistent with land use regulations and would compromise the Reservoir's water quality. After considerable litigation by the developers, the courts upheld the County's decision and the development was abandoned. Furthermore, in 1978 all publicly owned properties, except schools, which were located within water supply watersheds were rezoned to a conservation district designation by the County.

### **Multijurisdictional Watershed Management: Post 1980 Efforts**

After the development of the watershed management plan, a number of projects were created and implemented with the primary intent of protecting the watershed of the Rivanna River. Table 4.3 below, identifies the major events which have shaped the multijurisdictional approach. A \$5.3 million sewer interceptor was constructed as a public sewage collector for the growth area of Crozet, and thereby, eliminate a number of point source discharges from this community. The Lickinghole Creek Sedimentation Basin was also constructed in the mid 1990s to mitigate nonpoint source discharges from the Crozet growth area (Albemarle, 1989: 64).

**Table 4.3 Timeline of Events: Post 1980**

- 1980 \$5.3 million sewage interceptor constructed to alleviate point source discharges in Rivanna watershed.
- 1980 A moratorium enacted on development in Buck Mountain Creek until land purchased by County and City.
- 1981-1992 USEPA Clean Lakes Phase II cost-sharing program for BMP implementation awarded to County.
- 1982 Rezoning of County restricted developed in Rural Areas. Over 1,000 acres in the water supply watershed were rezoned as Rural Areas.
- 1982 Section 208 Watershed Management Study of the South Rivanna Reservoir completed.
- 1991 Creation of TJSPARE to identify and evaluate issues and concerns at the PDC wide scale. A major focus of TJSPARE is to assess regional water resources and related water quality.
- 1993 The Lickinghole Creek Sedimentation Basin is put into operation to alleviate nonpoint source discharge in the water supply watershed.
- 1994 Creation of Rivanna Roundtable as part of TJSPARE to focus specifically on planning and management issues at the Rivanna River.
- 1995 Multi-year sedimentation study completed at the South Fork Rivanna Reservoir to determine rate of sedimentation at the Reservoir.

Source: Hirschman et.al., 1991; Browne et.al., 1993; Hirschman, 1996; Collins, 1996.

The County began adopting a number of land use requirements and restrictions for the water supply watersheds, primarily the South Fork Rivanna. The Board of Supervisors adopted the Albemarle comprehensive plan amendments of 1980, which rezoned all urban areas in the South Fork Rivanna River watershed to rural areas. Furthermore in 1980, a moratorium was placed on all development in the Buck Mountain Creek watershed. This development restriction remained until the City and County reached an agreement as to the amount of land necessary for the proposed impoundment.

Between 1980 and 1982, the County rezoned over 1,000 acres of land within water supply watersheds to Rural Areas. While a large amount of land had been rezoned, development restrictions in these areas were not strong enough to provide adequate water quality protection. As a result, the County enacted a number of limitations on development and required that proposed developments meet certain special use permit criteria in these Rural Areas.

A follow-up study was conducted on the current state of the Reservoir's water quality to assess the existing plans and policies associated with the Reservoir. A Section 208 Watershed Management Study of the South Rivanna Reservoir, was completed in 1982, which concluded that the Watershed Management Plan developed in 1977 was still valid and should be fully implemented (Albemarle, 1989: 64).

The County has continued to develop management strategies designed to protect the watershed and water quality of the South Fork Rivanna Reservoir. The County in conjunction with the Rivanna Water and Sewer Authority highly encourages the use of BMPs for agricultural and forestry activities in the water supply watersheds. An EPA 314 Clean Lake Phase II cost-sharing program was developed in the 1980s, which provided funding for BMP implementation in mitigating agricultural runoff impacts. This project was an effective voluntary project for landowners to mitigate nonpoint agricultural runoff (Albemarle, 1989). According to the County (Browne, 1993), these projects have resulted in water quality stabilization at the Reservoir. “[Water] quality in the South Rivanna Reservoir has remained stable over the past ten years. The water quality data collected ...indicates that restoration activities, such as the implementation of agricultural [BMPs], are having a positive effect on reservoir water quality by reducing the rate of eutrophication and extending the life of the reservoir” (Browne et.al. 1993: iii).

The cooperative efforts between the City and County were imperative in developing the multijurisdictional approach in the region. The Virginia Water Control Board and the Rivanna Water and Sewer Authority were instrumental in bringing the two jurisdictions together, although a “natural” affiliation soon formed. A “natural” affiliation is one in which jurisdictions have a common bond, such as a shared watershed, contiguous boundaries, a mutually shared conflict, or other unifying concern. Albemarle and Charlottesville were able to identify a common problem among them and were subsequently able to collectively address that concern. This “natural” partnership was a critical component of their success for improving water quality at the Reservoir.

Success in this region was also due to the scale of this particular multijurisdictional approach. A problem was identified, which was unique and common

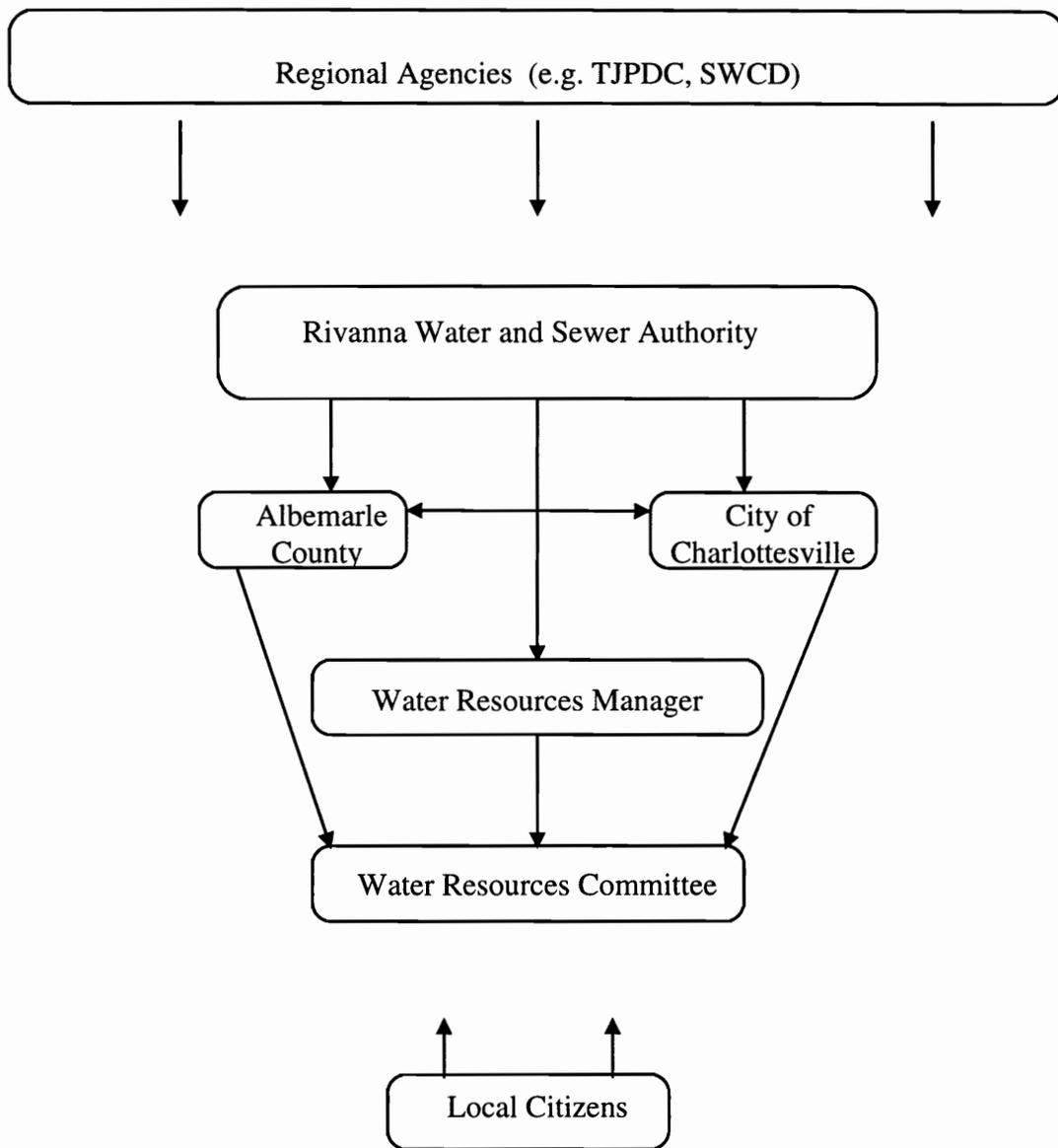
for only these two jurisdictions. While major water quality problems existed at the Reservoir, the rest of the region did not hold these water quality concerns. Including other jurisdictions into this framework was not necessary and may have resulted in an alternate and perhaps less desirable outcome with less effective policies and strategies.

### **Recent Watershed Management Efforts**

Several changes are taking place in the multijurisdictional approach in this region. Figure 4.4, graphically illustrates this change in interjurisdictional arrangements, which now includes the TJPDC. The region is maintaining the small scale agreements, however, watershed wide strategies at the Rivanna River are beginning to be explored. Other localities and regional agencies, primarily the Thomas Jefferson Planning District Commission, are using the Reservoir as the centerpiece and attempting to develop strategies to protect water quality at streams and rivers throughout the region.

Regional streams and associated watersheds are divided into three categories. First, are those streams which are used for a variety of purposes and virtually no appropriate management or protection measures are employed. Approximately 95% of the region's streams and watersheds fall into this category (Collins, 1996). Second, are streams with no required minimum water quality standards as defined through broad public recognition. Citizens and local jurisdictions, however, are interested in the use and protection of these streams. Third, are those streams which are afforded minimum water quality protection through regulatory programs, such as scenic stream designations. While the majority of the streams can be placed in the first category, water quality has remained relatively high.

To maintain this high level of water quality throughout the region, the TJPDC in conjunction with the County and City of Charlottesville is attempting to develop goals, objectives, and subsequent water resource related management plans on a regional scale.



**Figure 4.4: Stakeholders at South Fork Rivanna Reservoir Since Early 1980s.**

According to Collins (1996), current water quality at the Rivanna River and other streams is stabilized, although this could deteriorate in the near future. The TJPDC has identified urban sprawl as a potential problem and is assisting localities in developing watershed programs to prevent similar problems. The TJPDC recognizes that growth is desirable and necessary, although it contends that the creation of watershed management programs prior to development will provide for the maintenance of a certain level of water quality while simultaneously permitting growth.

Multijurisdictional planning in the region, while not yet fully realized, is a high priority of the TJPDC, the localities, and the area residents. The PDC has initiated a multijurisdictional approach in dealing with various issues, including water resources management. Through the use of various committees, the TJPDC has worked closely with the localities of Albemarle, Louisa, Fluvanna, Greene, Nelson, and Charlottesville, as well as individual citizens to address local and regional planning and management concerns.

Although only an advisory agency, this direct link with residents has resulted in the development of a more comprehensive planning process by local governments. Citizens have been incorporated into the planning process through these “brainstorming” committees for approximately five years (Collins, 1996). These citizen committees have resulted in a strong constituency and has permitted the development of a long term planning process. In regards to water resource protection, the citizens have been involved primarily in two particular projects. The first is an on-going study to inventory and assess the region’s environment. The second initiative is being developed to focus specifically on one area or resource, that being the Rivanna River Watershed.

### *TJSPARE*

As part of the multijurisdictional approach aimed at involving area citizens, the PDC created the Thomas Jefferson Study to Preserve and Assess the Regional Environment (TJSPARE), often referred to as the “Sustainability Council”. This Study was developed to provide local governments with knowledge of resources, constraints,

and to assist the localities in identifying acceptable limits of development and growth. An Advisory Panel comprised of local citizens, government officials, technical experts, and organizational representatives was established to carry out the study and to develop community support for the program. The Advisory Panel was developed to turn the “TJSPARE professionally-conceived idea into a largely community-based volunteer effort” (Hirschman et.al., 1992: 32).

The Council is attempting to identify and assess sustainability and determine how it can be incorporated into regional planning efforts. The Council’s goals are varied and include economic as well as environmental objectives. Indicators are identified and researched to determine if the goals are met. For example, maintaining clean water in the region is a goal of the Council, while water quality studies are the indicators used to evaluate the progress in meeting the goal.

The Study was designed by the PDC to assist the Council in achieving broad planning objectives through data related projects and the development of a sustainable development model. First and foremost, it encouraged and actually relied upon citizen involvement, thus establishing strong public support for the project. Second, it was designed to develop and employ technology based information, such as GIS, for resource analysis. Third, the project was designed to identify carrying capacity and apply various build out analyses. Finally, the data derived from the study is currently being used to develop and implement land use planning and management strategies at the local level.

### *Rivanna River Roundtable*

The Rivanna River Roundtable was designed much like TJSPARE, although concentrating on one particular geographical and topical area: the Rivanna River. The objective of the Roundtable was to identify common concerns and issues throughout the watershed and to address each of these in a comprehensive manner. The actual Roundtable is comprised of citizens, local government leaders, and organizational representatives from each of the affected jurisdictions, including the counties of Albemarle, Nelson, Fluvanna, Greene, and Louisa, and the City of Charlottesville.

As with TJSPARE, the Roundtable is designed to assist local and regional agencies in the planning and decision making process. The Roundtable is still in the early stages of development, therefore, effectiveness of the program is still unknown, although it is expected that this citizen involvement has resulted in more acceptable management strategies at the local level. Localities are not merely educating the residents, but incorporating their ideas into the strategies. Citizen involvement is often critical when attempting to develop land use restrictions, such as stream buffers, which directly impact the actions of the landowners. Water quality stabilization at the Rivanna River may be due to a number of factors, although it is improbable that this would have occurred without interest and compliance by the citizens in implementing various management strategies.

### **Water Quality Monitoring**

Water quality monitoring, watershed management, and land use regulations were first started in the late 1970s. After the original management plans were developed, intensive monitoring was implemented to determine the impacts of the Plan and the management strategies. Other water quality testing was developed during this time period to monitor the impacts of the regional BMPs, which were implemented as part of the management plan.

The County has received funding from various sources to monitor water quality of the reservoir and its tributaries. The County completed a Section 208 Watershed Management Study of the South Fork Rivanna Reservoir in 1982 and concluded that the original watershed plan was still valid and should be fully implemented. In 1993, the County ended Phase II of the USEPA Clean Lakes Program, which was developed to monitor the reservoir's water quality. A sedimentation study of the reservoir was also conducted over the past several years and ended in 1995. Water quality monitoring has been conducted for approximately 10 years at the Reservoir and it has been found that water quality has been maintained and eutrophication stabilized. The rate of

sedimentation has stabilized and no large algae blooms since approximately 1980 (Hirschman, 1996).

### **Watershed Management Policies**

Regional watershed strategies employed by urbanized areas (e.g. Occoquan Basin Nonpoint Pollution Management Program) have not yet been developed, although watershed based zoning is being used by Albemarle. Use of overlay districts has become quite common and are given credit for improving water quality at the South Fork Rivanna Reservoir. Overlay districts have been implemented throughout the County to preserve and to provide protection for water supplies, natural resources, rural character, and even human health. The County's water resources are protected by a number of various policies. These policies are outlined in Table 4.4 and described below.

**Table 4.4: Watershed Management Policies**

- ♦ Runoff Control Ordinance protects against and minimizes the pollution and eutrophication of the public drinking water supply impoundments.
- ♦ Water Resource Protection Areas Ordinance establishes areas comparable to the Resource Protection Areas defined by the CBPA. These Areas apply to all land within a water supply watershed, consisting of perennial streams, contiguous non-tidal wetlands, and a 100 foot landward buffer.
- ♦ Scenic Stream Overlay Districts conserves elements of the County's scenic beauty as are contained along scenic waterways.
- ♦ Rural Areas Zoning severely restricts development and discourages public facilities, such as public sewer and water lines and major roads in water supply watersheds.
- ♦ Flood Hazard Overlay Regulations restrict unwise use of lands subject to inundation which may result in soil erosion, sedimentation and siltation, pollution of water resources, or general environmental degradation.
- ♦ Stormwater Detention and Soil Erosion Ordinances,
- ♦ Critical Slopes Regulations,
- ♦ Supplementary Regulations for Forestry, and
- ♦ Site Plan Requirements identify soils suitability and restrict the storage of potential pollutants in the water supply watersheds.

Source: Albemarle, 1989.

### ***Runoff Control Ordinance***

In 1977, the Albemarle County Board of Supervisors adopted a Runoff Control Ordinance, which was the first step toward implementing the recommended watershed plan. The purpose of the ordinance was to protect against and to minimize the pollution and eutrophication of the public drinking water supply impoundments as a result of land development in the watershed areas. The regulations stipulated that building and septic setbacks are to be at least 100 feet from perennial and intermittent streams. Furthermore, the Ordinance requires the use of runoff control calculations for new development limiting post-development runoff to those quality and quantity runoff standards existing prior to development.

### ***Water Resource Protection Areas Ordinance***

Water Resource Protection Areas are comparable to the Resource Protection Areas defined by the CBPA. These Areas apply to all land within a water supply watershed, consisting of perennial streams, contiguous non-tidal wetlands, and a 100 foot landward buffer. Current watershed management throughout the County is based on the Chesapeake Bay Preservation Act, although it is not required under the Act's guidelines to enact, abide by, or enforce the requirements.

According to the Chesapeake Bay Preservation Act, local governments outside the specified Chesapeake Bay area may employ the criteria within the Act and incorporate these into their comprehensive plans, zoning ordinances, and subdivision ordinances. Albemarle is one of only two localities outside this area that has voluntarily enacted the Act's regulations (the other being Culpeper County). Albemarle's ordinance, although patterned after the state model, does not include "Resource Protection Areas". The County has, however, implemented the Resource Management Areas, which apply only to developed areas and agricultural lands, while forestry is exempt if BMPs are used.

Albemarle is now trying to coordinate a County wide watershed management policy, with special attention still being paid to the protection of drinking water supplies. The policy will, however, apply to all water resources, not just the Reservoir. A draft of

the ordinance, which is similar to the requirements of the CBPA is currently being considered by all of the stakeholders.

The new ordinance would require a new approach to stream buffers and to water quality and water quantity management. Currently, stream buffers are set at 100 feet regardless of the terrain or flow of the river. The proposed ordinance will require that buffers be designed with the terrain. The 100 foot stream buffer, according to Hirschman (1996), is arbitrary and doesn't consider the size or streamflow of the individual river. The proposed ordinance will also develop standards of water management for particular areas. This will move away from uniformed standards and tailor the standards to these particular areas.

Within Albemarle County the areas are classified as "growth", "rural", and "subdevelopment" according to current growth patterns and future requirements developed in the County's comprehensive plan. This approach is more flexible because it will allow for higher standards for those regions at greater risk, such as "growth" areas. While this ordinance will be designed to fit a particular area, those areas closest to the drinking water supplies will continue to have other extensive restrictions, regardless of the area's designation.

### ***Scenic Stream Overlay Districts***

Scenic Stream Overlay Districts were created "to conserve elements of the County's scenic beauty as are contained along scenic waterways" (Albemarle Co., 1980: 193). A number of special use requirements and general restrictions exist in this district and may be applied to any other zoning or overlay district. This point is noteworthy since it allows or requires a number of land use restrictions at the same site. Specifically, it is prohibited to cut any tree greater than six inches in diameter within 15 feet of the stream bed. It is further prohibited to build any building or structure within 65 feet of the stream and no more than 25% of the forest canopy can be reduced on any one parcel.

### ***Rural Areas Zoning***

The County severely restricts development and discourages the location of public facilities such as public sewer and water lines and major roads in water supply watersheds to mitigate urban runoff and water quality impacts (Albemarle, 1989: 57). The County has enacted Rural Areas Zoning in water supply watersheds to meet this water quality objective.

Many of the lands within this zoning district were designated with the intent to protect drinking water supplies and water supply tributaries (Albemarle, 1980: 93). A comprehensive rezoning of the County in 1980 placed major limitations on development in these Rural Areas by removing all land from the “Urban Area” located in the South Fork Rivanna Watershed. A Rural Preservation Tract is a tract designated within a Rural Area Zone and is designed to provide specific protective measures for agricultural and forestal lands, water supply regions, and significant natural or historical resources.

The County’s Rural Areas play a crucial role in water supply protection, including protection of surface drinking water impoundment watersheds and protection of groundwater supplies for the Rural Area population. Crozet and Ivy, located entirely within water supply watersheds, were rezoned to Rural Areas and scaled back in size.

### ***Flood Hazard Overlay District***

The intent of the Flood Hazard Overlay District (FHOD) is to provide safety and protection from flooding. More specifically it is to restrict unwise use of lands subject to inundation which may result in soil erosion, sedimentation and siltation, pollution of water resources, or general environmental degradation. The FHOD includes all of those areas within the 100 year floodplain in accordance with the Federal Emergency Management Agency designation. The County has further required that stream alterations within the FHOD must not be developed in such a way as to decrease the flood carrying capacity of the stream.

## **Watershed Management Strategies**

The County has created various programs individually and several projects in collaboration with Charlottesville and other governmental agencies to implement their policies. The strategies are outlined below in Table 4.5.

### ***Stream Buffers***

Stream buffers have been implemented by the County to enhance stream water quality and to provide landowners with increased economic returns. Albemarle has recommended the use of buffers in a number of situations to protect the streams and their associated floodplains, and thereby, preserve the character of the community.

**Table 4.5: Watershed Management Strategies in Albemarle-Charlottesville Region**

- ♦ Stream Buffers enhance stream's water quality and provide landowners with increased economic returns.
- ♦ The Rivanna River Greenway Corridor preserves stream valleys and their tributary drainageway, and contiguous steep sloped terrain as an open space network.
- ♦ Agricultural and Forestal Districts promote the continuation of a viable agricultural and forestal industry and resource base and provide related benefits such as protection of water supply watersheds with proper conservation techniques and preservation of open space.
- ♦ Public Water Supply Protection protects water supplies as well as the drinking water supply tributaries .
- ♦ BMPs, both structural and nonstructural, are located throughout Albemarle and throughout the TJPDC region and are used primarily as stormwater controls.
- ♦ Density Controls. Cluster Development is used primarily in the Rivanna River watershed to protect the River's water quality.

Source: Derived from Albemarle, 1989 and Hirschman, 1996.

Recommendations include the preservation of extensive floodplain and critical slopes along the Rivanna River and other streams as open space in order to protect the ecological integrity and the historic characteristic of the waterbodies. Areas north of I-64 are being considered for designation into a Rural Historic District and most of the land is to be included into a Agricultural/Forestal District. Furthermore, floodplains along

smaller tributaries are restricted from development and have been designated as open space for inclusion in the park system.

Originally the Farm Bureau was opposed to the 100 foot stream buffer, since it would fence livestock out of the rivers. More recently the County has worked closely with the Farm Bureau primarily with the State's cost share program to create agricultural BMPs in collaboration with the SWCD. The County has created these buffers to enhance streams water quality and to provide landowners with increased economic returns.

### ***The Rivanna River Greenway Corridor***

The purpose of the Rivanna River Greenway Corridor is to preserve the Rivanna River valley and its tributary drainageway, and contiguous steep sloped terrain as an open space network. Much of the Greenway system is found at the South Fork Rivanna River, which is the primary supplier of the South Fork Reservoir. The County has recommended that the area between Route 643 and the South Fork of the Rivanna remain in an open state to preserve the community's identity and to prevent continuous development from Charlottesville to the North Fork.

This Greenway corridor area above the Reservoir provides protection for the Reservoir and the River and simultaneously provides an opportunity for passive recreation. Two primary areas of the County are being targeted as critical components of the Greenway system to protect the area's water resources. Environmental sensitive areas consisting of steep slopes and tributary stream valleys are to be provided protection under the Greenway system and, are therefore, not to be disturbed during development. The County comprehensive plan further recommends that the North Fork Rivanna River floodplain be designated as open space and included into the Greenway system (Albemarle, 1989: 23).

### ***Agricultural and Forestal Districts***

The primary goal of the Agricultural and Forestal Districts is to promote the continuation of a viable agricultural and forestal industry and resource base (Albemarle,

1989: 40). It is, however, recognized by the County that agriculture and forestry also provide related benefits such as protection of water supply watersheds with proper conservation techniques and preservation of open space. Forestal watersheds are generally a good source of high quality water due to low sediment yields. Forested areas are also beneficial in that they reduce the amount of surface runoff, thereby, protecting critical slopes.

Most of Albemarle's agricultural lands are used as grassland, either for hay production or pasture. "Of the remaining 3 to 5 percent of farmland that is cultivated, only 1 percent is located in a water supply watershed. Therefore, the environmental impacts associated with crop production, such as erosion, sedimentation, and excessive nutrient loading are not considered severe in the watershed areas" (Albemarle, 1989: 49).

The County actively encourages the establishment of conservation plans with all methods available to the county or appropriate agencies for agricultural/forestal operations located within watersheds. A Conservation Plan is a resource management guide which a landowner may voluntarily request for a farm property. The Plan is designed by the landowners with assistance from the NRCS and addresses the landowner's goals and resource problems and helps the landowner take responsibility for present and future conditions of natural resources on their land.

Agricultural uses are basically exempt from many water protection regulations, therefore, voluntary techniques such as the Conservation Plan must be conveyed to farmers to encourage positive measures. The County has made a great deal of progress with rural landowners primarily through public environmental education programs. Information, such as brochures, are made available to the public explaining procedures for voluntary techniques to preserve agricultural and forestal lands. Much of the County's efforts have been to encourage the commitment to and implementation of agricultural and forestal districts and conservation plans. As of 1989 there were nearly 53,000 acres, or 11.2% of the county in agricultural/forestal districts (Albemarle, 1989: 49).

### ***Public Water Supply Protection***

All water supply impoundments are protected by a public water supply (PWS) designation by the Water Control Board. A PWS designation implies that additional water quality standards are applicable to both the water supply stream and its tributaries. The intent and design standards of the PWS are to protect the water supply as well as the drinking water supply tributaries. Land lying within the boundaries of the watershed of any public drinking water impoundment must consider various factors developed by the County.

The North Fork Rivanna River is designated as a PWS five miles above the intake at Piney Mountain, while the Rivanna River is also a designated PWS within Albemarle for five miles and above the Lake Monticello intake in Fluvanna County. A PWS is important for the North Fork Rivanna River intake since the intake is located on a stream and not an impoundment, and is therefore, not protected by the Runoff Control Ordinance. Furthermore, the North Fork Rivanna River watershed lies partly in Greene County, therefore, without the PWS designation, development could occur outside Albemarle's authority.

### ***Best Management Practices***

Both on-site and regional BMPs being used throughout Albemarle with the primary objective of protecting water quality at the reservoir and tributary streams. EPA funding was granted in the Section 208 program to develop and implement agricultural and highway BMPs in the South Fork Rivanna Reservoir. Development of BMPs are also encouraged by the County in collaboration with the Virginia Department of Forestry, Virginia Cooperative Extension Service, Natural Resources Conservation Service, and County agencies for agricultural and forestal activities which contribute to the nonpoint source pollution(Albemarle, 1989: 53). These agricultural and forestal BMPs are not mandated, instead are voluntary techniques to be implemented by individual landowners, especially those with land in agricultural/forestal districts. Regional BMPs are also being developed by the County, primarily in the water supply watershed to protect Reservoir

water quality. For example, the Lickinghole sedimentation basin which has been developed to mitigate point source pollution from the Crozet community.

### ***Cluster Development***

Cluster development is used by Albemarle at a number of sites to direct development away from sensitive environmental areas, mainly water supply watersheds. This type of density control is used quite often throughout the Albemarle portion of the Rivanna River watershed. It is used in combination with agricultural and forestal districts to restrict development in large sensitive areas and redirects this growth to less fragile areas outside the Reservoir's watershed.

It is not necessary to fully explore the specific BMP and cluster development techniques implemented by the County. It is more significant to identify the various components and how the tools are used in coordination with policies and other management strategies. The County has developed and coordinated policies and the subsequent management strategies to provide a holistic approach in water quality and watershed protection.

## **Conclusions and Lessons Learned for Watershed Management in Virginia**

### ***Effectiveness in Achieving Watershed Management Objectives***

The Albemarle-Charlottesville watershed management program has resulted in the stabilization of water quality at the South Fork Rivanna Reservoir. Prior to the Albemarle-Charlottesville program, the Reservoir had persistent algal blooms and extremely poor water quality, and subsequently, various options were considered for its replacement. However, recently water quality has improved and continues to supply water to Charlottesville and various parts of the County.

### ***Institutional Characteristics and Program Components***

A number of specific institutional characteristics and program components have contributed to the overall effectiveness of the program. These components are listed

below in Table 4.6. The institutional framework for the region was established with the enactment of the South Fork Rivanna Reservoir Watershed Management Plan and also with the County’s adoption of the Chesapeake Bay Preservation Act regulations. The consolidation of County water-related policies and programs also helped to define the regional framework by providing consistent management objectives and strategies to protect water quality at the Reservoir and at waterbodies throughout the County. The Management Plan was significant in providing a framework in achieving the watershed management objectives since it coordinated the jurisdictions’ efforts and required the development of specific programs to directly improve the Reservoir’s water quality.

**Table 4.6: Institutional Characteristics from Albemarle-Charlottesville Program**

<p>Institutional Framework and Planning</p> <ul style="list-style-type: none"> <li>Development of South Fork Rivanna Reservoir Watershed Management Plan</li> <li>Establishment of Watershed Management Official (Subsequently Water Resources Manager)</li> <li>Consolidation of policies and management strategies</li> <li>Use of CBPA</li> </ul> <p>Stakeholder Involvement</p> <ul style="list-style-type: none"> <li>Establishment of Rivanna Water and Sewer Authority</li> <li>Identification of “natural” multijurisdictional agreements</li> <li>Involvement of all stakeholders</li> </ul> <p>Implementation Strategies</p> <ul style="list-style-type: none"> <li>Use of stream buffers</li> <li>Development of overlay districts</li> <li>Enactment of density controls</li> </ul> <p>Monitoring</p> <ul style="list-style-type: none"> <li>Establishment of baseline conditions</li> <li>Monitoring of techniques, water quality, and watershed management plan</li> </ul>
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This program, as with the previous case studies, illustrates the tiered approach to multijurisdictional watershed management. A bilateral approach, forced by the DEQ, was the first agreement in the region. Although mandated, this agreement between these two jurisdictions was inevitably necessary to achieve water quality protection. Through this agreement, a regional agency (Rivanna Water and Sewer Authority) was established and water related management efforts were then coordinated. The Authority assists the

localities in developing and implementing specific projects and has assumed responsibility for acquiring, maintaining, and financing water supply facilities. Both the City and the County are represented on the Authority, and Albemarle retains authority over land use matters in its jurisdiction.

The local level of the tiered approach is also represented in this program. Albemarle has developed a number of policies and techniques to protect the water quality at the Reservoir and other waterbodies in the County. These site-specific projects operate within the regional context by protecting tributary water quality, but are independent of other agencies policies and strategies.

#### *Institutional Framework and Planning*

- ♦ Development and implementation of the South Fork Rivanna Reservoir Watershed Management Plan provided the foundation for regional multijurisdictional watershed activities by coordinating management efforts between Charlottesville and Albemarle.
- ♦ The establishment of a Watershed Management Official as a joint position between the two jurisdictions contributed to their coordinated and collaborative efforts. This Official, now the Water Resources Manager, works with the regional Authority in policy formulation and program implementation, thereby, establishing a link between the two key stakeholders.
- ♦ Consolidation of policies and management strategies improved the comprehensive approach by developing consistent goals and objectives in the protection of critical waterbodies such as the South Fork Rivanna Reservoir. Strategies include point source restrictions in the watershed as well as nonpoint source controls and structures. Nonpoint source controls include the Watershed Management Plan, as well as more specific controls such as the runoff control ordinance, density controls, agricultural/forestal districts, and various others.
- ♦ Albemarle is only one of two jurisdictions outside the Tidewater to implement the CBPA. By adopting the Act, Albemarle has established a framework which is

consistent with State's objectives and also provides a framework on which to hang their individual strategies and techniques.

### *Stakeholder Involvement*

- ♦ Development of the Rivanna Water and Sewer Authority provided the regional institutional framework and allowed the localities to resolve conflicts and reach a consensus on water related concerns, primarily at the Reservoir.
- ♦ Identification and development of a "natural" or formal multijurisdictional agreement between Albemarle and Charlottesville encouraged dispute resolution and permitted the development of multijurisdictional efforts, which were acceptable to both stakeholders.
- ♦ Albemarle has taken responsibility at a local level to provide watershed and water quality protection at the South Fork Reservoir and at other waterbodies throughout the County.
- ♦ Success of the entire watershed management protection program has relied upon input from agencies, citizens, and community groups. For example, TJSPARE has incorporated agency and citizen input in the planning and implementation processes.

### *Implementation Strategies*

- ♦ Stream buffers have been used by the County to protect feeder tributaries of the Reservoir. Buffers, crossing both public and private land, is a method used by the County to mitigate water quality impacts while simultaneously providing economic benefits to private streamside landowners.
- ♦ Overlay districts, such as that established at the South Fork Rivanna Reservoir and tributaries, is a technique to provide the waterbody protection from activities which degrade water quality. the regional multijurisdictional approach and provide increased water quality protection.

- ◆ Density controls, such as cluster development, provided increased water quality protection at the Reservoir and the Rivanna River by directing development and growth outside the watershed and to less critical areas.

### *Monitoring*

- ◆ Several studies were conducted by regional and local agencies to identify problems and their sources prior to the enactment of policies and techniques. This baseline monitoring permitted the development of strategies to effectively tackle specific problems.
- ◆ Constant monitoring of specific techniques, local water quality, and the watershed management plan contributed to the effectiveness of the watershed management program's objectives.

### *Representation of the Watershed Protection Approach in the Albemarle-Charlottesville Program*

The Albemarle-Charlottesville watershed multijurisdictional approach basically follows the EPA Watershed Protection Approach. The four features of the WPA (problem identification, stakeholder involvement, integrated solutions, measuring success) are depicted in this region. Water quality degradation at the Reservoir was a significant problem identified by the localities and the DEQ. While land use controls were considered the primary factor, considerable disagreement existed about who was responsible. As a result, the DEQ mandated the establishment of a regional agency to rectify the institutional conflict.

Agreement by all stakeholders on the primary problem and its causes provided the foundation for a multijurisdictional effort. While water quality was a problem, the primary cause was due to inappropriate land use controls for which neither jurisdiction took responsibility. Due to SWCB's involvement, the problem was identified and agreed upon. In addition, each jurisdiction was given responsibility for various management components resulting in the consolidation of policies and management techniques.

An agreement resulted from the SWCB mandate and the subsequent establishment of the Rivanna Water and Sewer Authority. The two jurisdictions were then forced to cooperate and coordinate their planning and management efforts. While other stakeholders were involved later in the process, Albemarle and Charlottesville and the resulting Water and Sewer Authority were the primary participants. While involvement by the other stakeholders was important, the agreement and collaborative efforts by the localities were critical to the initial development and effectiveness of the program.

Albemarle, which was responsible for land use controls, implemented a number of integrated solutions to protect the water quality at the Reservoir and its tributaries. As described above, these ranged from County wide policies to site-specific techniques. Furthermore, Albemarle has coordinated its policies and strategies by requiring landowners to develop with respect to water supply protection guidelines.

This region has incorporated measures of success in all stages of program development. Monitoring occurs at a number of levels to clarify the success of specific projects and the overall success of the regional watershed management program. Water quality and technical monitoring is conducted by the Authority, Albemarle, and non-governmental organizations. The results are then used to measure success of those techniques and to characterize the effectiveness of the program.

### ***Lessons Learned for the WPA and Other Watershed Management Programs***

This program may be useful to other jurisdictions and regions in developing their own watershed management programs and also contributes to the clarification of the Watershed Protection Approach, especially its implementation. Table 4.7 identifies the primary lessons for other programs and the WPA in specific. Those points listed in italics are components drawn from this program are not included in the WPA, but were critical to the success of the Albemarle-Charlottesville watershed management program.

**Table 4.7: Lessons Learned for the WPA and other Watershed Management Programs**

Problem Identification: Identification of and responsibility taken for problem by *local jurisdictions and/or upper level government agency*

*Regional Framework: Establishment of a regional agency (e.g. Rivanna Water and Sewer Authority) to develop watershed wide objectives and plans and to coordinate localities' efforts*

*Bilateral Approach: Involvement of localities (e.g. Albemarle and Charlottesville) to create and implement watershed management plans*

Stakeholder Involvement: Initial involvement of *key stakeholders* to develop and implement management program

Integrated Solutions: *Development of Regional solutions (Watershed Management Plan) and Implementation of Local solutions (coordinated policies and techniques)*

As with the WPA, an important characteristic of this program was problem identification. Water quality degradation was recognized by the localities as the problem; however, intervention by the SWCB was required to realize the severity and necessity in improving the quality. A problem must not only be identified, but stakeholders must take an active role in improving the situation. Alternatively a federal or state agency, such as the SWCB in this program, may force recognition and responsibility of the problem.

To mitigate and rectify the problem, the SWCB mandated the establishment of a regional agency providing the framework for a regional approach and forcing the collaboration between the two localities. The regional structure, although not included in the WPA, provided the foundation for the management program. Without the establishment of the Authority it is unlikely that the other components would exist. The regional structure forced the development of integrated solutions, which resulted in collaborative involvement by the two key stakeholders.

Effectiveness of this watershed management program occurred due to the “natural” bilateral agreement developed among Albemarle and Charlottesville. Therefore, not only involvement of stakeholders, but **key stakeholders** was critical. This suggests a hierarchy of stakeholders in which those developing and implementing the plans are the key players, while other stakeholders may only play a minor role in the institutional process. In this program, the TJPDC and non-governmental organizations

have recently become more prominent, although typically to implement a specific program component.

Albemarle and Charlottesville with assistance from the SWCB established regional policies and plans and then implemented the plans at the local level. The South Fork Rivanna Reservoir Watershed Management Plan establishes a regional framework to identify potential remedies and provide direction in implementing the integrated solutions. Localities are then charged with developing strategies in accordance with the plan and then implementing these specific techniques at the local level.

The four primary features of the Watershed Protection Approach are basic characteristics of a watershed management program, although not the only features to be considered or incorporated into a program. As described here, the regional framework and the tiered approach to multijurisdictional management have been major components of this program and may be critical in the success of a watershed management program based on the WPA.

## **V. Multijurisdictional Watershed Management Along The Rappahannock River**

This case study will examine the Rappahannock River watershed and the strategies used by agencies and organizations charged with management of the Rappahannock and the tributaries. The study will identify and evaluate watershed management activities implemented by individual agencies and those developed at a multijurisdictional level. This case study describes and evaluates projects along the length of the River, but focuses primarily on the Fredricksburg region. The Rappahannock is managed throughout its course by a number of jurisdictions, which manage other rivers and tributaries based on their experiences in the Rappahannock projects. Finally, the study identifies lessons which may be useful to other watershed management programs and provides lessons relating to the Watershed Protection Approach.

### **Background**

The Rappahannock River serves as a jurisdictional boundary throughout its 184 mile course. Fredricksburg, located in the upper Rappahannock, is the largest city along the River and has experienced one of the highest growth rates in the state. Likewise, Spotsylvania and Stafford Counties, which surround Fredricksburg, have also experienced recent rapid growth rates.

The Rappahannock River is used for a variety of purposes. Perhaps the most significant use is as a source for drinking water supplying a large part of the local population. In addition, a number of communities along the course of the River are increasingly using the Rappahannock for wastewater discharge. The River also supports some of the highest levels of water-related outdoor recreation in the State. In spite of this heavy use it is still considered the cleanest major tributary in the Chesapeake Bay.

In addition to the Rappahannock, two other important waterbodies in the region are the Rapidan River and the Ni Reservoir. The headwaters of the Rapidan River are in

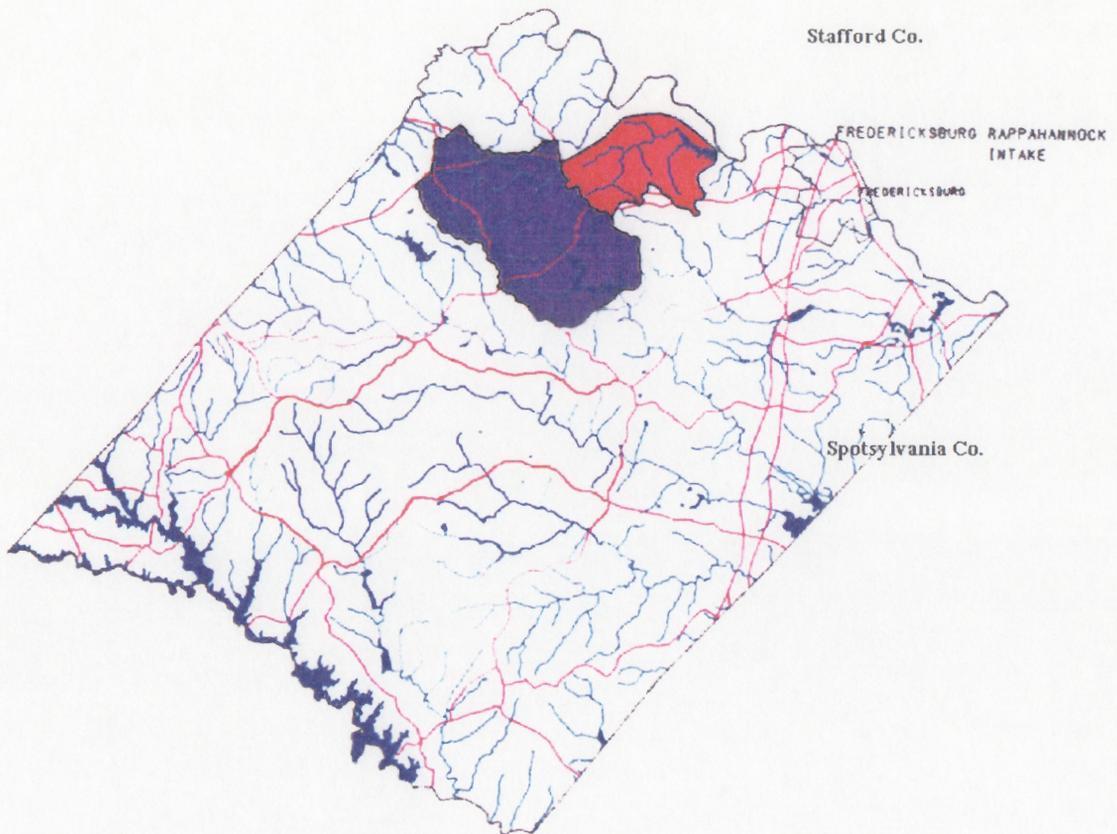
Orange County and it flows into the Rappahannock in Spotsylvania County. The Ni Reservoir located entirely within Fredricksburg, is supplied by an intake from the Rappahannock River. The Reservoir was originally constructed in the early 1960s and is used as the primary drinking water supply for Spotsylvania County and a small section of Fredricksburg. Figure 5.1 shows the relative location of the Reservoir and the jurisdictional boundaries. Several other reservoirs are located along the course of the upper Rappahannock (See Figure 5.1) and serve small communities around the area.

### **Water Supply Protection and Planning**

A potential water supply deficit has been identified as a common regional problem and has been a source of frustration for all localities. To complicate matters, disagreements between jurisdictions about water rights have resulted in conflicting and uncoordinated perspectives. According to the City of Fredricksburg (1994: 56), the region will face a water supply deficit by the year 2030. This forecast will most severely impact Spotsylvania, which has a rapidly growing population relying almost entirely on the Rappahannock as its drinking water supply. In response to the City's forecast, Spotsylvania began searching for other water supply opportunities.

### ***Hunting Run Reservoir Proposal***

In March of 1995 Spotsylvania proposed the construction of the Hunting Run Reservoir. This proposed Reservoir will be supplied by the Rapidan River and provide a yield of approximately 8 million gallons per day for the County residents. The Hunting Run Reservoir will eventually supply water on a regional scale, including parts of Stafford, Culpeper, and Orange counties, and the City of Fredricksburg. A number of federal, state, and local agencies, and private organizations are included into the project planning and implementation stages. These groups include the USEPA, Corps of Engineers, USFWS, DCR, Virginia Game and Inland Fisheries, DEQ, the City of Fredricksburg, Stafford County, Virginia Institute of Marine Science, and Friends of the Rappahannock.



**Figure 5.1: Water Supply Watersheds in Fredricksburg Region**

- Motts Run Reservoir
- Ni Reservoir

Source: Prepared for the Watershed Management Project by Information Support Systems Laboratory, Virginia Tech

However, the Hunting Run Reservoir proposal has been the most recent source of disagreement concerning water rights and use in the region. The DEQ has determined that withdrawal by Spotsylvania and current consumption rates by Fredricksburg will surpass the maximum sustainable yield of the Rappahannock during drought weather. Although not opposed to the Reservoir, the DEQ has proposed specific guidelines and restrictions on River consumption rates by the two jurisdictions. The City has argued against the minimum in-stream flow requirements mandated by the DEQ and believes it has a right to withdraw as much water as necessary, which they have historically done. The City argues that the minimum in-stream requirements along with the construction of a new reservoir will restrict its use of the Rappahannock and overburden City residents (Boyer, 1996).

The Hunting Run Reservoir has been approved in spite of the opposition and was accepted over two other alternatives, which were rejected due to greater environmental impacts (Boyer, 1996). Construction of the Po River Reservoir would have required developing an Environmental Impact Statement due to the destruction of wetlands during construction, while the Hunting Run Reservoir only required an Environmental Assessment. The County has concluded that project implementation will be successful primarily because it has fostered cooperation among all parties, and therefore, little public opposition occurred.

### ***Land Acquisition***

In the late 1960's, Fredricksburg acquired 4,800 acres of the Rappahannock River corridor to protect their source of drinking water from nonpoint and point source pollution. The City recognized that water quality impacts also occurred outside it's jurisdiction and began acquiring land along the River in Spotsylvania and Stafford counties as well as within the City. This land acquisition was the primary measure taken by any of the jurisdictions to protect regional water quality until 1990. During the 1990's Stafford and Spotsylvania counties began taking a more active role in preservation of the

River corridor through overlay districts and land use restrictions. This is due to the counties interest in expanding water supplies to an increasing regional population.

The City of Fredricksburg and the counties of Stafford and Spotsylvania have proposed a regional effort to withdraw 24 million gallons per day from the Rappahannock. However, these withdrawals and future withdrawals must meet the minimum instream flow requirements set by the DEQ. Because future withdrawals may be constrained by the River's carrying capacity, the localities have established multijurisdictional efforts to protect and manage the water supplies.

### ***Rappahannock River Management Plan***

The Rappahannock River Management Plan was developed by the City of Fredricksburg to provide a comprehensive framework for environmental protection of the River and surrounding watershed. The Plan was not adopted, although it did provide valuable water quality and water quantity data and also identified a number of water related issues and concerns. Because the Rappahannock crosses a number of jurisdictional boundaries, the Plan recognizes the necessity of developing a multijurisdictional approach to manage the River and it's watershed. This is illustrated in the following excerpt from the Management Plan. "In addition to the need for a local commitment, there must also be a regional commitment. Watersheds and aquifers are affected by factors beyond the boundaries of any one jurisdiction. As a consequence, watershed-based planning in the Rappahannock basin must be regional and multijurisdictional." (Fredricksburg, 1994: 61).

The Management Plan identifies six basic components, which must be addressed in a multijurisdictional fashion to protect the River's water quality (See Table 5.1). The Rappahannock River Management Plan has not been implemented, although its development sparked interest among various stakeholders. The City of Fredricksburg did adopt and implement the Watershed Property Management Policy in 1991, which was later incorporated into the Plan. The Plan was not accepted by any localities primarily

because Fredricksburg developed the Plan with little input from other local jurisdictions or area residents.

No strong regional framework currently exists in this region, although the Plan was a useful step towards this goal. Because the Plan was not accepted by the local jurisdictions or formalized in any way, it does not provide a policy structure for the region. Development of the Plan may contribute to the regional policy and planning framework; however, a regional plan should be adopted by localities to achieve implementation.

**Table 5.1: Rappahannock River Watershed Management Plan Components**

- (1) Public Policy identifies various components of water quality standards and describes how these are incorporated into public policy and specifically the Watershed Property Management Policy.
- (2) Water Resource Development characterizes current and expected water use by locality and describes various water quantity and quality related concerns. This chapter also identifies potential water supply deficiencies and subsequent water quality impacts and offers suggestions for localities to mitigate these problems.
- (3) Recreational Resource Development describes the current types, amounts, and limitations of recreation on the Rappahannock and further describes why these activities must be incorporated into the general watershed policies.
- (4) Educational Resource Development describes the significance of the Rappahannock as an environmental educational tool.
- (5) Economic Resource Development recognizes that the Rappahannock has economic value, which should be derived indirectly through protection of the River, rather than exploitation of the watershed.
- (6) River Watershed Management identifies “emerging issues” and describes how these are being incorporated into public policy and management strategies.

Source: Fredricksburg, 1994.

### ***Watershed Management Committee***

Although Fredricksburg’s attempts to enact the River Management Plan were unsuccessful, it has encouraged the discussion about the adoption of watershed wide planning objectives. The City and other interested stakeholders established a loosely formed Watershed Management Committee for the purpose of creating a forum for

expressing water related concerns throughout the region. The group, while not a formal organization, includes several local jurisdictions, the Rappahannock Area Development Commission (RADCO), CBLAD, the Corps of Engineers, and various citizen groups. A number of localities are represented on the Committee including the City of Fredricksburg, the counties of Stafford, Spotsylvania, Culpeper, and Orange, and the towns of Orange, Culpeper, and Remington.

As a result of the meetings, the Committee reviewed the Rappahannock River Management Plan and initially encouraged and assisted local jurisdictions in adopting the Plan. The Committee's purpose has since broadened from focusing on the Management Plan, to include all watershed management and planning issues. The Committee meets quarterly to identify and discuss any water related issues throughout the Rappahannock watershed (Rives, 1996). A number of federal and state agencies (COE, CBLAD) attend the meetings and also provide insight into various planning and management techniques.

The Committee, which has no formal obligations or agenda, does not require the participation of any jurisdiction or agency. This informality, according to Nelson (1996), creates a more open forum and allows for more innovative ideas and brainstorming sessions. Furthermore, it is believed that this type of loosely formed group allows "interested stakeholders" to get involved, and subsequently, provides a broader viewpoint to water resource protection. This voluntary arrangement may actually encourage further participation and eventually lead to the development and implementation of a watershed plan acceptable to all parties.

This Committee may be a useful forum to generate ideas and encourage participation; however, more formal actions are required to develop and implement regional programs. As these water quantity and quality problems become more pronounced, other conflicts may arise about the effectiveness of specific regional and local programs. Without a strong regional framework, local implementation may be haphazard and inconsistent with neighboring jurisdictions.

## Implementation of Watershed Management Strategies

A number of management strategies have been developed by the local jurisdictions to protect the Rappahannock and the reservoirs. While Fredricksburg has taken the lead in the region, the other jurisdictions have also developed various management strategies. The individual localities are beginning to coordinate their policies and management strategies through the Committee, and thereby, provide more comprehensive protection for the River (See Table 5.2). Many of the programs were implemented within the last two to three years, therefore, results and conclusions cannot yet be drawn from them.

**Table 5.2: Overview of Watershed Management Strategies at the Local Level**

Jurisdiction	Overlay District	Density Controls	BMPs	Stream Corridors
Fredricksburg	Watershed Property Mgmt. Policy	N/A	On-site	Rappahannock River Buffers
Stafford Co.	Reservoir, Shoreline Area Mgmt. Plan	N/A	Regional On-site	N/A
Spotsylvania Co.	Reservoir and River	Cluster Development	N/A	River Overlay
Culpeper Co.	Reservoir	Cluster Development	N/A	N/A

Source: Fredricksburg, 1994; Spotsylvania, 1994; Stafford, 1994.

### ***Overlay Districts: Reservoir and River Protection***

Although Fredricksburg owns part of the Rappahannock River watershed in the region, the City realized the need to more fully protect it by formalizing management policies and guidelines. The City, therefore, adopted this Watershed Property Management Policy in 1991 to develop comprehensive strategies to protect the watershed and water quality primarily from nonpoint source pollution. The City is attempting to create comprehensive strategies and expand watershed protection by establishing a cooperative approach with other localities.

The Overlay District in Stafford County is proposed to protect the water quality of the County's water supplies through a number of performance standards. These standards include controls on erosion, nonpoint source pollution, earthwork, and requirements for revegetation, and a buffer zone around the reservoirs. A Reservoir Protection Overlay District is proposed for Abel and Smith Lakes, the County's water supply reservoirs, although no current or proposed buffer zone width requirements currently exist. While a number of reservoir protection standards and restrictions are made in the comprehensive plan, these have not yet been adopted and implemented by the County.

A River Protection and Reservoir Protection Overlay Districts has been established by Spotsylvania to protect that County's water resources. These are used at the County's water supplies and tributaries primarily for the purpose of protecting drinking water sources. Additional restrictions apply to the most critical water supply sources, including the Rapidan and Rappahannock Rivers and the Ni Reservoir. Buffers and land use restrictions, such as cluster development have been established in these districts to mitigate nonpoint source pollution.

### ***Land Use Control and Management***

While shorelines are still relatively undeveloped, these areas are experiencing increased growth and resulting pressure on the watersheds' natural resources. Stafford County has determined that shorelines are critical areas and has developed a number of land use strategies and a "Shoreline Area Management Plan" to minimize the impacts on the shoreline resources. This Shoreline Area Management Plan has been created to manage future growth and development. In addition the Plan is used to minimize negative environmental impacts such as erosion, sedimentation, and other forms of nonpoint source pollution impacting the rivers' shorelines (Stafford County, 1994: 95). The Plan is then reviewed by Friends of the Rappahannock to assess and clarify the role and potential effectiveness in mitigating nonpoint source impacts.

The Shoreline Area is broken down into three categories: Critical Resource Protection Areas, Sensitive Resource Protection Areas, and Land/ Resource Management

Areas. The three areas are all considered sensitive and must be protected; however, they differ as to the level of development and environmental protection permitted and required. Critical Areas, located at the shoreline incorporating wetlands and other protected areas, require the highest level of protection. Sensitive Areas, located further inland and at less environmentally sensitive areas, are also protected, although limited non-intensive developments are permitted. The Land Resource Areas, the least sensitive areas, may be located further inland and/or at existing developed or potentially developed areas. Certain development is permitted in Land Resource Areas which meets specific performance standards to mitigate negative environmental impacts, such as erosion control techniques and other BMPs.

A Stormwater Management Plan has been developed as a first step in creating a Comprehensive Stormwater Management Plan for the region (Stafford Co., 1994: 96). This is to be used for water quality control, flooding, and erosion. A system of regional stormwater detention facilities in five watersheds is recommended for the facilities. Stafford also recommends that additional water quality studies be carried out and that on-site stormwater management controls be implemented for all development projects (Stafford Co., 1994: 96). This program is just beginning, therefore, its effectiveness is not yet known.

Spotsylvania County has enacted a number of land use programs, management strategies, and regulations to restrict development in specific regions to protect the water quality of their rivers and reservoirs. The primary strategy to be implemented is cluster development, which concentrates development away from critical water resource areas and requires substantial open space, primarily around these waterbodies. While all of these localities have recently developed and implemented local management strategies, there is little consistency in the programs or collaboration between the jurisdictions. This is beginning to change through the Committee, although regional cohesion is minimal.

## **Role of Citizens along the Rappahannock River Corridor**

The upper stretch of the Rappahannock down to the Stafford and Spotsylvania county lines was designated under the State Scenic Rivers Program in 1985. This designation was due in large part to the efforts of the Piedmont Environmental Council (PEC) and the Friends of the Rappahannock (FOR). In addition, in 1990 the Middle Rappahannock to Fredricksburg was also included into the state scenic river designation, to become the longest scenic river in Virginia (Fredricksburg, 1994: 44). This designation is regionally significant since it indirectly encourages protection from a number of nonpoint sources such as agricultural and forestry activities.

The State Scenic River designation does not afford any legal protection for the river, although it does heighten awareness and interest of local landowners and residents. In addition, the designation promotes the idea of protecting the river and watershed, therefore, encouraging further protective legal action by local legislators. Since the designation of the Rappahannock, many of the land use strategies described above have been implemented. Although an indirect link, these management programs may be a result of the River's designation status.

FOR also works regularly with planning staffs by reviewing development proposals for the purpose of promoting lower development densities near the River, while allowing adequate public access to the River. Furthermore, the organization encourages the implementation of Best Management Practices to control erosion, sedimentation, and nutrient runoff from nonpoint source pollution. FOR also assists local governments with comprehensive and zoning plan development for consistency with the CBPA regulations. FOR also works cooperatively with the Stafford County's Wetlands Board in developing it's "Shoreline Management Plan." Furthermore, the organization coordinates work on other local land issues throughout the Rappahannock River with other citizen groups including the PEC, Citizens for Fauquier, Friends of Culpeper, and the Rappahannock River Valley Association.

## **Water Quality Monitoring**

DEQ with pressure from the PEC began developing a Rappahannock River Basin Water Quality Management Plan in 1989. This was developed later than other plans due to the prior cleanliness of the River. It was further delayed since there were no major proposals for changes in land use along the River. Therefore, development of a water quality management plan for the Rappahannock River was considered a low priority.

A major component of the Water Quality Management Plan was the development of a water quality model for point source discharge. This model simulates the effects of wastewater discharge on the Rappahannock's water quality. The model then determines the acceptable effluent limits for point source dischargers. Other state and federal anti-degradation policies exist, which add a degree of guidance to management of the Rappahannock. Policies, such as the State Scenic Rivers Program described above, afford protection to waters of exceptional recreational or ecological significance.

## **Conclusions and Lessons Learned for Watershed Management in Virginia**

### ***Effectiveness in Achieving Watershed Management Objectives***

While water quality at the Rappahannock has been and remains relatively high, water quantity concerns continue. While attempts were made to develop and implement a regional framework, this has yet to be adopted by any locality. Therefore, local implementation programs are not guided by a strong regional structure. However, this program represents the four features of the Watershed Protection Approach and, therefore, illustrates the limitations of the EPA Approach.

### ***Institutional Characteristics and Program Components***

Although weak, an institutional framework exists and has provided the first step toward a regional focus. Table 5.3 lists the major components which have shaped the regional focus and local program implementation. An informal committee was formed to discuss water related concerns and to develop a watershed wide plan. Having no formal obligations or agenda, the Committee, has provided a more open forum for localities and

others to present their views and explore a wide range of options. However, this does not substitute for a regional authority in developing formal watershed policies and plans. Nor does this informal committee provide a regional entity capable of developing a framework on which to base local watershed management strategies.

The Rappahannock River Watershed Management Plan, developed by the City of Fredricksburg, increased awareness and interest in the River and tributaries. Although never formalized, it established a number of watershed wide objectives and resulted in the formation of informal agreements between the localities. However, the manner in which this Plan was established illustrates the necessity of including all stakeholders, especially key participants which have interest in watershed management and authority for action. Neither contiguous localities nor citizen groups were consulted during the development of the Plan; as a result, the product was an unacceptable and ineffective document. In addition, this Plan did not provide the institutional component necessary for consistent and coordinated watershed management strategies.

**Table 5.3: Institutional Characteristics from Rappahannock Case Study**

Institutional Framework and Planning	No regional framework exists: Rappahannock River Watershed Management Plan not implemented due to lack of multijurisdictional participation. Local implementation programs not linked to regional approach and may be inconsistent with other localities efforts.
Stakeholder Involvement	The informal committee provides a forum for stakeholder involvement, but has no legal authority and does not provide direction for local implementation. Citizen groups, such as FOR and PEC, working in collaboration with many or all jurisdictions in a watershed may provide a stronger regional foundation than currently exists.
Strategies	Although a State Scenic River designation does not provide legal protection, it heightens awareness of landowners and local governments.
Monitoring	Water quality monitoring is conducted at two levels: local government and non-governmental.

### *Institutional Framework and Planning*

- ♦ Informal agreements, developed between Fredricksburg and the upstream counties, have permitted the localities to develop specific water related policies and techniques without the necessity of regional approval. Informal agreements are an effective first step, since the localities will not commit to a formal agreement which may ultimately restrict their ability to use or manage the River as they deem appropriate. However, informal agreements do not restrict nor bind localities to specific consistent and collaborative programs and may result in the development and implementation of conflicting and ineffective local watershed management programs.
- ♦ The Rappahannock River Watershed Management Plan illustrates the need to incorporate all interested stakeholders in the planning and implementation process. This Plan, created by Fredricksburg, identified water quality and quantity problems and proposed a number of measures to mitigate these concerns. Many of these measures were outside of Fredricksburg. The Plan was not adopted by any locality, but it did raise considerable regional interest in the protection of the Rappahannock. Development of a regional plan (e.g. Rappahannock River Watershed Management Plan) is important, although its adoption and implementation by local jurisdictions is imperative for an effective watershed management program.

### *Stakeholder Involvement*

- ♦ Establishment of an informal committee comprised of all interested stakeholders provided a forum to discuss water and watershed related issues. This committee, which included elected officials, local government staff, Rappahannock Area Development Commission (RADCO), citizen groups, and landowners, provided an opportunity for all stakeholders to express interest in and aver specific water related concerns. The committee does not, however, provide a regional foundation nor does it direct the implementation of local management strategies.
- ♦ Friends of the Rappahannock (FOR) and Piedmont Environmental Council (PEC) are involved and collaborate with local governments throughout the watershed to develop

and implement management strategies. As a result of this watershed wide collaboration, local efforts are likely more consistent with other local programs, therefore, providing some foundation for a regional framework.

### *Implementation Strategies*

- ♦ Designation of the Rappahannock as a state scenic river is regionally significant since it serves as a centerpiece for regional watershed management. While there are no legal restrictions or requirements associated with the designation, the River benefits from the designation through increased awareness and interest by localities and residents. This designation may then result in the mitigation in point as well as nonpoint source pollution, such as agricultural and forestal activities.
- ♦ Extensive use of stream buffers by the City has mitigated impacts on water quality. The acquisition of nearly 5,000 acres of land surrounding the River minimizes water quality impacts, although this large scale acquisition may not be possible or desired for other localities.
- ♦ The Shoreline Management Plan, developed by Stafford and reviewed by FOR, establishes land use and development controls along the Rappahannock in mitigating nonpoint source impacts. This Plan was only recently implemented, therefore, its effectiveness cannot yet be assessed. Because the Plan is reviewed by FOR, it may be consistent with other local programs, although no regional approach exists.

### *Monitoring*

- ♦ Monitoring at the Rappahannock and its tributaries has increased dramatically over the past 10 to 20 years by governmental agencies and non-governmental organizations, primarily FOR. These data have resulted in the formulation of more effective policies and management techniques throughout the region.

### ***Representation of the Watershed Protection Approach in the Rappahannock Program***

This watershed management program includes the four features of the WPA, yet its limitations illustrate the gaps and generality of the EPA Approach. Potential water quantity and quality degradation at the Rappahannock were targeted as high priority problems. These concerns were initially identified by Fredricksburg by conducting water monitoring programs and by projecting future regional water use.

The City of Fredricksburg initiated the watershed management program, although other jurisdictions soon became involved as localities became increasingly reliant upon the River as a source of drinking water and wastewater discharge. Fredricksburg and the other managing localities have realized that without coordinated efforts, water quantity and water quality at the Rappahannock could become a major regional conflict. Therefore, the stakeholders have participated in a committee to reach consensus on watershed wide objectives and to formulate informal agreements.

The citizen groups, FOR and PEC, have been major participants in the development of a regional framework and implementation of local watershed management techniques. These non-governmental organizations may have a more significant role at the Rappahannock than at other regions due to their contribution to a more regional focus. These groups have been regionally significant due to their participation in the committee and also because of their role in the Rappahannock's Scenic River designation. They have also contributed to the local approach, by assisting localities in designing and implementing watershed management techniques.

Integrated solutions are being developed and implemented primarily through collaboration with FOR and PEC and also to some extent through the committee. By reviewing the Rappahannock River Watershed Management Plan, the committee has established a consensus on various problems and their solutions and has encouraged the development of regional objectives. Attempts are being made to coordinate local policies and techniques among the local jurisdictions, although the collaboration is relatively voluntary and is not based on a formal document. Many of these attempts are still in the early stages of development, therefore, their effectiveness and success is not yet known.

Monitoring is a major concern of the localities and non-governmental organizations. Water quality has been monitored at various sites by local governments and citizen groups (e.g. FOR and PEC) to assess the effectiveness of individual techniques and the relative success of the watershed management program. However, because the program is still in its early stages, measuring program success is not yet a common application.

The previous three case studies showed that a strong regional framework contributed to the success of their watershed management programs. The middle Rappahannock region has attempted to develop a multijurisdictional approach, although this strong regional framework does not exist. Although, localities are implementing strategies, some of which may be effective, they are not well coordinated throughout the watershed. Citizen groups have provided some regional consistency, although a political authority may be necessary to develop a regional framework and coordinate and direct the implementation of local policies and techniques.

### ***Lessons Learned for the WPA and Other Watershed Management Programs***

The region has experienced water quality and quantity problems, which are common to other localities and regions throughout Virginia. Therefore, this program contributes to the clarification of the WPA and may be useful to other jurisdictions in implementing their own watershed management programs.

Three primary lessons have become apparent in the “planning” and “stakeholder” features of this program. First, a regional management plan should only be developed with involvement and input by all stakeholders. Fredricksburg developed a plan without incorporating participation by other stakeholders and could not successfully implement the plan. Second, informal regional plans, such as that demonstrated here, may be an effective agreement to initiate interest and participation. While this arrangement may permit localities to accept and implement a plan without formal adoption, it does not require any commitment to the plan or other localities.

Because a formal and acceptable regional framework does not exist; local management strategies are not fully coordinated. Although informal committees may be an effective forum to encourage stakeholder involvement and may result in a more acceptable and useful regional plan, for the committee and its subsequent plans to be effective, all stakeholders should be committed to a more formal regional body.

In contrast to the Northern Virginia and Albemarle-Charlottesville regions where a strong regional framework exists, this is a less developed program primarily because no major water quality problem has arisen to unify the localities. Cooperative efforts are facilitated when solving an identified immediate concern affecting several jurisdictions, than dealing with a future potential problem. As water quantity and water quality concerns increase, the Rappahannock region will likely develop a stronger regional framework and establish more coordinated efforts among the localities.

The four features of the WPA are prevalent and illustrate the necessity of “regional planning” and “local implementation”. Citizen groups have contributed significantly to what regional framework exists. However, this involvement should be formalized with a regional political or managing body. This agency could then develop or assist the development of a regional plan and/or policy. Fredricksburg’s attempt at a regional plan, illustrates the unacceptability and ineffectiveness of a locality attempting to develop and implement a regional framework. With input from all stakeholders an independent or collaborative regional agency would provide a more consistent and acceptable watershed focus.

In addition, a nonpartisan watershed wide plan or policy would likely be adopted and implemented by all localities. This regional plan would also provide a foundation for more integrated solutions and establish consistency in local management strategies and techniques. This program is just beginning and results cannot yet be drawn; however, it is becoming apparent that while the four WPA features exist, the regional framework and local implementation components are lacking.

## **VI. Experiences of Other Multijurisdictional Approaches**

This chapter explores six other watershed programs, which have demonstrated innovative multijurisdictional approaches to water quality protection. The six programs were assessed and categorized into one of five general approaches: Monitoring by non-governmental organizations, Education programs, Long term monitoring, Watershed conservation districts, and Landowner associations.

The six programs are located throughout Virginia and, in contrast to the four previous in-depth studies, do not focus solely on the protection of drinking water supplies. Many of these are citizen based initiatives designed to monitor and manage water quality at a specific water body. The case studies are designed to identify and assess specific program components and do not address the regional comprehensive approach. Each program exhibits some component which contributed to water quality improvement and represent a feature or features of the EPA Watershed Protection Approach.

### **Monitoring Programs: Non-governmental Organizations**

In general, most citizen organizations have been created in response to a particular problem or proposed action. The citizen groups identified in this case study are no different. Many of these groups were created during the 1970s and early 1980s, when the water quality of the Chesapeake Bay and other waterbodies was in serious decline. Citizen groups were formed to force the governments (local, state, and federal) into controlling and regulating industrial, urban, and agricultural use and discharge of pollutants into the water. There are three main areas in which citizen groups have been involved. These three areas are:

- 1 water quality monitoring,
- 2 influencing elected officials in water management and planning decisions, and
- 3 creating and distributing educational material, and coordinating programs to clean-up the waterbodies.

Water quality monitoring has been conducted by many organizations throughout the Chesapeake Bay and its tributaries. The organizations use this data to identify water quality hazards, problem areas, and trends of the local waterbodies. Citizen groups use this information to inform and persuade local officials in land use and water resource management decisions.

The testing conducted by these organizations has become more standardized and scientifically sound, and therefore, more accepted by officials as credible and useful. Citizen monitoring programs have provided valuable support in terms of collecting water quality samples and gathering photographic documentation. Recently, however, citizen monitoring programs are reaching new levels of sophistication through volunteer certification programs and preparation of quality assurance management plans. Water quality monitoring commonly implemented by citizen groups is based on the criteria and standards designed by The Izaak Walton League "Save Our Streams" program. This monitoring system is relatively easy to use and the results of which have become widely accepted by officials and decision makers.

Second, citizen groups have become increasingly involved in working directly with local officials in the planning and management of water resources. Their efforts have directly and indirectly influenced decision makers on watershed protection measures. Many localities rely on the information provided by the citizen groups, primarily those data derived from water quality monitoring.

A third program is the creation and distribution of educational material. Currently, nearly all water-related citizen groups publish and distribute some type of newsletter or brochure aimed at informing residents as to the sources of and hazards associated with pollution. Many of these organizations also provide technical assistance to landowners and recommend various pollution mitigation techniques.

### *Alliance for the Chesapeake Bay*

The Chesapeake Bay, in particular, is the site of numerous citizen groups concerned with protecting the Bay and its tributaries throughout Virginia, Maryland, and Pennsylvania. The Alliance for the Chesapeake Bay has developed numerous educational materials, provided technical assistance to residents throughout the Bay's watershed, and monitored water quality at the Bay and tributaries throughout the three states.

The Chesapeake Bay citizen monitoring program has become an acceptable and efficient method of gathering basic reliable water quality data. The weekly information collected by the volunteers is used to augment the data from the Chesapeake Bay and state level monitoring programs. The Alliance is funded primarily by the Department of Environmental Quality, which has provided these funds for approximately 10 years. The Alliance also receives technical and financial support from other state agencies, including CBLAD and the Coastal Zone Management Agency.

The Alliance currently monitors water quality at various sites throughout the Bay's tributaries in Virginia, Pennsylvania, and Maryland.

- ♦ In Virginia, the monitoring sites are located on the Potomac, Rappahannock, Piankatank, York, Lynnhaven, Elizabeth, James and various creeks and embayments of the Eastern shore.
- ♦ In Pennsylvania the Alliance monitors water quality on the Conestoga River
- ♦ The Alliance also monitors water quality on the Middle, Severn and Patuxent Rivers in Maryland.

Volunteers are trained in accurate sampling techniques for all of the tests. Tidal water samples are taken by volunteers and then conduct a variety of tests. These tests include determining: surface dissolved oxygen using a micro Winkler titration kit; pH using a color comparator kit; salinity using a hydrometer; water clarity using a Secchi disk; and water and air temperature. Ammonia is measured using a color comparator kit at one point on the James River.

The data collected by the Alliance is accessible to all interested parties, including local governments, although localities rarely request the data. According to Judd (1996),

the organization has not often initiated the contact and is beginning to take a more proactive approach by encouraging local governments to evaluate and use the collected data.

The Alliance has also provided funding and technical assistance over the past several years to help establish other citizen groups. For example, the Chickahominy River Association and the Mattaponi and Pamunkey Rivers Association (MPRA) were both started with assistance from the Alliance. Both of these organizations have relied upon the Alliance for technical and financial assistance and are very similar in nature to the Alliance.

### ***Mattaponi and Pamunkey River Association***

The MPRA was developed in the early 1990s for the purpose of providing a regional focus and encouraging local governments to act in a multijurisdictional fashion. The MPRA, as its name implies, focuses on both rivers and their watersheds. According to Mills (1996), this association operates at this regional level in order to include all interested stakeholders and foster a multijurisdictional approach. The MPRA does not focus strictly on one issue or resource, nor does it voice opposition to all development proposed along the rivers. Instead, the association has adopted a regional approach and acts as an advisor to local governments.

The MPRA recognizes that governments throughout this area have very few resources, in terms of finances and staff, and are not able to conduct public education or basic water quality monitoring. The organization, therefore, provides these services and works closely with the localities to implement projects based on the results. The MPRA has built a strong constituency among local residents and government officials, which is based on education not advocacy. With this supporting foundation, the MPRA is now putting pressure on residents and localities to adopt changes in land use activities. This region, therefore, is slowly adopting a more unified approach to land use controls and water quality protection.

### ***Conclusions and Lessons Learned from Monitoring Programs***

The Alliance and the MPRA are examples of non-governmental organizations role in local land use management. These citizen groups have become major players in watershed management activities, due to their extensive monitoring programs and political activism. Two primary components are identified (See Table 6.1) in this case study, which have contributed to achieving watershed management objectives and, therefore, supports the Watershed Protection Approach. Governmental agencies are beginning to realize the importance and usefulness of citizen groups and are attempting to incorporate them into the planning, management, and monitoring processes. Many agencies, which operate on a limited budget, are not able to monitor water quality appropriately. Therefore, they are relying on non-governmental organizations to monitor water quality and to provide accurate data for the purpose of assessing program effectiveness.

**Table 6.1: Institutional Characteristics from Monitoring Programs**

- |   |
|---|
| <ul style="list-style-type: none"><li>♦ The Alliance and the MPRA are non-governmental organizations, which perform governmental tasks such as data collection and educational programming, and therefore, build public constituencies for watershed management.</li><li>♦ Dissemination of water quality data has provided elected officials with more appropriate and timely information in developing water related policies and strategies.</li><li>♦ Concentration on a particular river or resource by a citizen group excludes interested stakeholders and may limit the organization's effectiveness in meeting their objectives.</li></ul> |
|---|

The Alliance and other organizations have been monitoring water quality at the Bay and other waterbodies for decades, although this data was not being used due to general perceptions that it was unreliable and unsubstantiated. In the past several years, agencies at the federal (EPA) and state (DEQ) levels have incorporated the data into project reports and program designs. Furthermore, the Alliance is attempting to make the

data more useful and available to local governments, which could directly benefit from the results.

## **Education Programs**

### ***Virginia Water Resources Research Center***

The Center has identified three primary objectives to evaluate individual projects. First, the Center assists the development of new technology and encourages more efficient methods for resolving local, state, and national water resources problems. Secondly, the Center is becoming more interested in training water related professionals through research on the job. Thirdly, the Center disseminates this information through technology transfer and application of research results (Godfrey, 1994: 2).

While the overall objectives of the Center remain relatively unchanged, it is now concentrating more heavily on the provision and exchange of information between institutions and agencies. According to Shabman (1995), a large amount of information has been collected by various sources, although not readily available to agencies, groups, and other stakeholders which would benefit from the data and reports. The following discussion identifies two particular programs developed by the Center, which illustrate educational projects to inform the public and foster involvement in watershed management.

### ***Copper Creek and Moccasin Creek***

The Water Center has developed two guidebooks to assist residents of Copper Creek and Moccasin Creek watersheds in identifying nonpoint source pollutants and their related water quality impacts. The guides recommend and describe a number of measures that residents can take to alleviate these pressures. Copper Creek and Moccasin Creek are both located in Scott and Russell counties in southwestern Virginia and run parallel to one another for approximately 60 miles, although they empty into different rivers. Copper Creek is part of the larger Clinch River watershed, while Moccasin Creek flows into the North Fork Holston River.

Water quality at both creeks is declining due to polluted runoff as a result of sedimentation and nonpoint source pollution from agriculture, construction, and logging practices along the stream banks. The Water Center identified three relatively inexpensive mitigation measures which area landowners can implement to mitigate these water quality impacts. First, manage local stream corridors by keeping livestock away from the stream and the stream bank. In addition, landowners are encouraged to reestablish a vegetative buffer between their farmlands and the stream. Second, encourage nutrient load management by applying proper amounts of nitrogen and phosphorous fertilizers on farmland. Third, encourage proper management, usage, storage, and disposal of pesticides.

The guidebooks describe the streams and surrounding land uses and provide assistance to landowners in identifying and mitigating nonpoint source pollution problems. A directory is also included in the guide, which lists organizations in the Copper Creek watershed region, providing technical and/or financial assistance to landowners.

### ***Conclusions and Lessons Learned from Education Programs***

This program has incorporated relevant stakeholders, primarily landowners, into the management process. This program further illustrates the development of the local strategy within the tiered approach. Specific management techniques were employed by local agencies and landowners, such as stream buffers and environmental education, to stabilize local water quality and will eventually contribute to improving water quality at the larger watersheds (See Table 6.2).

**Table 6.2: Program Components from Education Programs**

- ♦ Inexpensive land use measures, such as fencing out livestock, implemented by landowners at a stream or river mitigates water quality impacts.
- ♦ By providing technical assistance and environmental education to landowners, agencies and organizations will create public awareness and interest in local watershed protection.

The Watershed Protection Approach is represented in this study due to problem identification, involvement of critical stakeholders, and development of integrated solutions. The primary cause for water quality declines was due to inappropriate agricultural activities around the stream banks. The Center, in association with local landowners, then established various integrated solutions to rectify the problem.

### **Long Term Monitoring**

#### ***Polecat Creek Watershed***

A monitoring system has been developed for the Polecat Creek watershed in Caroline County, which employs a design known as the “Wheel and Axle approach (CBLAD, 1993: 10). This project is designed to monitor the water quality in a particular stream by one agency. While the data is relevant only for the Polecat Creek, the monitoring system is a common one and can be used at other monitoring sites and watersheds.

Chesapeake Bay Local Assistance Department (CBLAD) has created this system as a long term monitoring project. Long term monitoring is possible due to the establishment of two separate, but complimentary studies. These are (1) special study sites and (2) fixed stations. The special study sites are intensive surveys conducted over a limited period of time, perhaps according to funding. The fixed stations are the backbone of the monitoring system and should not be interrupted. If it is necessary to decrease monitoring intensity, the special study sites would be eliminated while the fixed stations continue monitoring for trend analyses. Five necessary steps in designing and developing the wheel and axle concept and have been identified and are listed in Table 6.3 below.

The axle is the backbone of the monitoring program and is used to perform statistical trend analyses. The axle has fixed stations and fixed methodologies for the consistent collection of water quality data. Two networks or axles have been established in the Polecat Creek watershed. A trend network for surface water is an in-stream network of stations monitoring chemical, biological, and physical parameters. The physical parameters consist of benthic macroinvertebrate sampling and fish community structure studies. The trend network for rainfall is an off-stream network of stations monitoring quantity, quality, and intensity of rainfall.

**Table 6.3: Steps in the Design of a Water Quality Monitoring Information System**

1. Define information expectations in terms of goals and objectives.
2. Confirm statistical design criteria by statistically characterizing the water quality population to be sampled.
3. Design the monitoring network to answer the questions “Where, What, and How.
4. Develop operating plans and procedures, including sampling routes, training of personnel, and analysis procedures.
5. Develop information reporting procedures, such as the type of information, the format, and method of dissemination.

Source: Tingler et.al., 1993:7.

The wheel is a network of stations of special studies or intensive stream surveys to complement the axle studies. The “wheels” are short term studies designed for the purpose of monitoring a particular water quality problem. The Polecat Creek watershed monitoring system has only just started and it will be some time before the project’s success is known. The program is, however, interesting for this report, since it’s design is such that it can be duplicated elsewhere around the region.

### ***Conclusions and Lessons Learned from Long Term Monitoring Programs***

A financially feasible monitoring program may be designed to monitor long term water quality trends and short term impacts. This project permits special studies when funding is available, although the long term monitoring or axle must be consistently

maintained. This supports the WPA feature of measuring success, since it intends to monitor water quality and to measure the effectiveness of the entire program.

This monitoring project serves as an example for localities and regional agencies to establish and implement a financially feasible program. This may be an opportunity for those areas with limited funding to establish a useful monitoring program. This can be developed at a subwatershed level and/or expanded to a more regional level. Special study sites may be established as funding is available, while maintaining the long term “axle” monitoring programs.

## **Watershed Conservation District**

### ***Dragon Run Watershed***

The Dragon Run subwatershed is located in the Lower Rappahannock watershed bordering the counties of Essex, King and Queen, Middlesex, and Gloucester. The Dragon Run stream was ranked by the Smithsonian in 1974 as the second most ecologically significant area in the Chesapeake Bay. It was first provided protection by being designated as a state scenic river in 1985. In 1988 the Stream was designated and adopted as a Conservation District by the Middle Peninsula PDC, the Steering Committee, and three of the four counties. The middle peninsula has, however, experienced high growth rates over the past several years impacting the character and quality of the stream. Because of these water quality and land use concerns, various agencies and organizations became involved in the planning and management of the watershed. Local citizens concerned about preserving this unique area encouraged local governments and regional organizations to establish protective measures.

In 1984, the PDC initiated a forum, including local jurisdictions, elected officials, and landowners, to discuss legal and political issues surrounding the Dragon Run. As a direct result of this forum, the Dragon Run Steering Committee was established, which was comprised of landowners and local government officials. The Committee, initially unsuccessful due to lack of guidance, soon became reactivated with the financial and technical support of the PDC and the Chesapeake Bay Foundation. The Committee

reached a consensus in 1987, finding that a Conservation District was most viable for the watershed. The Conservation District Plan provides protection for areas “necessary for floodplain management, aquifer recharge, water storage, critical wildlife habitat, or similar functions” (Essex Co., 1988: 5A.1). These areas include wetlands and swamps and other areas with Fluvaquent and Sulfaquent type soils. The District, similar to the CBPA, also provides for a 100 foot buffer around these areas (Essex Co., 1988: 10-2).

The PDC recently developed the first management plan of the Dragon Run Watershed in 1994, which encourages the adoption of specific policies and strategies by all the local jurisdictions. In addition, the PDC is assembling data for all of the watersheds in it’s district to assess possible inclusion into the Exceptional Waters Program. It is using the Alliance for the Chesapeake Bay protocol for monitoring water quality and is also using GIS to inventory and monitor land cover, wetlands, floodplains, soils, natural heritage sites, VPDES, endangered species, and shellfish areas.

### ***Lake Barcroft Watershed Improvement District***

The Watershed Improvement District (WID) was developed under an obscure Virginia law, which states that farmers with drainage problems can create a watershed district. This District then has the power to tax area residents for the purpose of improving the watershed conditions. The Lake Barcroft WID is a direct result of this. The Lake Barcroft watershed has changed rapidly over the past several years from a forested to an ultra urban area with serious urban pollution impacts.

Approximately 10 years of water quality monitoring data has been collected at the Lake on a weekly and biweekly basis, which indicate water quality degradation and water quantity conflicts, such as flooding. Urban runoff, as well as, flooding have been identified as the major factors in the Lake’s water quality problems. As a result, approximately \$100,000 per year is spent on sediment and debris removal from the Lake. It has been recognized that there is a need to establish an interdisciplinary approach to identify and develop solutions.

While the watershed development cannot be reversed, the situation may be improved by recognizing the opportunities. District administrators believe that the impacts can be mitigated by identifying and determining an engineering solution. They understand, however, that this is an expensive and time consuming process and may take several years to retrofit the watershed.

The objective, therefore, is to detain the stormwater temporarily and minimize the floods and the stream flows. This can be accomplished through check dams, such as riprap. Funding for this project comes from three main sources. These sources are taxes paid to the WID, county funding, and federal pass through grants. While many projects are established in new developments, this project serves as a demonstration project to retrofit older developed watershed areas.

### ***Conclusions and Lessons Learned from Watershed Conservation Districts***

A number of lessons are drawn from these programs which have contributed to the regional institutional framework and the management strategies implemented at the local level (See Table 6.4). The Dragon Run Conservation District is the result of a “joint exercise of local authority” to protect this federally recognized environmentally sensitive area (Owens, 1991: 4,5). This Authority allows Virginia localities to form partnerships and to act in a regional manner. Dragon Run is an example of the utility of this partnership and identifies the way in which these are developed. It is presumed that water quality stabilization, which has remained at relatively high levels, is due to the implementation of this program (Uzel, 1995).

Although the District has been developed between three localities, this provides an example of a bilateral approach in which plans, agreements, and management techniques are developed and implemented. Further, this program illustrates the WPA, since it has explored and included all four features of the EPA Approach.

**Table 6.4: Institutional Characteristics from Watershed Conservation Districts**

<p>Institutional Framework and Planning</p> <ul style="list-style-type: none"><li>♦ Joint exercise of local authority by contiguous localities provides protection to valuable water bodies and other environmentally critical areas.</li><li>♦ Protection of waterbodies and watersheds may be initiated by local citizens, such as the Dragon Run example.</li><li>♦ Development of a Watershed Improvement District within a SWCD provided an opportunity for local residents to develop management programs outside the realm of political boundaries.</li></ul>
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A Watershed Improvement District was developed within the Northern Virginia SWCD to improve erosion, sedimentation, and drainage controls. It is developed outside the realm of political boundaries, which permits and requires more citizen based initiatives and strategies. The validity of the WPA is supported in this study since the four features are represented. Furthermore, these programs illustrate the local level of the tiered approach, through the development and implementation of various integrated solutions.

### **Landowner Associations**

#### ***Smith Mountain Lake***

Smith Mountain Lake employs a different approach in developing policy and land use management strategies around the Lake. Bedford, Franklin and Pittsylvania counties, which surround the Lake, are responsible for the watershed planning and management processes. Independent organizations, however, exert a great deal of pressure on these localities, resulting in a more open and comprehensive planning approach. Two non-governmental stakeholders directly involved in the process are the Smith Mountain Lake Policy Board and the Smith Mountain Lake Association (See Table 6.5).

**Table 6.5: Stakeholders at Smith Mountain Lake**

- ♦ Bedford County
  - ♦ Franklin County
  - ♦ Pittsylvania County
  - ♦ Smith Mountain Lake Policy Board
  - ♦ Smith Mountain Lake Association
  - ♦ Ferrum College
- Source: Johnson et.al., 1994

*Smith Mountain Lake Policy Advisory Board*

A Policy Board was originally developed to coordinate the policies and management strategies of the surrounding counties. The Policy Advisory Board is an organization formed by the three counties surrounding Smith Mountain Lake. The Board was developed to serve three primary purposes. First, the Board advises the counties on water related legislative and planning issues. Second, the Board implements the Smith Mountain Lake Shoreland Management Plan, which requires specific land use controls to protect the Lake's water quality. The Board also maintains the Lake's navigation system and disposes of lake debris removed by the Appalachian Power Company.

The Board coordinates a number of community projects and also provides educational programs to aid in the lake's protection. The Board coordinates an annual cleanup event at the lake and assists property owners and the Appalachian Power Co. for easy removal and disposal of debris from the lake.

*Smith Mountain Lake Association*

The Smith Mountain Lake Association volunteer monitoring program, designed in 1985 as an early warning system of water quality deterioration, has recently detected definite trends in water quality decline (Johnson et.al., 1994: i). The database of the lake is now large enough to identify areas of declining water quality and is beginning intensive monitoring of algae and nutrient levels in these "hot spots." Due to these water quality

pressures, the Smith Mountain Lake Association (SMLA) is urging the three counties surrounding the Lake to take actions to prevent the continued deterioration.

Water quality parameters measured by this volunteer monitoring program include water turbidity, total phosphorous and chlorophyll-A. The first 5 years of monitoring revealed relatively constant levels of each these parameters. With several years of data, the monitoring program indicated increased trends and resulted in the identification of a number of “trouble spots” in the summer of 1993. The 1993 results showed highly significant increases over the past year in total phosphorous and chlorophyll-A concentrations. According to Johnson (1993: 8), however, these significant increases may be due to lab errors and the underestimation of concentrations in the past several years data. Since 1991 the average pH concentration has increased by more than 60%. Increasing visitation pressures and increases of nutrient levels from agricultural and urban runoff are the major contributors to the water quality decline. Through collaborative efforts the SMLA and the SMLPAB have identified possible actions to prevent further decline. These actions are found below in Table 6.6.

**Table 6.6: Strategies to Prevent Further Water Quality Decline at the Lake**

- ◆ Monitor and encourage erosion control activities, especially in Franklin, Bedford, and Pittsylvania.
- ◆ Determine regulatory significance of “nutrient enriched waters.”
- ◆ Encourage landowners to decrease use of fertilizers and regularly inspect septic systems and drainfields.
- ◆ Continue support of Blackwater Demonstration Project and establish other similar projects.
- ◆ Explore feasibility of sediment trapping in the upper channels.

Source: Derived from Franklin News-Post (1/7/1994).

Faculty at Ferrum College have helped initiate the water quality program and have recently received funding to implement a three phase digitizing project to track and improve water quality at Smith Mountain Lake. Phase One consists of creating a series of GIS maps of the entire Smith Mountain Lake watershed. Phase Two allows for

calculation of delivery rates of nutrients and silts into area rivers and streams. Phase Three will use satellite imagery to determine the lake's circulation pattern.

### *Local Jurisdiction Involvement*

The organizations gather a great deal of water quality data and make the information available to all interested stakeholders. The two organizations collaborate with and assist the local jurisdictions in implementing policies and strategies reflecting the water quality results. The three counties have attempted to lessen water quality impacts by implementing a number of land use controls and management strategies to decrease nonpoint source pollution. Franklin County, with support from SMLA and Ferrum College, are developing a demonstration project in the Franklin portion of the watershed. The Blackwater Demonstration Project is developed to encourage more responsible agricultural and dairy practices and lessen the impacts on the Lake's water quality. Other projects, such as the previously described Shoreland Management Plan, are also being developed by the local jurisdictions. While the localities are not prevalent stakeholders in the region, they have played a vital role in developing and implementing projects in collaboration with the two primary organizations.

### *Little River Watershed*

The Floyd County portion of the Little River watershed was targeted as having a serious sedimentation problem. In response, the National Committee for the New River (NCNR) requested and was awarded a 319 grant to implement various mitigation measures. The NCNR established a Citizen Advisory Committee comprised of local cooperating agencies and organizations to implement the project.

The Citizen Committee, meeting on a monthly basis, worked together to reach consensus on various objectives. The Committee consisted of the Virginia Tech Cooperative Extension, Virginia Department of Forestry, NRCS, and other cooperating agencies. Two groups with conflicting views are located in the region and are included in the project: farmers and other landowners. To resolve these issues, both groups

collaborated in this Committee to develop the Little River Watershed Association. Through this Committee, they reached consensus on policies and specific management techniques to improve water quality. However, the most limiting factor for the Association and success of this project is funding, with the majority of money coming from federal and state grants.

### ***Conclusions and Lessons Learned from Landowner Association Programs***

Table 6.7 identifies various institutional characteristics and program components which have contributed to the effectiveness of the Smith Mountain Lake and Little River programs. Water quality at Smith Mountain Lake has continued to decline, although this is disputed due to previously inaccurate data. Water quality at Smith Mountain Lake has been a major concern of local residents, who have attempted to mitigate impacts and stabilize water quality. The Smith Mountain Lake Association was established in response to the water quality declines and has been instrumental in promoting and encouraging water related agreements among the localities. This program identifies three features of the WPA and, therefore, lends support to the practicality of the Approach.

The establishment of a water related agreement between the relevant stakeholders provides the foundation for a multijurisdictional approach. This agreement in Floyd County included representatives from federal, state, and local agencies, as well as local landowners. Furthermore, a Watershed Association was developed, which included all the stakeholders, especially the two conflicting groups. This Association provided an opportunity for all participants to become involved and develop a plan, which is acceptable to all parties.

**Table 6.7: Institutional Characteristics from Landowner Association Programs**

**Institutional Framework and Planning**

- ♦ Establishment of a water related agreement between state, federal, and local agencies, as well as local landowners developed the foundation for a multijurisdictional approach at the Little River Watershed. This agreement forced landowners and local agencies to accept responsibility for water quality declines and develop a program mitigate the problems.

**Stakeholder Involvement**

- ♦ Enlist the support of regional organizations, citizen groups, and individual residents as they often have a great deal of information to contribute.
- ♦ Encourage participation by citizen organizations and academic institutions in the watershed planning and management processes.
- ♦ Work in collaboration with these groups in developing site specific plans and management strategies.
- ♦ Development of a Watershed Association including all stakeholders, especially conflicting groups, improved the multijurisdictional efforts by encouraging the input from all stakeholders to develop local policies and management techniques.

**Monitoring**

- ♦ Monitoring of local water quality and dissemination of the results may create public awareness and interest in watershed protection.

## **VII. Conclusions and Lessons Learned From Case Studies**

A number of lessons and conclusions can be drawn from the case studies presented in the previous chapters. This chapter outlines and briefly describes each of these lessons in four categories corresponding to critical components of watershed management programs: institutional framework and planning, stakeholder involvement, implementation strategies, and monitoring. These four categories illustrate and expand on EPA's characterization of the Watershed Protection Approach, especially its implementation. "Institutional framework and planning" consists of program organization, types of agreements, development of regional plans and stakeholder identification. "Stakeholder involvement" overlaps the previous category; however, this describes the roles of and interaction among the stakeholders, including both governmental and non-governmental. "Implementation strategies" consist primarily of local management programs designed to carry out the regional plans and may be either regulatory or non-regulatory programs. "Monitoring" is used to measure the success of implemented management plans, programs, and strategies. This is accomplished primarily through water quality monitoring by governmental agencies and citizen organizations.

Specific institutional and program components are drawn from these experiences and assessed for their relative effectiveness in achieving watershed management objectives. Further, this chapter describes the extent to which EPA's Watershed Protection Approach is represented in these case studies. Finally, lessons learned are formulated to assist other jurisdictions in implementing their own watershed management program and to contribute to the clarification and implementation of EPA Approach.

## **Institutional Characteristics and Program Components**

### ***Institutional Framework and Planning***

*1. A regional agency, developed through cooperative efforts, can be an overseeing authority for planning, coordinating, and monitoring land use and water quality policies and objectives.*

The best example of this is in the Occoquan watershed. The Occoquan Policy Board is comprised of members of each jurisdiction within the watershed, as well as Alexandria and the SWCDs. This Board, which meets 2-3 times per year, is responsible for developing watershed wide policies, strategies, and coordinating local government strategies. The Occoquan Lab is funded by local jurisdictions and utilities to monitor regional water quality and to develop recommendations for continued water quality protection.

The Rivanna Water and Sewer Authority also illustrates this finding. It is the regional agency developed by Albemarle and Charlottesville to acquire, maintain, and finance water supply projects. The Authority was created through a mandate by the Virginia Water Control Board to provide adequate protection for the water supply's watershed.

*2. Development of a Regional Authority may provide an opportunity for local jurisdictions to resolve conflicts and reach a consensus on water related concerns.*

Albemarle and Charlottesville were forced into establishing the Rivanna Water and Sewer Authority. This Authority is funded by both jurisdictions and provides a regional framework. The Authority is responsible for coordinating policies and management decisions throughout the watershed and assists Albemarle in developing and implementing land use controls.

3. A tiered approach to watershed management involving (1) a regional authority and regional planning, (2) multijurisdictional and bilateral agreements, and (3) local implementation projects, provides opportunities for all jurisdictions and organizations to identify common issues and develop solutions to the problems.

- Regional approaches involving the Planning District Commission and regional authorities provide a “multijurisdictional umbrella” for planning, coordination, collaboration, and consistency among jurisdictions. A regional approach is developed through the integration of all stakeholders including, interested jurisdictions and citizen organizations, establishment of a regional plan and/or policy, and the coordination of local policies and strategies.
- Bilateral agreements created between two jurisdictions are often developed to protect a particular watershed. A bilateral approach incorporates features from the regional and local agreements including watershed plans and local implementation to meet the watershed program’s objectives.
- Local programs and projects developed within the boundaries of a locality are intended to protect local water quality at a reservoir, stream, or other waterbody. Local agreements are commonly designed to exist within the confines of the regional approach. Local jurisdictions develop specific management strategies in implementing the policies and plans mandated for the region.

4. Development of a regional plan by key stakeholders can establish the foundation for multijurisdictional watershed management by identifying conflicts and common concerns and developing watershed wide goals and objectives.

A regional plan such as the Occoquan Policy or the Occoquan Basin Nonpoint Pollution Management Program provides a regional framework and establishes region wide objectives. The Policy integrated regional stakeholders and, thereby, coordinated the policies and management techniques of local jurisdictions. The Nonpoint Program was designed to advise localities on land use controls, policies, and management

strategies. The Program also assisted local jurisdictions in revising comprehensive plans, land use ordinances, stormwater management regulations, and in promoting BMPs.

While multijurisdictional plans were critical for the Occoquan, a bilateral plan was sufficient in a watershed affecting only two jurisdictions. The South Fork Rivanna Reservoir Management Plan was established through collaborative efforts by Albemarle, Charlottesville, and the Rivanna Water and Sewer Authority. This Plan has provided a regional approach to water quality protection at the Reservoir. A number of multijurisdictional components were employed due to this Plan, including establishment of the position of a watershed management official and adopting various regional management strategies to mitigate point and nonpoint source pollution.

Implementation of a multijurisdictional plan has not been possible in Hampton Roads; instead, those localities have relied on bilateral agreements. Development and implementation of region wide plans are improbable due to the different perspectives and concerns held throughout the region. Similarly, the Rappahannock region does not have a regional framework in place, although a previous attempt was made. However, this attempt, the Rappahannock River Watershed Plan, failed because the City of Fredricksburg developed the Plan without incorporating the views and concerns of all key stakeholders.

5. *Memoranda of Agreement* are policy tools to identify and address common concerns and sources of conflict among localities and Planning District Commissions.

These can be developed for any of the three tiers: regional, bilateral, local. These are first steps in developing a regional approach, but should be expanded upon to become more legally binding and provide a stronger regional framework.

6. *Joint exercise of local authority by contiguous localities (e.g. use of a common Overlay District) may provide protection to valuable water bodies and other environmentally critical areas.*

The Dragon Run Conservation District is an example of this type of water related agreement. Three localities bordering Dragon Run formed a partnership and developed a regional district to protect the water quality and watershed of an environmentally critical area. This has resulted in coordinated efforts and strategies being developed by the three stakeholders.

7. *Formal multijurisdictional agreements between localities involving key stakeholders encourage dispute resolution and permit the development of multijurisdictional efforts that are acceptable to all stakeholders.*

A problem which impacts specific localities may unify the localities and encourage the development of a bilateral or regional approach. For example, Charlottesville and Albemarle were forced into an arrangement to target water quality problems at the Reservoir. This agreement formed due to the City's reliance upon the water supply and the County's responsibility for land use controls around the Reservoir. Although the jurisdictions were forced into this arrangement by Department of Environmental Quality, the agreement was necessary to resolve these water quality issues.

8. *Informal agreements developed between localities facilitate discussion and can identify solutions to existing conflicts; however, formal agreements may be necessary for effective program development and implementation. Likewise, establishment of an informal committee comprised of all interested stakeholders provides a forum to discuss water and watershed related issues, although it may not go far enough in developing an effective regional framework.*

The upper Rappahannock and the Hampton Roads regions have both made use of informal agreements to identify problems and possible solutions. These type of agreements may be effective if all parties respect the forum. While these are a first step,

more formal agreements must be developed between jurisdictions to establish a regional institutional framework and permit the development of consistent local management strategies.

Development of an informal committee made up of elected officials, local government staff, the PDC, citizen groups, and landowners may create a more open forum and allow for more innovative ideas and brainstorming sessions. A committee, such as that in the upper Rappahannock, with no formal obligations or agenda does not require the participation of any jurisdiction or agency. However, this type of arrangement does not provide a regional institutional framework and does not require compliance by local governments. As a result, local governments may implement management strategies, but they may not be consistent with other localities nor fit into the regional context.

*9. Establishment and development of collaborative efforts among jurisdictions throughout a region can improve the consistency of management and monitoring strategies.*

In Northern Virginia the various public works departments have worked to develop consistent regional approaches to watershed protection. Cooperative efforts to monitor water quality have been developed between Prince William County and the City of Fairfax. Fairfax County is also encouraging the use of standardized water quality testing which can be used by all agencies and organizations and then be easily interpreted by other agencies and external organizations. The Occoquan region is also adopting regional BMPs and other watershed wide management strategies, which would be adopted by all the watershed jurisdictions.

*10. Collaborative efforts among agencies within a locality may improve the coordination and implementation of policies and action strategies.*

Proper communication between agencies within a locality is critical in maintaining a consistent and efficient management system. The Planning Department

must be clear about policies and develop policies which are feasible and consistent with the other agencies. The reverse is that Public Works and SWCDs must implement these policies according to their original intent. These agencies must then monitor the strategies and report back to the Planning Department with the results. The Fairfax County Comprehensive Plan is very clear and concise in that the Plan reveals specific policies and then outlines specific management strategies to implement these policies. Furthermore, the Plan describes a number of methods on how the strategies will be carried out. Public Works and other relevant agencies are able to implement the strategies outlined in the Comprehensive Plan. This would not be possible without close collaboration between these agencies.

*11. A Watershed Improvement District within a SWCD provides an opportunity for local residents to develop management programs outside the realm of political boundaries.*

The Watershed Improvement District established around Lake Barcroft is the only example of this association. Landowners around Lake Barcroft adopted the WID to mitigate impacts from stormwater runoff, which include flooding, pollution, and floating debris. The WID is permitted to levy taxes and fund programs to provide water quantity and water quality protection to the local waterbody.

*12. A Watershed Association including all stakeholders, especially conflicting groups, can improve multijurisdictional efforts.*

This Association would identify conflicts and have the authority to propose and implement site-specific management measures. For example, a Watershed Association was developed at the East Fork Little River watershed encouraging stakeholder involvement. Two groups with opposing perspectives existed in this region: environmentalists and the farming community. The Watershed Association was developed to identify and resolve conflicts among the groups and to identify possible solutions to the water quality issue. All residents were encouraged to participate in the

Association, and thereby, contribute to the identification and implementation of potential solutions. Several measures were then developed and implemented by the Association.

*13. Subwatershed agencies, such as the SWCD and public works departments, can be useful in implementing and evaluating programs.*

The SWCDs in Northern Virginia have been instrumental in implementing the Occoquan Policy and the Nonpoint Pollution Management Program. Because the agency works directly with landowners, it has an opportunity to encourage consistent management strategies and is able to observe and monitor program success.

*14. Bilateral or small scale multijurisdictional approaches may be most appropriate in subwatersheds in which a conflict is only identified by two or three localities . It is not necessary to involve all jurisdictions, only those with a common problem or concern.*

Hampton Roads is the site of numerous bilateral agreements due to the nature of reservoir ownership and land use control responsibility. In several instances in Hampton Roads, reservoirs are located in one jurisdiction while owned and operated by another. This arrangement requires cooperative efforts among the two jurisdictions to resolve land use and water quality issues. Further, other localities do not have a vested interest and are not essential to the success of the subwatershed program.

*15. Establishment of a Watershed Manager can bring expertise and staff commitment to watershed management programs and assist in development of watershed management plans and implementation of consolidated local management strategies.*

The position of a Watershed Management Official (now Water Resources Manager) was created by a joint action between Albemarle and Charlottesville to work with the regional agency, Rivanna Water and Sewer Authority, in order to develop and implement coordinated and effective management strategies. Originally, the position was supported financially by both jurisdictions while providing assistance to the land use locality (Albemarle) and the Authority. The Watershed Manager may operate at the

regional level, such as at Albemarle-Charlottesville or at the local level. Prince William County and the City of Portsmouth have a watershed manager to develop and implement local watershed management strategies.

### ***Stakeholder Involvement***

*1. In Virginia, the Planning District Commission most often plays a lead role in effective regional watershed management.*

In Northern Virginia and the Hampton Roads region, the PDC has taken an action-oriented approach to protect the water quality. The NVPDC and the HRPDC are very active in assisting local governments on policy formulation and management implementation. Both have also identified the watersheds in need of protection and are working closely with those affected jurisdictions. Both PDCs are also involved in developing educational materials for local governments and area residents. These materials assist landowners and governments in identifying potential problems (water quality hazards) and what they can do to rectify the problems.

*2. Involvement of regional agencies, such as the Planning District Commission and regional authorities, during the planning and management phases provides a regional framework and allows for comprehensive and coordinated policies and plans.*

Regional agencies, such as the NVPDC, provide valuable assistance to the regional framework and to localities. The NVPDC has provided that region with extensive data and technical assistance. The Policy Board is able to use this data in making more informed water related policy decisions.

*3. Local governments are critical stakeholders in regional watershed management as they implement site specific subwatershed projects, which contribute to regional objectives and plans.*

Local governments play a critical role in the multijurisdictional approach. While regional plans and policies are developed by regional agencies or policy boards,

implementation must be carried out at the local level. In Northern Virginia and Albemarle-Charlottesville regional policies act as institutional frameworks, although local governments are responsible for implementing these policies through the development of specific watershed management programs. The Occoquan has both a Plan and Management Program to identify regional objectives and to guide local actions. Every locality is then responsible for complying with these frameworks, although each jurisdiction has the ability to implement site-specific programs which are most effective and acceptable to the government and residents. This local implementation method discourages a traditional top down approach and permits and encourages strong local support.

*4. While state and federal agencies provide technical and financial assistance and, in some cases, mandates for regional watershed management, local and regional agencies are responsible for developing and implementing watershed management programs and projects.*

This has resulted in a bottom-up approach, allowing local and regional jurisdictions to develop plans and policies which are most effective for that region. This lesson is exemplified in the watershed targeting and prioritization approach developed by the EPA. The EPA funds local watershed programs, such as the Little River watershed program in Floyd County and the Lake Barcroft program, through 319 grants.

Within Virginia, both the Environmental Protection Agency and the Virginia Department of Environmental Quality have established water quality standards at rivers and reservoirs. In addition, these governmental agencies provide technical and financial assistance programs to maintain and improve local water quality. Programs are available to local governments as well as non-governmental organizations. The EPA 319 program is the primary funding mechanism identified in these case studies. For example, Prince William County, with a 319 grant, has developed a comprehensive stormwater management program and a subsequent GIS monitoring model.

5. *Non-governmental organizations and landowners are often key stakeholders during regional planning and local implementation processes. Their involvement often results in stronger public support and greater opportunities for success.*

Individual landowners and organized citizen groups have contributed to and in many cases have been responsible for the success of several programs. For example, the Lake Barcroft Watershed Improvement District is a direct result of local residents concerned about water quality and water quantity problems. The residents formed the District to address these problems despite the lack of support from the local jurisdiction. Residents, through the District, have targeted the problems, developed and implemented management programs, and monitored the programs success.

Friends of the Rappahannock and Piedmont Environmental Council have helped establish an institutional framework and have actually taken the lead in developing a regional focus for watershed management activities at the Rappahannock. Because they are not tied to political boundaries, these organizations have been able to assist local governments in implementing management strategies and in coordinating these strategies with other local efforts. As a result of citizen groups efforts, public involvement and subsequent support is beginning to occur. While the Rappahannock program is still relatively undeveloped, the success of this program has relied on and will continue to rely on the input from these organizations.

The involvement of other agencies and organizations is extremely important. Without support from citizen groups many policies and management strategies could not be implemented. Citizen groups throughout the State have been effective in encouraging and in some cases demanding watershed and water quality protection. In Loudoun County, the citizens pushed for and won approval for the development of stream corridor buffers.

Many citizen groups are actively involved in water quality monitoring and have a strong voice when actions by the government are inconsistent with the water quality results. The Alliance for the Chesapeake Bay has had considerable success with water

quality monitoring. Yearly results of the Chesapeake Bay Volunteer Monitoring Program are read and reviewed by the US EPA and incorporated into the Clean Lakes reports.

### ***Implementation Strategies***

*1. When developing watershed management strategies, a diverse set of appropriate strategies can lead to the most comprehensive and effective water quality protection.*

These strategies may include but not limited to land use restrictions, on-site and regional BMPs, density controls, reservoir and stream overlays and districts. The Occoquan watershed has been the site of numerous strategies developed and implemented by local jurisdictions. Establishing these strategies throughout the watershed has protected upstream water quality as well as at the Reservoir. Furthermore, the watershed and tributaries are cross several political jurisdictions, therefore, the collaborative efforts by all the localities was critical in mitigating water quality impacts.

*2. In most cases, Stream Buffers can provide a cost effective method to protecting tributary water quality.*

Buffers, designed similar to the EQCs in Fairfax County, can reduce the sediments and nutrients entering reservoirs and streams. Buffers can be established through public land acquisitions, such as Newport News, or through conservation easements on private land, such as Williamsburg.

*3. Overlay Districts at reservoirs and tributaries can improve the regional multijurisdictional approach and provide increased water quality protection.*

Overlay districts have been used by many localities to restrict development and provide buffer areas to protect reservoir and tributary water from point and nonpoint source pollution. Furthermore, overlay districts have been established by contiguous localities in protecting a watershed crossing jurisdictional boundaries. For example, Newport News has bilateral agreements with several localities establishing overlay districts around many of its reservoirs. The City created overlay districts within its

boundaries and encouraged other localities to adopt the same or similar district. The multijurisdictional water supplies and overlay districts have provided a link between the localities and has improved water quality protection for the reservoirs.

4. *Density Controls may provide water quality protection through land use policies and strategies.*

Density controls may be established as cluster developments or downzoning requirements. Clustering provides for development areas at “non-critical” area in order to direct development away from a critical resource, such as a reservoir, and thereby, mitigate nonpoint source impacts. Downzoning permits development near the resource, but requires fewer units per acre. For example, Fairfax County implemented downzoning and reduced lot size from 1 unit per acre to 1 unit per 5 acres. While not restricting all development, this approach severely curtails the level of development in an area.

5. *Development of Regional BMPs may be more financially feasible and technically effective measures in mitigating nonpoint source pollution.*

Development of regional BMPs are often constructed in a multijurisdictional fashion and may be more effective. Local jurisdictions, regional agencies, and developers are all included in the design and implementation of a regional method; therefore, the costs are distributed over the entire group. Furthermore, studies, conducted by Prince William and others, have shown that many on-site BMPs are not as effective as regional measures in controlling pollution discharge. Studies have also revealed that maintenance costs are much higher over the long term for on-site BMPs and are more prone to structural failure.

*6. Adoption of the Chesapeake Bay Preservation Act regulations by jurisdictions outside the mandated region provides a baseline of watershed protection and can improve multijurisdictional efforts.*

Albemarle and Culpeper counties are the only jurisdictions outside the mandated region to adopt the CBPA. Adoption of the CBPA by Albemarle has provided a basic policy framework on which to base other regional and local strategies and has resulted in the development of coordinated water related policies and management strategies.

*7. When planning and implementing management and monitoring strategies, funding is often a limiting factor.*

Do not include ideas or strategies that cannot be supported financially. Stream restoration efforts by the EPA and other state agencies are effective means of stabilizing stream banks and improving water quality. These are rather costly measures; however, and jurisdictions with limited funding should consider alternative measures. Stream buffers are less costly yet effective measures to stabilize stream banks. Collaborative efforts with the NRCS to provide technical assistance for farmers and other landowners has also proven effective to be an effective and inexpensive method to reduce nonpoint source pollution. Inexpensive land use measures implemented by landowners at a stream or river may mitigate water quality impacts.

More cost effective monitoring strategies are also being developed which enhance short term monitoring and permit more long term monitoring programs. These programs permits agencies to conduct special studies when funding is available, while consistently maintaining the long term monitoring or axle. CBLAD is conducting a monitoring project at Polecat Creek and plans to demonstrate the benefits and cost effectiveness of this type of project.

8. State Scenic River designation may serve as a regional focal point creating interest and awareness about the watershed and water quality. Subsequently, this designation may indirectly provide protection from nonpoint and point source pollution.

A State Scenic River, such as the Rappahannock, may be regionally significant by creating interest in the waterbody and subsequently contributes to water quality protection strategies aimed at mitigating nonpoint source pollution from agricultural and forestry activities. A State Scenic River designation does not provide any legal obligations or restrictions on landowners or government jurisdictions, nor does it provide any legal protection for the water quality or the watershed. However, the designation does draw attention to the river and may create increased interest and awareness among landowners and local governments. The designation may provide a focal point for regional interests and facilitate a regional institutional framework.

9. Providing technical assistance and environmental education to landowners can enhance public awareness and interest in watershed protection.

A number of government agencies and non-governmental organizations have provided educational and technical assistance to landowners to heighten public awareness and encourage local interest in resource protection. For example, the Virginia Water Resources Research Center developed educational programs for the residents of the Copper Creek and Moccasin Creek watersheds. The Center guidebooks to assist local governments and landowners in creating appropriate agricultural measures to mitigate nonpoint source pollution. By developing this program, attention was drawn to the area, thereby, increasing the knowledge and interest of the local residents about the watersheds and water quality.

## ***Monitoring***

1. *Monitoring projects can assess water quality changes over time, and analyze and evaluate the effectiveness of land use management strategies.*

Constant monitoring of specific techniques, local water quality, and the watershed management plan may improve the effectiveness of the comprehensive program. Identification and evaluation of changes and trends in water quality facilitates the assessment of the watershed management program.

2. *Non-governmental organizations and citizen volunteers may perform traditional agency tasks such as data collection and educational programming, saving public funds and build community support for watershed management.*

These organizations such as the Alliance for the Chesapeake Bay, FOR, and a number of others collect and make available a large amount of water quality data. Very few governmental agencies, however, have made use of this information. Funding is often a limiting factor for local governments, many of which cannot develop or implement water quality monitoring programs. These organizations have a regional perspective, which is not limited by political boundaries. Developing a partnership with regional associations may provide useful water quality and land use data. Furthermore, because of budgetary concerns, these partnerships may become increasingly necessary.

3. *The development of a regional GIS can be useful in evaluating BMPs and water quality protection.*

Several watersheds throughout Virginia are utilizing a GIS in water quality monitoring and various modeling programs. The GIS can be used to model water quality trends as well as land use scenarios. For example, Prince William County is developing a GIS to monitor and evaluate water quality and land use changes in three watersheds. The GIS is being used to compare the impacts from different levels of development. Subsequently, the County will develop a model to identify and assess potential land use scenarios, which will assist in the development and implementation of land use plans.

### *Overview of Institutional Characteristics*

The previous discussion identified the institutional characteristics and program components and provided one or two examples on its design and implementation. However, all of the programs have developed and implemented a combination of these components. Table 7.1 identifies and assesses each of the programs according to the four categories and their relative use and effectiveness.

As can be seen in the matrix, the Occoquan and Albemarle-Charlottesville watersheds have developed a strong institutional framework defined by regional plans, agencies, and consistent management strategies. In contrast, the Rappahannock region lacks a strong institutional framework, resulting in little or no direction for local implementation strategies. The other programs were included to illustrate their relative success and effectiveness in developing and implementing specific components and projects.

**Table 7.1: Overview of Program Components**

Institutional Framework		Occoq	Hamp Roads	Albem-Charl	Rappah	All Ches. Bay	VWRRRC	Polecat Creek	Dragon Run	Lake Barcroft	SML	Little River
1. Regional Agency	✓			✓								
2. Regional Authority				✓								
3. Tiered Approach	✓	✓		✓								
4. Regional Plan	✓			✓				✓				
5. MOA		✓							✓			
6. Joint Exercise				✓				✓				
7. Formal Agreement	✓			✓					✓			✓
8. Informal Agreement					✓							
9. Efforts in Region	✓		✓	✓		✓			✓			
10. Efforts in Locality	✓		✓	✓					✓			✓
11. WID										✓		
12. Watershed Association												✓
13. Sub-watershed	✓		✓	✓						✓		✓
14. Bilateral	✓		✓	✓					✓		✓	
15. Watershed Manager	✓		✓	✓								

✓ - Denotes high use of characteristic or component

✓ - Denotes moderate to low use of characteristic or component

**Stakeholder Involvement**

	Occoq	Hamp Roads	Albem-Charl	Rappah	All Ches Bay	VWRRRC	Polecat	Dragon Run	Lake Barcroft	SML	Little River
1. PDC	✓	✓	✓					✓			
2. Regional Agencies	✓	✓	✓	✓					✓		
3. Local Govern.	✓	✓	✓			✓	✓			✓	
4. State & Federal	✓	✓	✓			✓	✓			✓	
5. NGOs	✓	✓	✓	✓	✓				✓	✓	✓

**Implementation Strategies**

1. Diverse Strategies	✓	✓	✓	✓	✓							
2. Stream Buffers	✓	✓	✓	✓	✓	✓		✓			✓	
3. Overlay Districts	✓	✓	✓	✓				✓				
4. Density Controls	✓	✓	✓	✓					✓			
5. Regional BMPs	✓	✓	✓									
6. CBPA	✓	✓	✓	✓			✓	✓				
7. Funding Limited						✓	✓		✓		✓	
8. Scenic River				✓	✓							
9. Tech. Assistance	✓	✓	✓		✓	✓					✓	

**Monitoring**

1. Monitoring Projects	✓	✓	✓	✓	✓		✓		✓	✓		
2. Citizen Volunteers	✓	✓	✓	✓	✓				✓	✓		✓
3. Regional GIS	✓	✓								✓		

## **Representation of EPA Watershed Protection Approach**

These case studies suggest that the four features (problem identification, stakeholder involvement, integrated solutions, and measuring success) of the WPA are important, although other features exist which must be considered for effective implementation of watershed management. In addition, this paper has defined and clarified the methods in implementing the WPA. The four features have been modified to incorporate institutional frameworks and implementation concerns. The features may be more appropriately identified as Problem Identification, Institutional Framework and Planning, Stakeholder Involvement, Implementation Strategies, and Monitoring.

## **Lessons Learned for WPA and Other Watershed Management Programs**

Lessons identified in this chapter can provide localities and regional agencies with ideas and strategies for developing a multijurisdictional watershed management approach which is most suitable to meet their needs. All four of those sections, institutional framework and planning, stakeholder involvement, implementation strategies, and monitoring are common features of the EPA's Watershed Protection Approach and their inclusion may be advantageous to the program's success.

Problem identification is driven by stakeholder involvement. The problem is then prioritized by the stakeholders and eventually targeted for resolution by the key stakeholders. With the recognition of a problem, all stakeholders can participate in the development of the institutional framework. The framework should consist of a regional authority that is able to develop and mandate water related policies and plans. In addition, all stakeholders should contribute (e.g. technical, financial, personnel) to the regional agency to ensure representation and to maintain the regional focus.

With a regional framework in place, integrated solutions or management strategies may be developed. These strategies must be consistent with and foster the implementation of the regional policy. The strategies should be implemented at the local level to facilitate and maintain local involvement and to discourage a top-down approach. Finally, measuring success occurs at two levels. First, site specific monitoring must be

conducted to determine the effectiveness of local management strategies. This is conducted by localities and regional agencies and non-governmental organizations. Second, this monitoring in conjunction with other localities provides the basis for determining the success of the regional program in meeting the watershed management objectives.

Localities interested in creating a multijurisdictional watershed management program may implement components from each of the categories. Watershed programs should be developed with these components, with the understanding that limitations do exist. The development of a regional plan may provide a comprehensive framework, but may not always be plausible, as is the case in Hampton Roads. Involvement of stakeholders early in the process is necessary, although identifying and incorporating the key participants is critical throughout the process. Water quality monitoring and plan review should be conducted throughout the planning process. However, this is expensive and may be an obstacle to the multijurisdictional approach. The various techniques described here and elsewhere must be analyzed and evaluated according to local conditions. These techniques while transferable must be thoroughly investigated before being implemented. No single approach fits all regional programs. Therefore, the approach taken must be adapted based on needs and the existing situation in the region.

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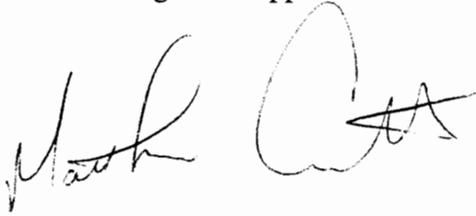
## **IX. Appendix A: Listing of All Case Study Candidates**

1. Occoquan Watershed
  2. Stream Valley Stewards: A Watershed Initiative Project Plan
3. Hampton Roads Region
  4. Nonpoint Source Pollution, Be Part of the Solution: A Guide for Hampton Roads Citizens
  5. Multi-objective Watershed Management Planning in Norfolk
6. Albemarle-Charlottesville
7. Chesapeake Bay
8. Copper Creek/Moccasin Creek
9. Smith Mountain Lake
10. Polecat Creek Watershed
11. Dragon Run Watershed
12. Targeting and Prioritizing Watersheds
  13. Little River Watershed
  14. Lake Barcroft Watershed
15. Roanoke River Watershed
16. Middle James River Watershed
17. Greens Creek Watershed
18. Blackwater River Watershed
19. The Clean Lakes Program in Virginia
20. Reston's Lakes Subwatersheds
21. A Water Quality Study of Lake Matoaka
22. A Blueprint for the Restoration of the Anacostia Watershed
23. Wetlands and Impaired Lakes Mitigation of NPS Impaired Lakes
24. Planning Considerations for Pond Management Using Storm Water
25. An Effective Mechanism for Municipal NPDES Compliance

26. Watershed Management: A Lasting Real World Solution to Lake and Water Quality Problems
27. Comparative Analysis of Watershed/Ecosystem Management
28. A Farm-Scale Water Quality Planning System for Evaluating Best Management Practices
29. Grassy Swales to Control Water Quality Runoff (Lake Barcroft WID)
30. Temporal and Spatial Variations in Chesapeake Bay Water Quality
31. Watershed Management and Team Building
32. The Binomial Assessment of Low Frequency Water Quality Data

## **X. Vita**

Matthew Criblez was born in Ohio, on August 13, 1965. He attended Ohio State University, Columbus, Ohio in the Fall of 1984 and obtained a B.S. in Park and Recreation Administration and Planning in December of 1987. After working as a park manager and ranger for two years, he was selected by Peace Corps to serve as a wildlife biologist in the Burundian National Parks, and subsequently, as a research officer for the Malawian National Parks. After working for the US Fish and Wildlife Service, he attended Virginia Polytechnic Institute and State University, Blacksburg, Virginia in the Urban Affairs and Planning Department in the Fall of 1994. His graduate study at Virginia Tech has included environmental planning with an emphasis on assessing watershed management approaches and strategies.

A handwritten signature in black ink, appearing to read "Mark Criblez". The signature is written in a cursive style with a large, looped initial "M" and a stylized "C".