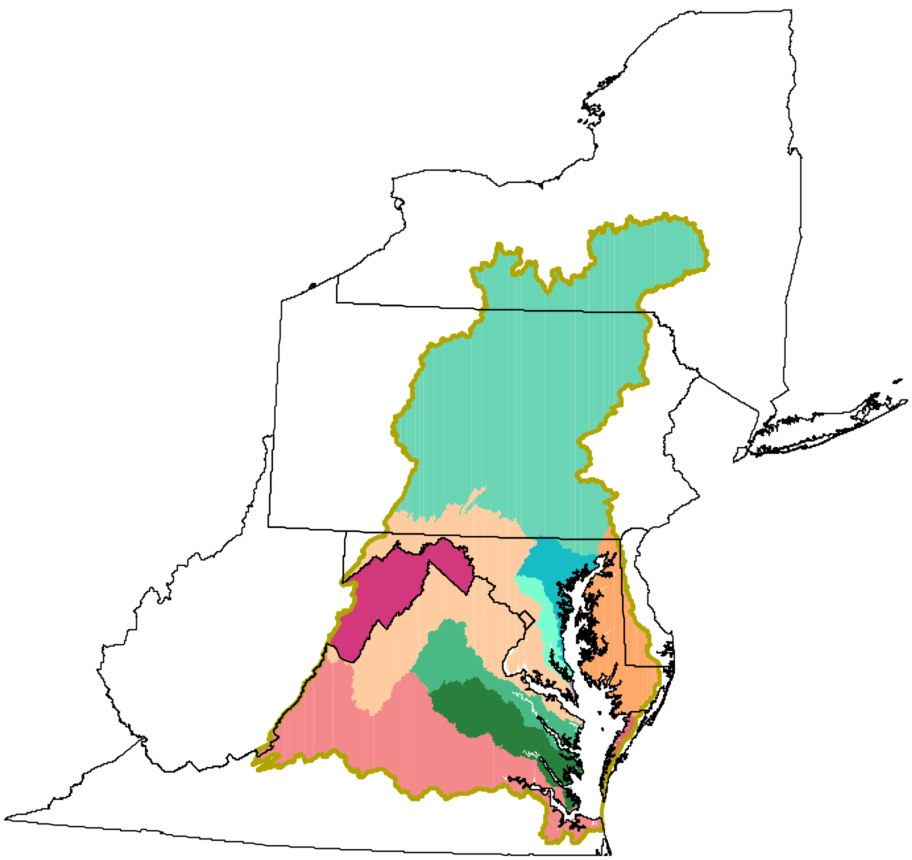
West Virginia's Potomac Tributary Strategy

A product of the
West Virginia Tributary Strategy Stakeholders Working Group

In cooperation with the
WV Department of Environmental Protection
WV Conservation Agency
WV Department of Agriculture



Submitted to the Chesapeake Bay Program

November 7, 2005

We would especially like to thank Neil Gillies, Cacapon Institute, and Michael Schwartz, The Conservation Fund's Freshwater Institute, for their contributions to the development of the West Virginia Potomac Tributary Strategy.

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WV Potomac Tributary Strategy: EXECUTIVE SUMMARY

The Chesapeake Bay is a national and local treasure, and an important source of livelihood, recreation and cultural heritage for the region. However, after receiving pollution from the surrounding landscape for many years, the Bay is in trouble. The states in the Chesapeake Bay watershed - Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia - the District of Columbia, and the U.S. Environmental Protection Agency have come together to find solutions to the Bay's problems. They have determined that the key to restoring the Bay's health entails reducing the flow of nutrients (nitrogen and phosphorus) and sediment flowing from the Bay States into the Bay, and have set maximum amounts for nitrogen, phosphorus and sediment, known as Cap Load Allocations (CLAs), for each of the jurisdictions.

Bay Program Partners have agreed to develop and carry out cooperative Tributary Strategies to reduce current pollutant loads to the CLA levels by the year 2010, an approach that allows innovation and flexibility. If this effort is not successful, the U.S. Environmental Protection Agency will begin developing a Total Maximum Daily Load (TMDL) for the Chesapeake Bay, a process that will place significant additional restrictions on pollution sources in all the Bay states, including headwaters states like West Virginia. A TMDL develops a pollution budget for a watershed that allocates the amount each pollutant source is allowed to release while still attaining water quality standards.

Load reductions of 33% for nitrogen, 35% for phosphorus, and 6% for sediment will be required of West Virginia between 2002 and 2010. The development of a West Virginia Potomac Tributary Strategy provided the framework for a comprehensive planning process to equitably reduce these nutrient and sediment loads. In order to engage the community in this process, the West Virginia Department of Environmental Protection, West Virginia Conservation Agency, and West Virginia Department of Agriculture formed the West Virginia Potomac Tributary Strategy Stakeholder Group. This document presents a strategy that seeks to reduce nutrient and sediment loads while minimizing economic and social burdens.

Key Elements of the West Virginia Potomac Tributary Strategy

Chapters 2, 3 and 4 provide background information on West Virginia, water quality concepts and West Virginia monitoring programs, and on sources of nutrients and sediment in the Chesapeake Bay watershed.

The Chesapeake Bay Program uses mathematical models to simulate changes in the Bay ecosystem due to changes in population, land use, or pollution management. Chapter 5 describes the model of particular importance to the West Virginia Potomac Tributary Strategy – the Chesapeake Bay Watershed Model (CBWM). This model estimates that each of the Bay jurisdictions faces different challenges in reducing its nutrient and sediment loads—agriculture was identified as contributing the largest nitrogen (48%), phosphorus (60%), and sediment (70%) loads in West Virginia. The CBWM estimates that, between 1985 and 2002, West Virginia nitrogen loads dropped 5%, phosphorus increased about 1%, and sediment decreased 17%. During the same period, the agricultural sector reduced nitrogen (14%) and phosphorus (6%) loads due to farmers' aggressive implementation of agricultural Best Management Practices. Use of modeled load estimates was very controversial to some WV stakeholders, and a number of them reject the use of these estimates in the West Virginia Potomac Tributary Strategy process. The

West Virginia Department of Agriculture is now collecting WV Potomac data for the Chesapeake Bay Program's nontidal water-quality network, data that will be used to improve and calibrate Chesapeake Bay Program watershed models.

Chapter 6 "Implementation Strategies"

The West Virginia Potomac Tributary Strategy stakeholder group established working groups to develop Implementation Strategies for the point source, urban and mixed open, agriculture, and forestry sectors. Implicit in each sector's Strategy and the overall Strategy for West Virginia, is that the activities required to meet the Cap Loads will not occur if funding is not secured.

The ***Urban and Mixed Open Strategy*** covers all urban, residential, and rural areas that are not managed agricultural or forested lands. The key features of the urban strategy are stormwater management, management of septic systems, reduction of nutrient inputs to land and water, preservation and restoration of natural vegetation, education, and technical assistance.

The ***Point Source Strategy*** includes recommendations to begin the process of characterizing the nutrient loadings from point sources, applying annual loading limits to both domestic wastewater and industrial point sources for nitrogen and phosphorus, seeking funding to help municipalities and public service districts (PSDs) absorb the costs of additional treatment, and considering participating in in-state and/or cross-border trading scenarios.

The ***Agricultural Strategy*** asks the West Virginia agricultural community to continue implementation of a variety of best management practices (BMP's) that reduce nutrients and sediment. West Virginia will continue to encourage and support the installation of BMP's, account for previously installed BMP's, promote increased educational opportunities for development and implementation of agriculture nutrient management plans, explore alternative uses of poultry litter, and research new and innovative BMP's.

The ***Forestry Strategy*** recognizes that proper management and use of forested lands will play an essential role in protecting West Virginia waters and the Chesapeake Bay. Logging operations are currently required by law to implement best management practices that protect water quality. In addition, the WV Division of Forestry is mandated by law to enforce State Code that relates to wildfires. The Forestry Strategy envisions hiring additional staff to better enforce existing laws to prevent excess erosion from logging, wildfires and the practices of private landowners.

Some West Virginia stakeholders have expressed concerns over the potential for nutrient and sediment loads generated by overabundant wildlife populations. The WV Department of Natural Resources developed a ***Wildlife Strategy*** that will increase control of white-tailed deer and Canada goose populations by promoting hunting, facilitating harvest through increased access to private lands, adjusting harvest objectives (for white-tailed deer), increasing utilization of available Canada goose nuisance damage control program, and creating/promoting forested riparian buffers that reduce nesting habitat for geese.

The actions that will be required to achieve the Cap Load Allocations for the Chesapeake Bay will have both financial and operational impacts on key sectors of the WV Potomac community – chiefly the political jurisdictions, the urban/suburban homeowner, and agriculture. **The estimated overall cost for West Virginia to achieve the Cap Load Allocations by 2010 is $873,546,759.**

1. INTRODUCTION AND PURPOSE

The Chesapeake Bay is a national and local treasure, and an important source of livelihood, recreation and cultural heritage for the region. However, after receiving pollution from the surrounding watershed for many years, the Bay is in trouble – and the states in the Chesapeake Bay watershed - Delaware, Maryland, New York, Pennsylvania, Virginia, and West Virginia - the District of Columbia, and the U.S. Environmental Protection Agency have come together to find solutions. Specifically, they have determined that substantially reducing the flow of nutrients (nitrogen and phosphorus) and sediment to the Bay from the Bay States will restore the Bay's health.

> **What it means: Watershed**
> A **Watershed** is the area of land that drains to a river or other body of water. West Virginia's portion of the Chesapeake Bay watershed is those lands that drain to the Potomac River and its tributaries, as well as a small area that drains to the James River. The James River portion is not included in this strategy.

Maximum amounts for nitrogen, phosphorus and sediment, known as Cap Load Allocations (CLAs), have been set for each of the jurisdictions. Pollutant loads from 2002 must be reduced to these levels by the year 2010. Otherwise, the EPA will begin a process that will place significant additional restrictions on pollution sources in Bay States, including headwaters states like West Virginia. This document presents a strategy to achieve the reductions required of the state of West Virginia by the year 2010.

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2. BACKGROUND

> **CHAPTER 2 -** *at a glance...*
>
> - **West Virginia has agreed to develop goals and objectives to reduce nutrient and sediment loads.**
> - **Reductions of 33% for nitrogen, 35% for phosphorus, and 6% for sediment are needed between 2002 and 2010.**
> - **West Virginia has been actively involved in pollution reduction programs, including several major agricultural programs.**
> - **The West Virginia Potomac Tributary Strategy Stakeholders Group was convened to develop a Potomac tributary strategy to meet the required cap load allocations.**
> - **Much of the Potomac region is growing rapidly due to close proximity of the Washington Baltimore Metropolitan area.**
> - **Manufacturing, retail trade and agriculture play important roles in the region's economy.**

The Chesapeake Bay and the Bay Agreement

The Chesapeake Bay is North America's largest and most biologically diverse estuary and, for more than 300 years, has sustained the region's economy and defined its traditions and culture. In 1983 and 1987, the states of Virginia, Maryland, Pennsylvania, the District of Columbia, the Chesapeake Bay Commission and the U.S. Environmental Protection Agency, representing the federal government, agreed to establish the Chesapeake Bay Program (CBP) partnership to protect and restore the Chesapeake Bay's extraordinarily productive ecosystem. (For more information on the Bay and the Bay Program, visit www.chesapeakebay.net.)

West Virginia Governor Bob Wise officially signed the **Chesapeake Bay Program Water Quality Initiative** Memorandum of Understanding on June 18, 2002, making West Virginia, along with New York and Delaware, a Headwaters Partner in the Chesapeake Bay Program. By signing the agreement, West Virginia demonstrated its intent to significantly improve water quality by establishing and implementing strategies to meet goals and objectives to reduce nutrient and sediment loads. With the agreement, the State also gained a seat at the Chesapeake Executive Council and a voice in deciding how best to achieve the Program's goals.

To correct this problem in the Chesapeake Bay, nitrogen, phosphorus, and sediment loading allocations for each state were evaluated, negotiated, and finally agreed upon by representatives from each of the Chesapeake Bay Watershed states participating in a Water Quality Steering Committee. The Chesapeake Executive Council Directive No.03-02 formalized the resulting allocations. The tool used to create these loading allocations is called the Chesapeake Bay Watershed Model (CBWM). Table 1 shows output from the model estimating loads in 1985 – the "baseline" year, 2002 loads, and the 2010 Cap Load Allocations (CLA) for nitrogen, phosphorus, and sediment. A more detailed description of the CBWM, West Virginia's nutrient and sediment loads, and a comparison with other Chesapeake Bay states are found in Chapter 5.

Table 1. Load estimates and Cap Load Allocations for the Potomac Drainage in West Virginia, produced by the Chesapeake Bay Watershed Model. Source: CBP.

Year	Nitrogen [1]	Phosphorus [1]	Land-Based Sediment [2]
1985	7.54	0.57	0.41
2002	7.15	0.57	0.34
2010 Cap Load Allocations	4.75 (33%[3])	0.37 (35%[3])	0.320 (6.2%[3])

[1] million pounds/year [2] million tons/year [3] percent reductions from 2002 numbers

The Bay Program has determined that the Potomac River is one of many rivers contributing excess nutrient and sediment loads to the Chesapeake Bay. Excess nutrients cause rapid growth of phytoplankton – microscopic plants in the water column – creating population "blooms." These blooms may become so dense that they, along with fine sediment, reduce the amount of sunlight available to the submerged aquatic vegetation (SAV), which are essential to the health of the Bay's ecosystem. Without sufficient light, these SAV cannot photosynthesize and produce the food they need to survive. Excess nutrients can also cause the explosive growth of algae, which may grow on the surface of SAV and further block essential light. Unconsumed algae and phytoplankton will eventually die and be decomposed by bacteria in a process that depletes bottom waters of oxygen. When oxygen is depleted, fish and other species may die unless they move to other areas with suitable habitat and sufficient oxygen. The problem of excess nutrients causing oxygen depletion, even "dead zones," in coastal waters is a worldwide issue, threatening coastal communities and important fisheries.

No one underestimates the technical, economic, and societal challenges associated with achieving these substantial reductions (see Chapters 6 and 7). West Virginia's goal is to reduce nutrient and sediment loads while minimizing economic and social burdens. Reductions will be achieved through upgrades to point sources such as municipal and industrial wastewater treatment facilities, and through implementation of best management practices (BMP's) for non point pollution sources, including agricultural lands, forest lands, and developed lands.

West Virginia's Commitment to Improving Water Quality

West Virginia's commitment to reducing pollution in our waters did not begin when Gov. Wise signed the Chesapeake Bay Program

Water Quality Initiative. Like all of the Bay States, West Virginia has been actively involved in pollution reduction programs for over twenty years. Many of these programs have been successfully implemented under federal and state programs, and documented by the USDA Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA), and other state and local agencies. Logging operations in the State are required by law to implement BMP's to protect water quality, and the WV Division of Forestry works to prevent the forest fires that leave forest lands vulnerable to erosion. Additional urban BMP's that impact nutrient and sediment loss are now being implemented by municipalities and the construction industry, and regulated by the State. The Chesapeake Bay Program (CBP) is crediting estimated reductions in sediment and nutrient loads that have occurred through implementation of these practices.

Programs implemented by the agricultural community have all been voluntary, clear evidence of a substantial grassroots movement among area farmers to reduce the flow of agricultural pollutants into West Virginia waterways, including the nutrients and sediment that then flow into the Bay. In the past fifteen years, two major programs have dealt specifically with the agricultural nutrients issue throughout the Potomac headwaters region in West Virginia. In the early 1990's, a nutrient management initiative designed to reduce the nutrient runoff from animal feeding operations began, involving local farmers, state and federal agencies and poultry integrators. As a result of this program, all poultry growers are required by the integrators to implement and maintain nutrient management plans for the manure and litter produced on their farms. All plans are written and/or reviewed by certified WV Nutrient Management planners. The West Virginia Department of Agriculture (WVDA) maintains a certified nutrient management laboratory in Moorefield, West Virginia that provides farmers local access to nutrient testing of manures and litter in order to stay in compliance with their nutrient management plans.

What it means: Poultry Integrator
Poultry Integrators are the companies that produce and process much of the poultry in America. These companies contract with farmers to raise turkeys and chickens for them. The integrators provide the birds and the feed, the farmers provide the facilities and the labor.

The Potomac Headwaters Land Treatment Program was initiated in the mid-1990's to address water quality concerns triggered by rapid expansion of the poultry industry. This project focused on accelerated development of nutrient management plans and installation of agriculture waste storage structures, mortality composters and livestock confinement areas. Eighty-five percent of poultry growers in the five county area of the Potomac Valley Conservation District are currently participating. The landowner is responsible for 40% of the costs in this program. Thirteen million dollars were allocated towards the installation of BMP's in this program with landowners contributing $8.67 million. The WV Agriculture Water Quality Loan Program (WVAWQLP – SRF) allows the landowner to borrow their forty percent of the cost through low interest loans (2-3%) thus reducing the upfront financial burden on participants.

Private support organizations like the West Virginia Poultry Association, the West Virginia Farm Bureau, and a number of active grass roots organizations (such as the South Branch Watershed Association of Hampshire County and the North Fork Watershed Association) have played an essential role in gaining financial and community support for programs to protect water quality.

Watershed Associations have also played an important role in bringing public attention and action to water quality improvement within the Potomac Watershed. Volunteers have organized eleven associations who have sponsored outreach efforts, planned and implemented water quality improvement projects and served as catalysts for healthy community development. The watershed associations in the Potomac Watershed are: South Branch Watershed Association of Hampshire County; North Fork Watershed Association; Friends of

Spring Run's Wild Trout; Bakers Run Conservation Society; Cacapon and Lost Rivers Trust Inc.; Friends of the Cacapon River; Sleepy Creek Watershed Association; Blue Heron Environmental Network Inc.; Tuscarora Creek Watershed Association; Opequon Watershed Inc.; and Jefferson County Watersheds Coalition.

West Virginia and the Chesapeake Bay Water Quality Initiative

To initiate the Chesapeake Bay and West Virginia's water quality improvement plans, the West Virginia Department of Environmental Protection, West Virginia Conservation Agency, and West Virginia Department of Agriculture sponsored the first West Virginia Potomac Tributary Strategy (WVPTS) Stakeholders' meetings in Martinsburg and Moorefield on April 15 and 16, 2003. The purpose of these initial meetings was to establish stakeholder participation in the development of a Potomac tributary strategy to reduce nutrient and sediment loads and meet the CLA. Anyone with a "stake" in the outcome was invited to attend, and individuals representing counties, municipalities, industry, agriculture, developers, environmental organizations, and state and regional governments were recruited by the three agencies noted above. The stakeholders committed to monthly meetings to develop the tributary

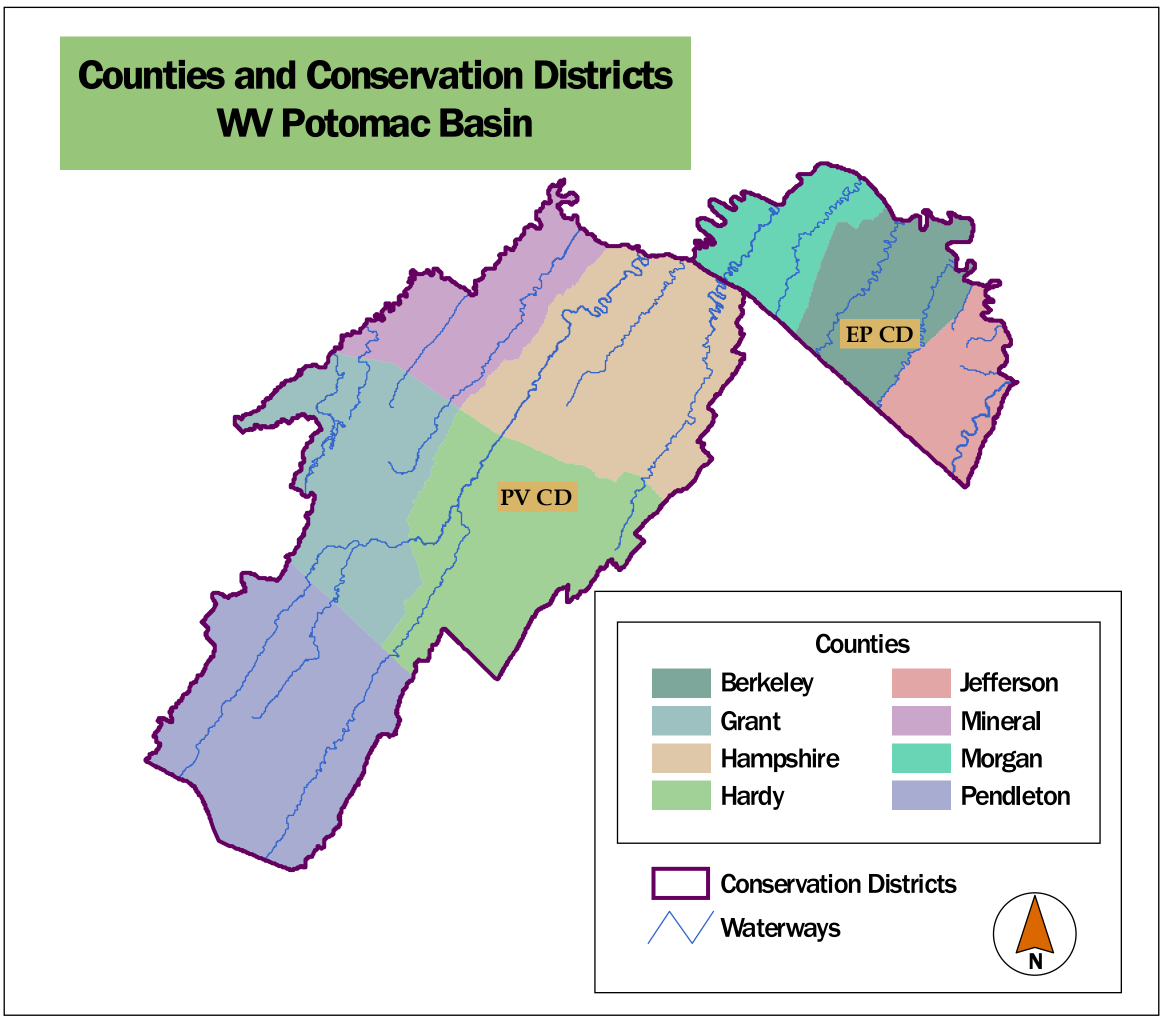

Figure 1. Counties and Conservation Districts in West Virginia's Potomac watershed.

strategies.

The Chesapeake Bay drainage area of West Virginia contains the counties of Berkeley, Grant, Hampshire, Hardy, Jefferson, Mineral, Morgan, Pendleton, Preston and Tucker. Preston and Tucker counties, together, were estimated to contribute less than half of one percent of West Virginia's potential nutrient and sediment load and were therefore not included in the WVPTS process.

Two working stakeholder groups were established from the eight Eastern Panhandle counties, taking into account each region's unique population issues and land-use measures needed to address local water quality problems. Berkeley, Jefferson, and Morgan counties are located in the Eastern Panhandle Conservation District (EPCD) and make up the eastern stakeholder group. With a land area of 763 square miles, this is the fastest growing region in the state and is rapidly being transformed into a bedroom community of the Washington-Baltimore Metropolitan Area.

What it Means: Conservation District

West Virginia's **Conservation Districts** are chartered, legal subdivisions of State government, and a universal unit of government in every state. West Virginia's fourteen Districts are each governed by a Board of Supervisors - local landowners elected from each county in the District. With the support and guidance of the WV Conservation Agency, the Districts develop and implement conservation programs based on set resource priorities; their job is to channel resources from all levels of government into action at the local level.

To the west, the five-county area of Hampshire, Hardy, Grant, Mineral, and Pendleton counties (land area of 2,722 square miles) is known as the Potomac Valley Conservation District (PVCD) and makes up the western stakeholder group. This region is dominated by agriculture, with large-scale poultry production and processing facilities, as well as a robust beef cattle market.

This document incorporates the efforts of the two stakeholder groups into a combined plan for West Virginia's Potomac watershed. However, it also reflects the fact that further work was needed from the state agencies to identify the type and amount of implementation practices necessary to meet the CLA.

West Virginia in the Chesapeake Bay Watershed

The problems facing the Chesapeake Bay may seem remote to the concerns of West Virginians, but the quality of the waters that flow out of our state play an important part in determining the health of the Bay. This section will provide a description of West Virginia's Potomac River watershed, including a physical description and an overview of land use, population and the economy.

The Potomac River Watershed

The Potomac River forms the Maryland-West Virginia boundary between Harpers Ferry, Jefferson County and Green Spring, Hampshire County, WV. Upriver of Green Spring, the Potomac splits into two major tributaries, the North and South Branches. The North Branch continues as the boundary and its watershed is divided by the two states. The South Branch is located entirely within WV.

Hydrogeomorphic Regions/ Physiographic Provinces

Hydrogeomorphic regions are based on generalized geology and physiography. They are important in the development of a West Virginia Potomac Tributary Strategy because they are used to model groundwater discharges and calculate best management practice (BMP) efficiencies. The unique soil, climate, and topographic characteristics of individual hydrogeomorphic regions result in differing efficiencies for certain BMP's. For example, in the instance of riparian forest buffers the efficiency of nitrogen removal on the Appalachian Plateau (Figure 2) is less than half of that of a buffer located in the Valley and Ridge Siliciclastic Region.

Geology

West Virginia's mountains, hills and valleys shape our climate, natural history, industries and way of life. Differences in topography, geology and land use within the state will also shape the strategies to be used in achieving the Cap Load Allocations. The 3,505 square mile Potomac watershed in West Virginia drains parts of two distinct physiographic provinces: the Appalachian Plateau and the Ridge and Valley. The Appalachian Plateau forms the watershed's extreme western edge. This province features narrow valleys, steep ridges, swift streams, low soil permeability, much coal (although none in the South Branch watershed), and horizontally bedded sedimentary rocks such as sandstone, shale, and limestone.

The Ridge and Valley Province, located east of the Appalachian Plateau, contains the majority of West Virginia's Potomac watershed. Parallel valleys are separated by long, steep ridges, which reinforce a classic trellised drainage pattern. The valleys, gentler slopes and rounded ridge tops of this province support agricultural pursuits. The rocks are arranged in cyclical sequences of sandstones, shales, dolomites and limestones. The eastern part of the Ridge and Valley Province, in Berkeley and Jefferson counties, is underlain primarily by limestones, dolomites and shales. The drainage pattern is primarily karst type,

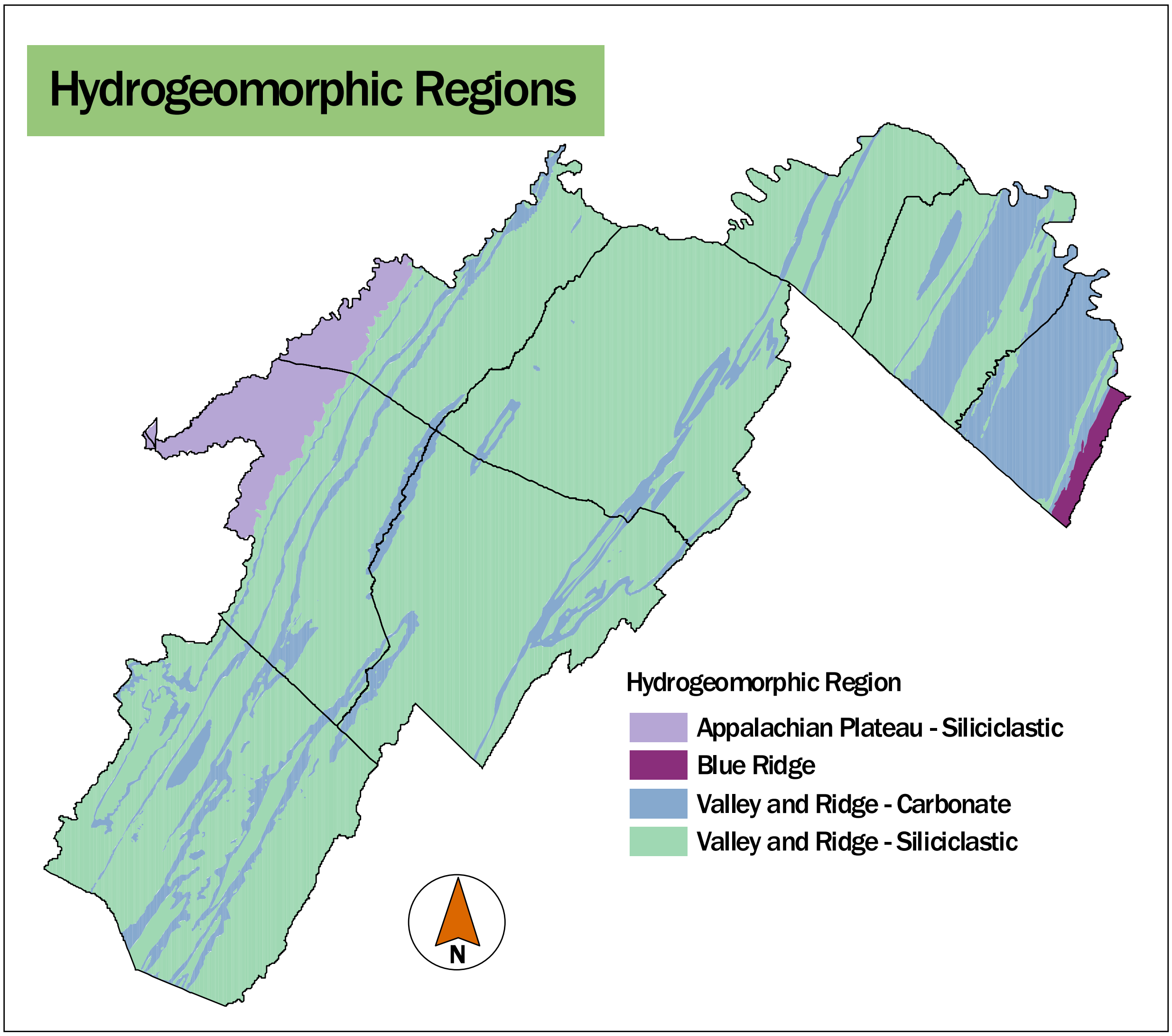

Figure 2. Hydrogeomorphic regions in West Virginia's Potomac watershed.

with some trellised drainage in the vicinity of the thickest shales.

Regions

The **Eastern Panhandle Conservation District** region contains the lower reaches of the Cacapon River, the Direct Drains (including Opequon, Sleepy and Back creeks), and the Shenandoah River (Figure 3). Approximately 48% forested, 28% is agriculture, 7% is urban and 17% is mixed open (see Appendix 1 for land use map.) The EPCD is predominantly characterized by broad, level to undulating, fertile valleys that are extensively farmed. Sinkholes, underground streams, and other karst features have developed on the underlying limestone/dolomite, and as a result, the drainage density (or number of surface streams) is low. The karst geology in much of this watershed lends itself to rapid distribution of pollutants from both urban and agricultural sources into groundwater and subsequently into surface streams fed by springs and seeps. Development has sharply increased due to the close proximity to the Washington-Baltimore Metropolitan Area.

The **Potomac Valley Conservation District** region is the home of three sizeable watersheds: the South Branch of the Potomac, the North Branch of the Potomac and the Cacapon

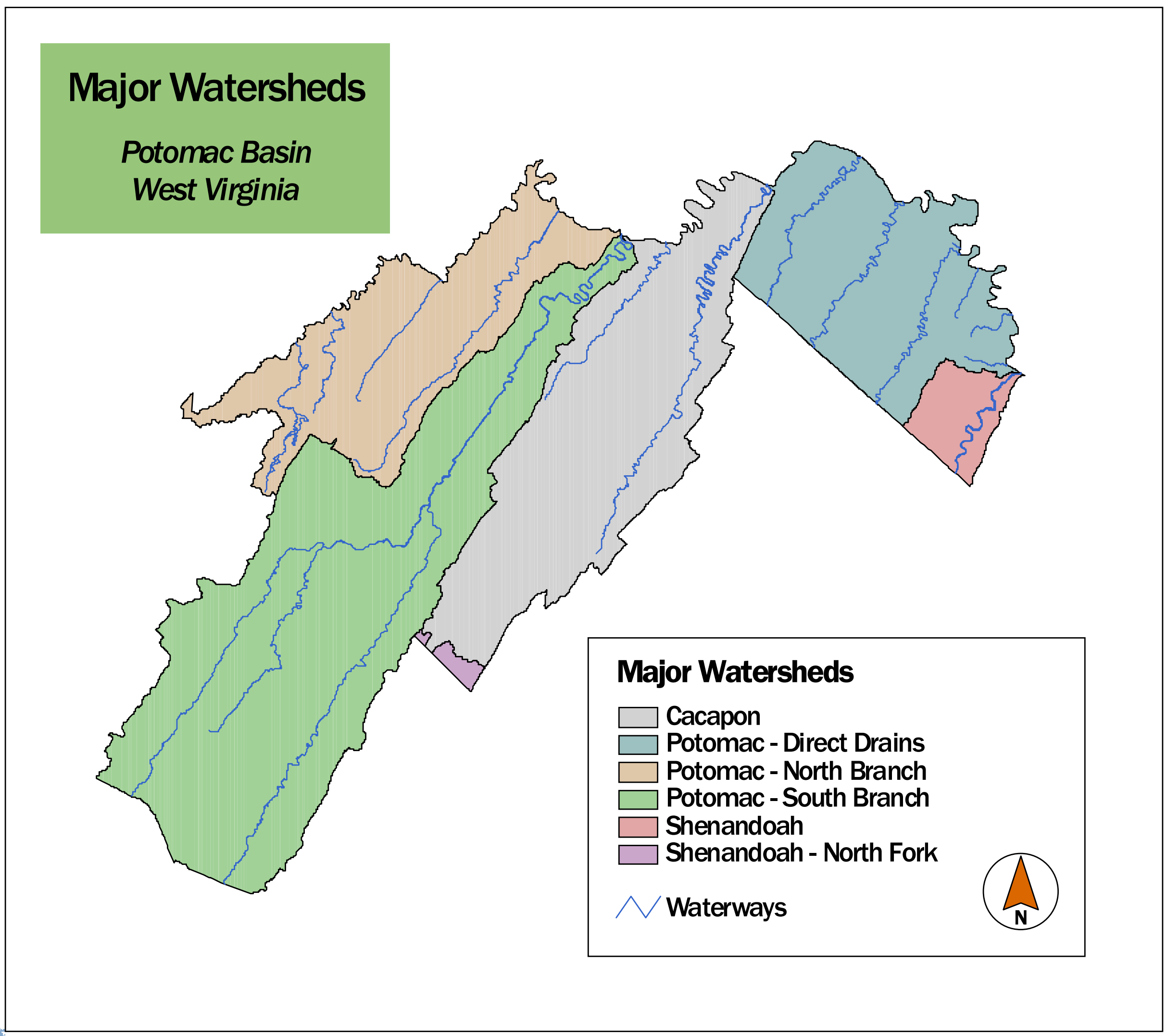

Figure 3. Major watersheds in West Virginia's Potomac watershed.

Table 2. U.S. Census Bureau - 2000 Population

County	Population	% Growth 1990-2000
Berkeley	75,905	28.1
Jefferson	42,190	17.4
Morgan	14,943	23.2
Hampshire	20,203	22.5
Hardy	12,669	15.4
Grant	11,299	8.4
Mineral	27,078	1.4
Pendleton	8,196	1.8
Total	212,483	11.3

(Figure 3). The PVCD is approximately 68% forested, with mixed (coniferous and deciduous) canopy trees (see Appendix 1 for land use map.) Twenty-four percent of the land is used for agriculture, and the valleys, gentler slopes and rounded ridge tops support many agricultural pursuits, primarily pasture and hay production, but also some orchard and row-crop production. One of West Virginia's most agricultural areas, the PVCD region includes cattle and poultry production - particularly in the South Branch and the headwaters of the Cacapon. Roughly 2% of the watershed is urban in nature, with the remaining 6% in mixed open. Development has sharply increased due to the close proximity of the Washington-Baltimore Metropolitan Area.

Population

County populations range from 8,196 residents in Pendleton County to 75,905 residents in Berkeley County (Table 2). The population of the whole region showed the highest growth in the State between 1990 and 2000, largely due to the close proximity to the Washington-Baltimore Metropolitan Area. The region saw an increase of almost 10,000 people (an 11.3% increase) during the decade, with Berkeley, Morgan and Hampshire counties growing the most quickly. Housing increases of 20.2 % were almost double the population growth rate. While projections differ, it is expected that Berkeley, Jefferson, Morgan, Hampshire and Hardy counties will continue to grow rapidly, while populations in Grant, Mineral and Pendleton counties appear stable.

Economy

Eastern Panhandle Conservation District. Rapid population growth is quickly transforming the Eastern Panhandle Conservation District into a bedroom community of the Washington-Baltimore Metropolitan Area. On average, 62.3% of the sixteen and older population is employed, with an average per capita income of $18,844. Eleven percent of the population lives below the poverty level. [1] The workforce is mostly in the non-farm private sector (79%), with 19% serving in local, state or federal government enterprises, and 3% working on farms. [2]

The 1997 Economic Census indicates that manufacturing and retail trade drive the economy in this region with income of $914,535,000 and $804,113,000, respectively. Manufacturing in this area includes commercial industries such as printers, plastics and rubber products, and machinery manufacturing. Other important sectors include the accommodation/foodservice industry ($117,016,000), health care ($77,752,000), professional/scientific services ($72,825,000), administration/waste management ($64,080,000) and farm products ($38,891,000). [3]

Recreation and tourism are important to the economy of the Eastern Panhandle with Jefferson and Berkeley Counties leading the tourism trade for the region. The tourism industry employs about 5,000 people within the three-county area. Harpers Ferry National Historical Park is the second largest tourist attraction in the State.

<u>Agriculture</u>

The EPCD has a large apple and peach industry, and many farms are dependent upon crop sales. In 1997, the agriculture census crop sales accounted for 64% of the market value in Berkeley County, 43% of the market value in Jefferson County and 63% of the market value in Morgan County. Because of the close proximity to the Washington-Baltimore Metropolitan Area, many of these farms are now being developed. The 1997 agriculture census showed a slight decrease in farm acreage in Jefferson and Berkley Counties and a slight increase in farm acreage in Morgan County from 1987-1997. [4]

Potomac Valley Conservation District. While parts of the Potomac Valley Conservation District are developing as rapidly as the EPCD, much of this region remains agricultural in character. On average, 59.6% of the sixteen and older population is employed, with an average per capita income of $15,519. Fourteen percent of the population lives below the poverty level. [5] The workforce is mostly in the non-farm private sector (75%), with 16% serving in local, state or federal government enterprises, and 9% working on farms. [6] A substantial percentage of workers categorized as “non-farm,” particularly in Hardy and Grant counties, work in agriculture related industries such as poultry and food processing facilities.

The 1997 Economic Census indicates manufacturing and retail trade drive the economy in this region with income of $725,347,000 and $346,055,000, respectively. Manufacturing in this area includes the poultry and food processing industries noted above, wood products, leather goods, and the highly specialized aerospace and missile development facilities in Mineral County. Other important sectors include farm products (excluding poultry - $235,608,000) health care ($58,618,000), and the accommodation/foodservice industry ($38,879,000). [7]

Recreation and tourism are important contributors to the economy. Forests dominate land use in the area, with approximately 70% covered in forest; this region includes the George Washington and Monongahela National Forests. The PVCD contains 59 public outdoor recreation sites with a total of 268,510 acres. [8]

Agriculture

The PVCD is West Virginia’s most significant agricultural area, accounting for over 52% of WV’s sales of agricultural products. [9] Pilgrims Pride, a local poultry integrator, is the fourth largest employer in the state of West Virginia and is the largest single employer in Hardy County. In the early 1990’s, the local poultry industry increased dramatically when WLR Foods (now Pilgrims Pride) expanded the processing plant in Hardy County. At that time, the poultry industry was primarily confined to Hardy, Grant and Pendleton Counties. A number of poultry farms are now found in Hampshire and Mineral counties as well. There are 870 poultry farms in the valley and the poultry and poultry products produced from these farms account for 58.3% of all animal agriculture products sold in the state each year. [10] The local poultry growers raise broilers, breeders and turkeys for five major integrators, Pilgrims Pride, Perdue Farms, Inc., Georges, Cargill Turkey, and the Virginia Poultry Growers Cooperative.

Livestock sales account for 99% of the market value of farm products not raised for the poultry integrators, while crop sales account for the remaining 1% of sales. Cattle production is the second largest agricultural industry in the area and many local farms raise both beef and poultry. These commodities depend on one another in maintaining the stability of the local economy. Many of the cattle are raised on pasture in the summer and hay and silage through the winter months. Much of the corn planted in this area is harvested as silage. Seventy percent of open agricultural land in the Potomac Valley Conservation District is pasture and hay land. The area also supports a significant orchard industry, primarily apples and peaches.

3. WATER QUALITY

CHAPTER 3 - *at a glance…*

- **Water Quality Primer discusses point and non point pollution sources, how pollution is measured, and the difference between local water quality problems and problems in downstream waters.**
- **Water quality studies in the Potomac area have mostly been concerned with local issues, rather than downstream issues related to the Chesapeake Bay Program.**
- **The West Virginia Department of Agriculture is now collecting WV Potomac data for the Chesapeake Bay Program's Non-Tidal Water Quality Network that will be used to improve and calibrate CBP watershed models.**

Water Quality Primer

This primer provides a brief discussion of key water quality terms and concepts to help the reader understand this report.

Sources of pollution. Pollution is usually described as coming from either a point source or a non point source. **Point source** (PS) pollution comes from an easily identifiable place - like a factory or a sewage treatment plant, and enters the environment at a clearly identifiable location – like a pipe or a smokestack. The flow of pollutants from point sources is regulated by the State and Federal governments, is fairly constant and predictable, and control measures can be applied at the source.

Non point sources (NPS). Because they are everywhere, non point sources of pollution are difficult to control and assess. They include streets, parking lots, lawns, farm-fields, barnyards, and construction sites. (Note that construction sites larger than one acre are regulated as point sources.) The flow of pollutants from non point sources is very unpredictable, and mostly occurs when rain and snowmelt wash the surface of the land.

Assessing pollution. There are two main ways to assess pollutants – concentration and load. **Concentration** is a measure of how much of some substance is found in a certain volume of water - often expressed as mill-grams per liter (mg/L) or parts per million (ppm). Water quality standards are principally designed to protect people and aquatic life from damage, and generally are based on harmful concentrations of a pollutant. For example, the nitrate (a form of nitrogen) standard for drinking water is 10 ppm because larger amounts than that have been linked to health concerns.

The **load** is the total amount of a substance that passes by some point in a certain amount of time - as in pounds per hour or tons per year. It is a calculation equal to the concentration times the total volume of water, and requires that an accurate measure of water volume be available. The majority of water quality standards are not based on load, but on concentration. However, and particularly in the evaluation of far field nutrient impacts, total load can be the most relevant way to determine the potential impacts of non point source pollution. While major NPS pollution events may occur rarely (usually due to precipitation), the total amount delivered during these events may greatly exceed the sum of the loads delivered at all other times. For example, non point sources of phosphorus usually "move" readily only with surface runoff. Because a few severe storms can create most of a watershed's annual runoff, over 90% of the annual phosphorus load can be delivered during these few events. [11] The Chesapeake Bay Program's Cap Load Allocations for nitrogen, phosphorus and sediment are the maximum load of these pollutants that the Bay can assimilate without harm, according to Chesapeake Bay Program models.

Another tool for "assessing" pollution is known as the **Total Maximum Daily Load**

(TMDL) process. This process is triggered when waters fail a State's water quality standards: i.e. when the waters are impaired. Under the Clean Water Act Section 303(d), states are required to develop lists of impaired waters. The law requires that these jurisdictions establish priority rankings for waters on the 303(d) lists and develop TMDLs for these waters. A TMDL determines the pollutant loads that a water body can assimilate without violating water quality standards, and then allocates those loads to point source and non point source categories based on the best available science. Once established and approved through regulatory action, TMDLs are implemented through both regulatory and non-regulatory programs. Or, more simply, a TMDL provides a pollution budget for a watershed that allocates the amount each pollutant source is allowed to release while still attaining water quality standards.

How do you measure the volume of water in a river?

In order to calculate pollutant loads you need to know the volume of water flowing in a river. To do this, you need to measure three things: width of wetted area, average depth from surface to river bottom, and the rate of flow (speed of the water) at a number of locations across the width of the stream. When you have these numbers, you multiply them together to obtain volume, usually expressed as cubic feet per second (cfs). This is a time consuming process and very difficult to do in large streams. The U.S. Geological Survey maintains flow stations at a number of sites in the Potomac watershed. (See the following website for more information: water.usgs.gov/cgi-bin/daily_flow?wv).

Since the Chesapeake Bay is on the 303(d) lists for both Maryland and Virginia, the standard regulatory approach would require a TMDL be carried out and a very specific implementation plan developed. However, the success of the Bay Program partnership in reducing pollution over the past two decades has led to an agreement where the usual TMDL process has been deferred. Partners in the Bay Program have agreed to develop and carry out a cooperative and voluntary approach to remove the Bay's water quality impairments by the year 2010. This approach allows innovation and flexibility as part of the implementation process and will involve significant local stakeholder involvement through the tributary strategy process. The West Virginia Potomac Tributary Strategy is a part of that process. The usual TMDL process will be triggered if the water quality goals are not achieved.

Where pollution impacts are felt. There are two ways to look at the impacts of pollution–locally and downstream. **Local impacts** are those that affect the people and environment in the watershed where pollutants are generated. For example, bacteria washed from the landscape into a river can raise the bacteria levels in the river in excess of the water quality standard, making the river potentially harmful for swimming. On the other hand, **downstream impacts** affect the people and environment downstream of where the pollutants are generated. The WV Potomac Tributary Strategy Stakeholder Group (WVPTS stakeholders) is charged with developing a strategy to reduce the loads of nutrient and sediment pollution that originate in West Virginia and contribute to the impairment of the Chesapeake Bay. If the stakeholder strategy fails to reduce these loads by the year 2010, the USEPA will begin the TMDL process and place significant additional restrictions on pollution sources in West Virginia.

Sampling Programs in West Virginia

A number of federal and state agencies and private organizations have conducted water quality studies in West Virginia's Potomac watershed. These studies have mostly been concerned with local issues for West Virginia waters, rather than the load and downstream transport questions of such importance to the CBP. This section provides a brief overview of the major sampling programs, beginning with the WV Department of Agriculture – which is now collecting the water quality data needed for the Bay Program. More detail and pertinent findings from each study are available in Appendix 2— Water Quality Monitoring Programs.

West Virginia Department of Agriculture

The West Virginia Department of Agriculture's (WVDA) Moorefield Laboratory began operation in 1993. Since 1998, the WVDA has conducted a comprehensive water quality monitoring program within the region. The purpose of this program has been to monitor seven streams placed on West Virginia's 303 (d) list of water bodies that are impaired due to fecal coliform bacteria (segments of the Lost River, South Branch of the Potomac, North Fork of the South Branch, South Fork of the South Branch, Mill Creek, Lunice Creek and Anderson Run). In addition to bacteria sampling, stream sites are tested for pH, conductivity, temperature, total phosphorus, ammonia and nitrate. Another component of this initiative is a DNA analysis program, run cooperatively by WVDA and Marshall University, to identify sources of fecal contamination in the Potomac River and Lost River watersheds.

As a separate initiative, in October 1999, the WVDA began collecting water samples on the main stem of the Potomac River. In 2004, this specific sampling initiative was discontinued to make way for the Chesapeake Bay Program's Non-Tidal Water Quality Network. This water quality monitoring network will enable all jurisdictions to portray accurately both trends and loads for nutrients and sediment from their respective streams. This sampling program will also be used to improve and calibrate CBP watershed models (see Chapter 5); watershed model runs are used to predict the effectiveness of management actions to reduce loads.

Monthly samples will be collected, as well as eight storm samples, at each site each year (each site is located at a USGS flow gage for more accurate data). This protocol will provide load data over a wide range of hydrologic conditions, which is needed because the CBP model uses average loadings, not direct measurements. Additional monitoring parameters such as ammonium, nitrate, phosphate, total suspended solids, suspended sediment and particle size were added for this program.

Nine candidate sites were chosen for this program including (see map in Appendix 2):

- Shenandoah River
- Opequon Creek
- South Branch of the Potomac
- Cacapon River
- Little Cacapon River
- Patterson Creek
- Back Creek

West Virginia Department of Environmental Protection

The State of West Virginia has adopted a comprehensive approach to managing the state's waters and their surrounding ecosystem, known as the Watershed Management Framework. The goal is to develop and implement management strategies through a cooperative long-range planning effort that includes government agencies, businesses, environmental groups, watershed associations, and citizens. One component of the Watershed Management Framework is the water quality monitoring performed by WVDEP's Watershed Assessment Section.

In 2000, WVDEP's Watershed Assessment Section (WAS) completed their first five-year cycle of watershed assessments. The cycle began in 1996 with the goal of monitoring each of the state's 32 major watersheds within a five-year period. Potomac watersheds included in this program are South Branch of Potomac, North Branch of Potomac, Cacapon/ Little Cacapon, Direct Drains, and the Shenandoah. This program collects a wide variety of biological, chemical, and habitat data of specific value to the Tributary Strategy process.

Another important component of DEP's monitoring efforts comes from the Total Maximum Daily Load (TMDL) Section. The TMDL Section, in partnership with the Watershed Assessment Section, conducts intensive studies within specific watersheds. TMDL sampling is performed monthly for a one-year period. Numerous sample locations and water quality parameters are selected to investigate known or suspected problems, such as fecal coliform bacteria, acid mine drainage, or excessive nutrients. Planned future TMDL development will occur in the North Branch and Potomac Direct Drains Watersheds (including Opequon and Sleepy Creeks) by 2008.

The National Pollution Discharge Elimination System (NPDES) permitting program provides water quality information associated with permitted discharges. The Compliance Monitoring group of WVDEP's Environmental Enforcement section conducts regular sampling inspections on regulated facilities. Site-specific chemical and/or biological studies may also be performed. Additionally, the facilities are required to monitor their outfalls and routinely submit effluent information to the agency.

WVDEP encourages local citizenry to become involved in monitoring and protecting the state's aquatic resources. The Stream Partners program provides seed grants to create community-based watershed protection organizations and to assist these groups in identifying the issues affecting their streams and developing improvement projects. The West Virginia Save Our Streams (WVSOS) is a volunteer monitoring program which teaches adults and children to monitor the biota and water quality of their streams and how to become guardians of their watersheds.

Other

The USDA-NRCS contracted with the **U.S. Geological Survey (USGS)** to conduct a surveillance level water quality study in 1994 and 1995 to assess the condition of the Potomac watershed's rivers in West Virginia. Nineteen sites in the South Branch drainage and four in the Lost River (headwaters of the Cacapon) drainage were sampled monthly for varying periods of time. [12] Their study "did not indicate high nutrient concentrations at any site." However, they noted significant algal growth at many sites during the summer and suggested this might be related to nutrient loading to the streams. Nitrate concentrations were positively correlated with numbers of feedlots and poultry houses. However, nitrogen concentrations were considerably lower than concentrations to the east of the study area in the Shenandoah River's Great Valley region, another agricultural region with integrated poultry agriculture.

Cacapon Institute (CI) is a non-profit corporation and WV certified laboratory that has conducted a number of water quality studies in area streams, starting with a comprehensive baseline study of the Cacapon River between 1989 and 1992.[13] CI is currently running a Cacapon River monitoring study at twelve sites located throughout the watershed.

Between March 1997 and July 2002, CI conducted studies in several watersheds (Lost River, North River, South Branch of the Potomac). They were designed to answer a number of questions, including: 1- are nutrients applied to the basin's agricultural soils entering the river; 2- do streams with different land use characteristics have different nutrient concentrations? Thirty-two tributary and mainstem sampling sites with different land use characteristics, ranging from heavily forested (>95%) to intensively farmed, were included. Sampling protocols included regularly scheduled dates and storm sampling. Chemical parameters included total and reactive phosphorus, nitrate nitrogen and turbidity (an indirect measure of sediment in the water).

These studies found that: phosphorus and turbidity were generally low at all sample sites, regardless of land use, except during active runoff events; nitrate nitrogen was much more variable than phosphorus and correlation analysis suggested agriculture, particularly row crops, was an important source of nitrogen ($r = 0.83$). [18] In addition to the obvious source of fertilized lands, phosphorus was found associated with naturally phosphorus rich soils running off a construction site and in springs feeding certain streams; and, in the South Branch, persistently high nutrient concentrations were associated with point sources (a trout hatchery and poultry processing plants).

4. SOURCES OF NUTRIENTS AND SEDIMENT

CHAPTER 4 - *at a glance...*

- **Most nutrients from point sources come from municipal and poultry processing wastewater treatment plants.**
- **Point source nutrients declined 33% in nitrogen and 53% in phosphorus between 1985 and 2002 in the Chesapeake Bay watershed.**
- **Point source and urban non point source nutrient pollution will increase in importance as the region's population grows.**
- **Estimating nutrient and sediment loads from non point sources is difficult.**
- **Loads from agriculture, urban lawns and atmospheric deposition can be estimated from the scientific literature.**
- **Loads from certain sources, such as dirt roads, failing stream banks, untreated sewage, and wildlife cannot currently be estimated and need to be assessed.**

Nutrients, such as nitrogen and phosphorus, occur naturally in soil, water and the atmosphere, and are required for the growth of plants. Nutrients are essential to all plant life in the Bay ecosystem, but an excess of nutrients is harmful. When the Bay was surrounded primarily by forest and wetlands, nutrients and sediment were mostly held in place by natural vegetation and relatively little flowed from the watershed into the Bay. Today, farms, cities and suburbs have replaced many of the original forests and wetlands. These changes in land use and increases in population have dramatically increased the amount of nutrients and sediment entering the Bay's waters. The sources are many: wastewater treatment plants, industries, vehicle exhaust, acid rain, and runoff from agricultural, residential and urban areas contribute nutrients to the Chesapeake Bay and its rivers. Bare ground from construction, farming and forestry, and denuded stream banks add to the sediment loads. This section will discuss the likely sources of nutrient and sediment loads to the Bay, and uncertainties associated with apportioning those loads among sources.

Point Sources

The nutrient loads delivered from large point sources are generally a known quantity, based on extensive monitoring at many point source facilities and by applying lessons learned from facilities where routine nutrient monitoring occurs to those where it does not. A large portion of the nutrients from point sources comes from domestic wastewater treatment plants. As long as the number of people served, daily flow, and level of treatment is known, a reasonable estimate of nutrients delivered to streams can be calculated. Another important source of nutrients from permitted facilities, in some areas, is animal and food processing facilities. Certain point sources, such as trout rearing facilities and quarries, can be a source of sediment as well. In addition, construction sites one acre or larger are regulated as point sources and, if poorly managed, can deliver large quantities of sediment to our waters.

As a result of rapidly improving technologies, and the funding to install those technologies, there was a 33% decline in nitrogen and a 53% decline in phosphorus delivered to the Bay from all point source facilities in the Chesapeake Bay watershed between 1985 and 2002 (in spite of a 19% increase in population during that time). The decline in phosphorus may also, in part, be due to region-wide bans on phosphate detergents (note: WV has not banned phosphate detergents). However, due to population growth, point source phosphorus loads have begun to creep upward. [14] Inevitably, nutrient pollution from wastewater treatment plants and other point sources will continue to increase in importance as the region's population continues to grow. The future of the Bay will depend on continuing development and implementation of the highest levels of nutrient reduction practicable from these sources.

According to the Chesapeake Bay model, WV point sources contributed 16% less nitrogen to the Bay in 2002 than in 1985. Unfortunately, during this same period the model estimates that phosphorus loads increased by 29%.

Non Point Sources

While the science behind predicting nutrient loads from point sources is relatively straightforward, the same cannot always be said for non point sources of nutrients and sediment.

One of the first challenges is to know where both manmade and natural nutrients in a watershed are found, and how much phosphorus and nitrogen is being imported into a watershed. Importation of nutrients as chemical fertilizer and animal feed is important, because it adds to the pool of nutrients that have the potential to wash into streams and on to the Chesapeake Bay. The foods that we eat and the nutrients in feed for animals in the agricultural industry are mostly imported. The nutrients in these foods enter the environment via various waste streams –either septic tanks or wastewater treatment plants for people, or fertilizers, and agricultural manure applied to fields.

Another term for imported nutrients is nutrient inputs. The US Geological Survey estimates that atmospheric deposition, animal manure, and commercial fertilizers comprise 97% of the total N inputs to West Virginia's Valley and Ridge province (at 57, 26 and 14% of total N inputs, respectively). Ninety-five percent of total P inputs come from commercial fertilizer (39%) and animal manure (56%). [15] The atmospheric deposition portion is coming from a mixture of point sources, such as power plants, and non point sources such as automobiles. Nutrients in fertilizer are entirely imported into this region, while some of the nutrients in manure are part of the "within watershed" nutrient cycle and some are imported in feed or as fertilizer to grow feed.

A great deal is known about some of these nutrient sources and how they behave in the landscape. For example, commercial fertilizer and animal manure are applied at the heaviest rates along the flood plain, particularly on cropland. [16] Where animal manure is an important source of agricultural fertilizer, as it is in West Virginia's Potomac watershed, phosphorus tends to accumulate in the soils over time. This occurs because animal manure typically has a nitrogen (N) to phosphorus (P) ratio of 3:1, while most grain and hay crops utilize N and P at a ratio of about 8:1. Because manure is typically applied at rates calibrated to meet crop nitrogen needs, phosphorus inevitably builds up in the soil. However, the water quality problems that might be associated with this buildup are alleviated, at least in part, by the very high capacity of many West Virginia soils to store phosphorus. [17] Ultimately, the capacity of these soils to store phosphorus may be exceeded and phosphorus related water quality problems will become more evident in our waters.

The nitrogen that is applied to soils and not incorporated into plant material moves into our streams readily, as nitrate, with both overland flow and through the soil profile; this accounts for strong correlations between row crops and nitrogen in area streams. [18] On the other hand, regularly elevated P concentrations are often associated with point source discharges from large wastewater treatment plants, generally not with non point sources such as agriculture and fertilized lawns. [19] Non point phosphorus mostly becomes "tied up" in our soils and plants, and moves into streams only during severe storms. In fact, over 90% of the annual phosphorus load can be delivered during a few severe weather events each year, [20] making it very difficult to quantify.

Atmospheric deposition of nitrogen is more evenly distributed throughout the watershed. It is generally believed that, in this region at least, our abundant forests still have substantial capacity to store additional nitrogen deposited from the atmosphere. Nitrogen falling on non-forested lands becomes a source of fertilizer and part of the nutrient cycle there. Nitrogen deposited on water immediately becomes part of the problem.

Urban and suburban development can have a profound influence on water quality. Decreases in vegetative cover and increases in impervious surfaces dramatically alter the hydrologic cycle, such as increasing the amount of stormwater and surface runoff, and decreasing groundwater recharge and infiltration. In addition, overuse of fertilizers on residential lands and managed areas like golf courses contribute to the problem.

> **What it means: Impervious Surface**
> Impervious surfaces are surfaces that do not allow water to penetrate, like rooftops, roads, and parking lots. Instead of soaking into the ground, water falling on impervious surfaces moves rapidly across the landscape, increasing erosion and transporting pollutants to streams.

While nitrogen, phosphorus and sediment loads from agriculture, lawns and atmospheric deposition might be predicted reasonably from the scientific literature, there are important unknowns. Unknowns include:

- The issue of the dirt roads that are so common in this region. Simply put, no one knows how much of the sediment seen in our streams following heavy precipitation is coming from erosion of dirt roads - or from construction activities, forestry, riverside camps, and mining.
- Poorly vegetated, failing stream banks lead to loss of land throughout the Chesapeake Bay watershed. These failing banks contribute sediment and associated nutrients during and following high water events. No one knows how much of the sediment in our streams comes from this source.
- Cacapon Institute discovered that some native WV soils are high in phosphorus. [21] Erosion of these soils due to poor land management practices has the potential to contribute significantly to the phosphorus load carried in our streams, and it is often difficult to distinguish between P losses from manure, fertilizer and native soil. [22]
- Some are also concerned over the possible role that abundant wildlife, such as deer and geese, might have in transferring excess nutrients to streams.

Trends in Nutrient Pollution in the Chesapeake Bay Watershed

The Chesapeake Bay Program notes the following major trends in sources of nutrients:

- "Nutrients from septic systems are increasing throughout the watershed as development spreads farther into the countryside, beyond the reach of centralized sewer systems.
- Stormwater runoff from urban and suburban areas is increasing as more land is developed.
- Nitrogen from wastewater treatment plants is declining in rivers where enhanced nutrient removal (ENR) technology is being used. It is increasing in other rivers.
- Phosphorus from sewage treatment plants has declined sharply, in large part because of the phosphate detergent ban. (New evidence indicates that phosphorus from point sources went down until 1999 but has since been going up. Importantly, West Virginia has never passed a phosphate ban.)
- Among the major land use categories, urban and suburban lands contribute, per acre, the largest amount of nutrients to the Bay when septic and wastewater treatment plant discharges are factored in.
- Runoff from farms is generally declining as farmers adopt nutrient management and runoff control techniques, and because the overall amount of farmland is declining." [23]

How does the Bay Program know these things? To the greatest extent possible, the CBP uses real world measurements to assess conditions in the Bay watershed. For example, it uses actual flow data from wastewater treatment plants to estimate loads from those sources and uses water quality monitoring data, where it exists, to determine what has happened in the past and is happening today. Where water monitoring data do not exist, and where questions concern future conditions, the CBP uses predictive models to supply answers.

As was noted in Chapter 3, West Virginia currently lacks the type of water quality data needed to accurately assess our contribution to the Bay's pollution problems. For that reason, the WVPTS stakeholders have been largely dependent on the CBP's models to furnish the information needed to make decisions. As a number of the WVPTS stakeholders consider these models to be fatally flawed, this has proven to be a source of contention in the process of developing strategies. However, as the models are central to the tributary strategy process, Chapter 5 describes how these models work and the kind of information they provide.

5. THE CHESAPEAKE BAY WATERSHED MODEL AND LOAD ESTIMATES

CHAPTER 5 - *at a glance...*

- **The Chesapeake Bay Program uses mathematical models to simulate changes in the Bay ecosystem due to changes in population, land use, or pollution management.**
- **The Chesapeake Bay Watershed Model (CBWM) simulations are not the same as actual conditions. They are the best scientific estimate of what average loadings are likely to be.**
- **The CBWM simulates one acre of each land use within each of the 94 separate model segments to represent all similar land use within the segment.**
- **Each of the Bay jurisdictions faces different challenges in reducing its nutrient and sediment loads.**
- **Based on model estimates, between 1985 and 2002 nitrogen loads dropped 5%, phosphorus increased about 1%, and sediment decreased 17% in West Virginia.**
- **A number of the WVPTS stakeholders consider model estimates to be inaccurate, and reject the use of these estimates in the WVPTS process.**

What is the Chesapeake Bay Watershed Model?

The Chesapeake Bay Program uses various mathematical models to simulate processes in the 64,000 square mile Chesapeake Bay drainage basin, which is much too large and complex to isolate for experiments in the real world. These models allow Bay scientists to simulate changes in the Bay ecosystem due to changes in population, land use, or pollution management. There are three main models used by the CBP: the Estuary Model, the Airshed Model, and the Watershed Model. The Estuary Model, commonly referred to as the water quality model, examines the effects of the loads generated by the Airshed and Watershed Models on Bay water quality. The Airshed Model tracks nitrogen emissions from all sources in the airshed, and covers the eastern United States from Texas and North Dakota eastward to Maine and Florida.

The CBP model of particular concern in developing West Virginia's tributary strategy is known as the Chesapeake Bay Watershed Model (CBWM). The current version of the Watershed model divides the watershed into 94 model segments; a version currently in development will utilize more than 500 segments and work on a much finer scale. The model uses rainfall, evaporation, and meteorological data to calculate runoff and subsurface flow for all the basin land uses including forest, agriculture, and urban lands. The surface and subsurface flows simulate soil erosion and the pollutant loads from the land to the rivers. The model also routes flow and associated pollutant loads from the land through lakes, rivers, and reservoirs to the Bay.

The CBWM uses mathematical representations based on the best available science to create its simulations of the real world. These simulations allow Bay scientists to predict changes to the Bay ecosystem, both positive and negative, due to changes in management, such as reducing the quantity of fertilizer applied to agricultural lands, installing new pollution controls at sewage treatment plants, and controlling urban sprawl.

As with all models, the CBWM simulations, or scenarios, are not the same as actual conditions. They are, however, the best scientific estimate of what average conditions are likely to be in a complex system where reality is enormously difficult to measure. The CBWM uses knowledge of cause and effect relationships gained through monitoring programs and research to produce estimates of what might happen in the Bay watershed in the future, and to predict probable conditions in areas that lack adequate monitoring data. In addition, as with all other models, the quality of the information "input" to the model will have a significant impact on the quality of the simulations. One of the goals of the WVPTS stakeholders and their agency partners is to make certain that the information input to the model from West Virginia is as accurate as possible. This is critical, because the model will be used to estimate the results of the pollution reduction strategies developed by the WVPTS stakeholder group.

Overall, as with all predictive tools, the CBWM has both strengths and weaknesses. Some of the things the model does well are:

- Equitably accounts for all major load sources based on the best available science.
- Reasonably represents the relative impact of management actions at the model segment, major tributary and basin levels.
- Reasonably predicts the likely relative impact of one set of actions compared to another; for example, nutrient and sediment reductions that might be expected from planting a cover crop versus installing a riverside grassy buffer.

On the other hand, the CBWM:

- Can't predict what is not known. For example, the model simply does not include contributions of sediment from dirt roads because the predictive tools to estimate those loads do not currently exist. On the plus side, the CBP is constantly seeking to fill in model gaps as scientifically defensible information becomes available.
- Is limited by the quality of input data. This has been a real concern for West Virginia, particularly in the areas of actual water quality data to calibrate the model for our state and in accurately accounting for environmental practices in agriculture (see Chapter 6).
- Is not currently set up to be a local TMDL model for West Virginia (it could be with the proper input information). For better or worse, WV has had to use it in that manner due to the lack of the correct kind of real world data.
- Is not a crystal ball, and cannot be expected to tell us precisely what will happen at a specific time. The CBWM uses professional estimates of future land uses, population, animals, and air to evaluate the relative impact of "what if" management scenarios.

A recent "white paper" by the CBP's Scientific and Technical Advisory Committee indicates that, based on water quality monitoring results, the CBWM is likely to overestimate progress made by the states towards achieving their cap load reductions. This happens because the CBWM generally uses best management practice "efficiency" assumptions based on idealized research studies, rather than from field studies on these practices as they are actually installed. This paper also considers critical the need for long-term small watershed studies to better determine BMP efficiencies.[24] For more information on the CBP's models, visit http://www.chesapeakebay.net/model.htm.

How the Watershed Model Works

At its core, the current Watershed Model (version 4.3) operates at the level of 94 "segments" in the nine major Chesapeake Bay tributary watersheds. Model calibration also takes place at the segment level (see box). A new version of the model (version 5) that will have 500 segments and, therefore, allow much greater precision, is due in 2006.

What It Means: Model Calibration

The CBWM uses mathematical relationships (such as between water quality, land use, hydrology and soil type) derived from many small scientific studies and applies them more generally on a large scale. For example, the scientific literature indicates that a forested riparian buffer will likely prevent the transport of at least 30% of the nitrogen that would otherwise flow from cropland into streams. In order to determine how closely the model approximates reality, the modeling team conducts "calibration runs" where the model is tested against real world monitoring data. The WVDA is working to produce West Virginia data to help better calibrate the model.

Each segment is divided into Forest, Mixed Open, Agriculture, and Urban land use categories based on the best available data (for example, agricultural acreage is based on the agricultural census in each state.) The Urban land use is further broken down into Urban Pervious (land area where water can soak into the ground) and Urban Impervious (where water cannot soak into the ground). The Agriculture land use is further broken down into Cropland (conventional / conservation till), Hayland, and Pasture.

Within each model segment, each land use subcategory is uniquely defined for that area based on: hydrologic parameters; sedimentation rates; nutrient inputs; plant cover and uptake rates; nutrient cycling / export rates. The CBWM simulates one acre of each land use to represent all similar land use within the segment. In other words, one soil, cover type, nutrient application rate, slope, infiltration rate, and particle size distribution represents one land use type within any given segment. The effectiveness of BMP's may differ from segment to segment based on local conditions.

Using the above information, the CBWM is used to estimate past and current conditions, and to predict how changes in land management will affect future conditions. For example, the model can be used to estimate the sources of nutrients and sediment to the Bay in any given year. Figure 4 presents model estimates of the sources of nitrogen, phosphorus and sediment in the entire Bay watershed in 2002. [25]

How West Virginia Compares to Other Bay States

Pennsylvania and Virginia contain the largest percentage of the Chesapeake Bay watershed, followed by Maryland, New York, West Virginia, Delaware, and Washington DC (Figure 5). As the watershed areas of each jurisdiction differ greatly, it is not surprising that their relative contributions to the Bay's sediment and nutrient problems differ as well. Figure 6 compares nutrient and sediment loads from the seven political jurisdictions, as estimated by

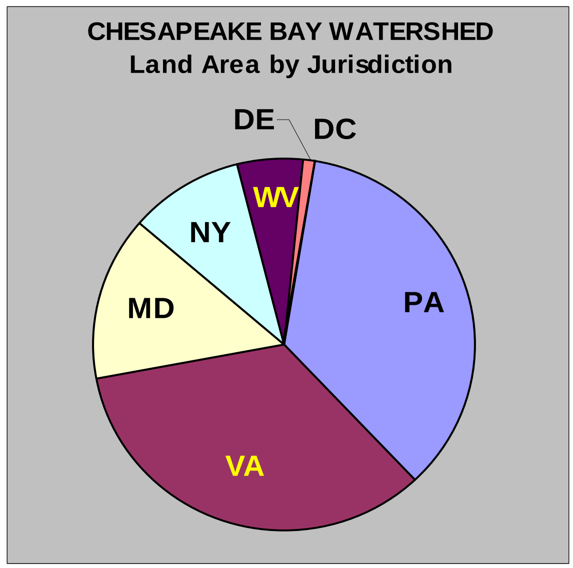

Figure 5. Land area by jurisdiction.

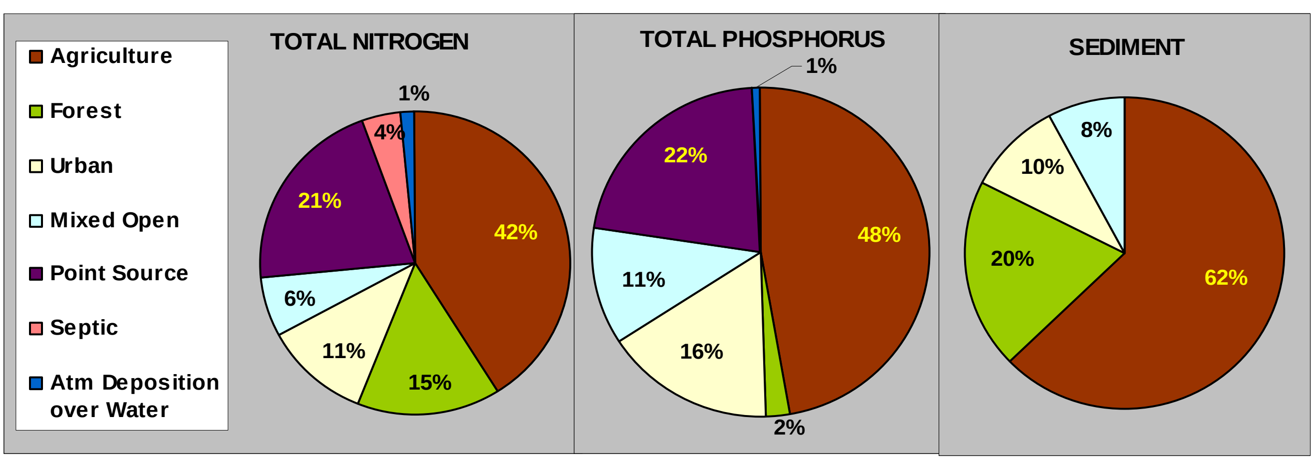

Figure 4. CBWM estimates of the sources of nitrogen, phosphorus and sediment in the entire Bay watershed in the year 2002.

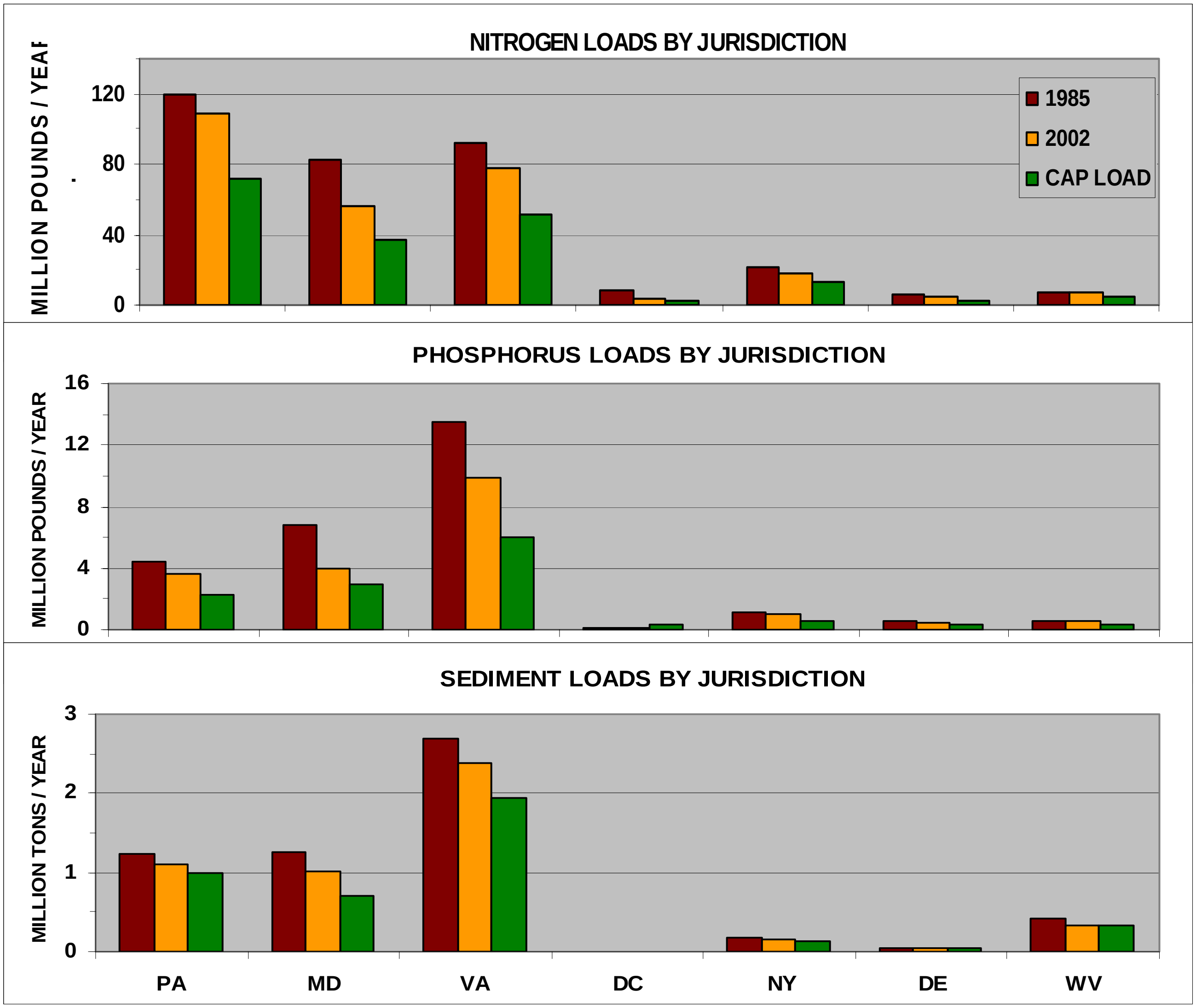

Figure 6. Nutrient and sediment load estimates from the seven political jurisdictions, as estimated by CBWM, for 1985 baseline, 2002 progress, and 2010 Cap Load Allocations.

CBWM, for 1985 baseline, 2002 progress, and 2010 Cap Load Allocations. The jurisdictions with the largest land area (Pennsylvania, Virginia and Maryland) also contribute the largest nutrient and sediment loads. Each jurisdiction has a different mix of land uses that produce their nutrient and sediment loads and require a different mix of remedies. For example, nitrogen from the highly urbanized Washington DC area comes almost entirely from point sources, in particular the mammoth wastewater treatment plant at Blue Plains, while nitrogen from rural Delaware comes mostly from highly concentrated agriculture. Thus far, CBP signatories Maryland, Virginia, and Washington DC have made the most progress in reducing their baseline (1985) nutrient loadings – but all jurisdictions still have a long way to go to meet the Cap Load Allocations.

Load Estimates by Land Use for West Virginia

Figure 7 provides West Virginia nutrient/ sediment loads as estimated by the CBWM for the baseline year (1985) and indicates progress made in reducing these loads as of 2002. These estimates indicate an overall 5% reduction in Total Nitrogen (TN), an increase in Total Phosphorus (TP) of less than 1%, and a 17% decrease in sediment. By land use, agriculture was identified as contributing the largest loads for TN (48%), TP (60%) and sediment (70%). Reductions in TN loads from point sources and agriculture were notable (16% and 14%, respectively), while nitrogen from septic fields increased by 96%. Reductions in TP loads were notable for agriculture (6%) and from urban non point sources (18%), while TP from point sources increased by 29%. The agricultural sector was solely responsible for substantial reductions (24%) in sediment loads.

The agricultural sector's reductions in TN (14%) and TP (6 %) occurred during a period of rapid change in the region's agricultural industry, as noted in Chapter 2. Between 1985 and 1997, the dairy and swine industries declined dramatically (43% and 48% respectively), beef increased slightly (6%), and the poultry industry boomed (layers increased by 198%, broilers by 159%, and turkeys by 43%). Overall, the CBP estimates that TN generation from animal manure increased by 39% during this period, and TP by 41%. [26] Despite these increases, estimated load reductions noted for the industry occurred because of aggressive implementation of Best Management Practices in the region (see Chapter 6).

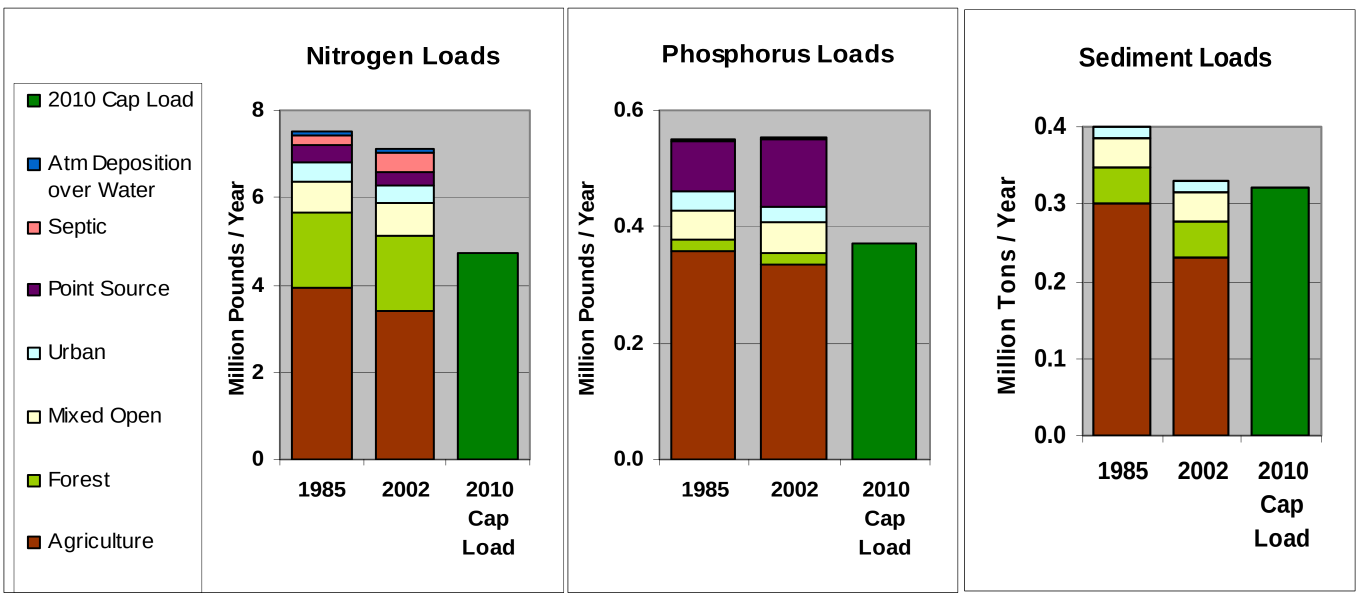

Figure 7. Compares delivered loads of nitrogen, phosphorus, and sediment in 1985 and 2002 for each of the seven major land use categories in WV's Potomac watershed only, as estimated by the CBWM. 2010 Cap Load Allocation provided for comparison purposes. Source: CBP, Sweeney, 2002 model run.

6. IMPLEMENTATION STRATEGIES

CHAPTER 6 - *at a glance...*

- **Implementation strategies are organized by load category. The implementation strategies consist of programs and BMP implementation plans designed to reduce loads to meet the Cap Load Allocations for each category.**
- **Strategies are presented for Urban and Mixed Open, Point Sources, Agriculture, Forestry, and Wildlife.**
- **The estimated overall cost to implement strategies necessary to achieve the West Virginia Cap Load Allocations is $873,546,759.**
- **Many of the programs required to meet the Cap Loads will not occur without sufficient funding.**

Non point sources of pollution are mostly controlled through the voluntary implementation of best management practices (BMP's) and through public education. BMP's for nitrogen, phosphorus and sediment can be broadly defined as "economically sound, voluntary practices that are capable of minimizing nutrient and sediment contamination of surface and groundwater." BMP's are based upon research from government agencies and universities, and upon practical considerations to prevent harmful runoff from entering local streams and, ultimately, downstream water. Implemented BMP's are reported to the Chesapeake Bay Program annually, and are used to determine progress towards reaching the water quality goals for 2010. Evaluating the success of the implementation of Best Management Practices will be achieved by monitoring the long-term status and trends of water quality, particularly by state agencies.

BMP's play a role in the nutrient and sediment reduction process through the management of land use and growth. The following sections provide an overview of agricultural, urban, forestry and wildlife BMP's, as well as the process technology methods used to control point source discharges. For more information, and to view a listing of BMP's currently accepted by the Chesapeake Bay Program, see Appendices 3 and 5.

The WVPTS stakeholder group established working groups to develop Implementation Strategies for the point source, urban, agriculture and forestry sectors. However, participation in some areas was low. The agriculture and urban working groups consisted of volunteers from the stakeholder group with agency support. The remaining sections were written by agency staff using recommendations from the WVPTS stakeholder group when possible. Ultimately, the type and amount of practices were adjusted to meet the Cap Load Allocation (CLA) by agency staff and contractors.

The Implementation Strategies consist of education programs, process upgrades, and BMP implementation plans designed to reduce loads to meet the CLA's. It is expected that implementation of these strategies will first target the most impaired watersheds in order to maximize improvements to local waters as well as the Bay. Implicit in each sector's Plan, and the overall Plan for West Virginia, is that the activities required to meet the Cap Loads will not occur if funding is not secured.

Urban and Mixed Open Strategy

This portion of the WV Tributary Strategy concerns nutrient and sediment loads from developed lands which are categorized by the CBWM as impervious and pervious urban, and mixed open lands. This strategy also covers nitrogen reductions from septic systems. Effectively, this strategy covers all urban, residential, and rural areas that are not managed agricultural or forested lands. Impervious refers to surfaces such as rooftops, roads and parking lots which typically do not absorb rainfall. Pervious lands include yards, parks, golf courses and school grounds which can absorb some rainfall. Mixed open lands are non-urban landscapes that are a mixture of trees, shrub land, and grasslands; including residential areas. Significant loads in the Potomac basin of WV originate from these developed lands and it is likely that this component of the landscape will continue to expand. It will be a considerable challenge to both reduce current loads to meet the designated CLA's, and accommodate new growth with its associated increases in pollutant loads. Therefore, a strategy is needed to both reduce loads from current developed lands and to plan for minimizing new loads from lands to be developed in the future. An effective strategy will require multiple components: stormwater management; nutrient management; management of septic systems; development planning; education and outreach; and tracking and monitoring of implementation progress.

The urban strategy acknowledges that urban and suburban development has a profound influence on the quality of West Virginia's waters. Increases in impervious surfaces and decreases in natural vegetation dramatically alter the local hydrologic cycle. Impervious surfaces disrupt the natural hydrology of streams, limit groundwater recharge, increase surface flow to streams, and exacerbate stream bank erosion. Pollutant loads from developed lands in the form of fertilizer use, failing septic systems and sewer infrastructure, and road and parking lot runoff are largely unassessed and unmanaged. At the same time, there is a perceived need to make West Virginia's urban centers stronger and more attractive to local populations, with an emphasis on physical infrastructure, a diversified economy, and financial sector development. The solution remains to maintain a balance between commerce and the environment.

The key features of the urban strategy are stormwater management, reduction of nutrient inputs to land and water, preservation and restoration of natural vegetation, education, and technical assistance. Managing these features will serve to both reduce the flow of runoff into surface waters and reduce the nutrient and sediment load of these waters. Other components of the urban strategy will be assistance to counties and municipalities in obtaining funding for these strategies; obtaining credit for past implementation of urban BMP's; obtaining credit for new BMP's; and tracking implementation of the Urban Strategy.

In order to reduce the amount of sediment and nutrient loading from urban and mixed open sources, this strategy suggests implementation of stormwater management on 72% of urban lands by 2010. Implementation of urban nutrient management is suggested for 33% of urban and mixed open lands by 2010. Implementation of erosion and sediment controls will be implemented in full compliance with West Virginia stormwater guidelines. Furthermore, the implementation of the EPA's NPDES Stormwater Phase II program will serve to provide an additional framework for improved stormwater management. This level of implementation exceeds the load reductions required to meet the Cap Load allocated to urban and mixed open lands. The total cost of implementing Urban and Mixed Open Best Management Practices, and the strategies outlined below is estimated at $305.9 million through 2010. Of this cost, $303 million is for the implementation of best management practices, while the remainder is for the programs and assistance required to successfully implement this Strategy. County and municipal governments will require aid in obtaining financial assistance to cover these costs.

Stormwater Management

One of the most significant problems associated with development is increased stormwater runoff, yet how we manage this problem affords us with many of the best opportunities for load reductions. Stormwater management practices intercept surface runoff from developed areas, filter and treat this runoff, and then discharge it at a controlled rate to minimize the environmental and physical impacts on receiving waters. Proper implementation and enforcement of sediment and erosion controls is essential during construction or other activities which disturb the soil. Local programs need to be in place to ensure that stormwater management systems are properly constructed and maintained and continue to function as designed. In addition to existing stormwater management strategies, consideration should be given to increased implementation of infiltration and filtering practices, which have the potential to significantly reduce loads where applicable.

Of further concern is the issue of combined sewer overflows (CSO's), where stormwater (by accident or design) is conveyed in the same pipes as wastewater. Combined sewer overflows have the potential to reduce treatment capacity at wastewater treatment plants and can result in untreated wastewater being discharged directly into waterways. Effort will be made to identify problems associated with CSO's and develop plans to reduce their associated nutrient loads.

Management of non point source pollution from urban and residential sources necessitates the development of comprehensive watershed management strategies that consider water quality and quantity, surface and groundwater, and riparian habitat and ecosystems. Stormwater management should occur within the boundaries that watersheds impose rather than the current site-by-site approach constrained by political boundaries and generalized technical requirements. Implementing stormwater management in a comprehensive, watershed-based approach allows for the implementation of innovative water quality improvement practices and non-structural practices such as ordinances, land conservation, low impact development, and public education.

A watershed-based planning approach also allows more stringent regulations to be required in environmentally sensitive areas; focuses on flooding and water quality issues for entire watersheds and how activities across jurisdictional borders affect one another; provides specific solutions to defined watershed problems; promotes cooperation among the various jurisdictions to address water resource issues; facilitates maintenance activities and inspection procedures; and can provide information for counties and municipalities to incorporate into their own plans thus resulting in cost savings. Management of stormwater across political boundaries could be facilitated through the creation of overlay or planning districts now possible under §8A of the West Virginia Code. Another potential avenue would be the establishment of stormwater utilities.

Watershed-based stormwater management plans should be developed and implemented that assess the status and geographic coverage of all existing stormwater management systems in order to identify gaps in stormwater management networks requiring retrofits or other management strategies. An assessment of the potential cumulative watershed-wide impacts of stormwater will also allow managers to target stormwater management implementation in areas of high priority.

In order to ensure that stormwater management is being implemented consistently throughout the basin it is important that all counties and municipalities understand, and have the capacity to develop, stormwater management plans and follow current state stormwater regulations. Development of this capacity will require substantial financial assistance. This will also require an increase in state personnel responsible for the oversight of stormwater programs. To ensure the effective implementation of local and state stormwater management programs, procedures, roles, and responsibilities will need to be clarified.

Nutrient Management

Managed, non-agricultural grasslands, (lawns, golf courses, schoolyards, athletic fields, parks, etc.) represent a significant land base for which nutrient management strategies will be developed and implemented. The Urban subcommittee recommends that the WV Nutrient Management Training and Certification program be modified to include urban criteria, and that development of certified nutrient management plans should be recommended to managers of significant fertilized grasslands. Managers of these grasslands would also benefit from educational opportunities concerning nutrient management as would lawn management service providers and homeowners. An evaluation of consumer fertilizer use is also needed to assess whether over-fertilization is an issue and how this could be addressed in the Potomac basin of West Virginia.

The use of nitrogen-based deicing materials on airport runways represents a potentially significant nitrogen load to receiving waters during snowmelt events. The U.S. Bureau of Transportation Statistics indicates that there are 47 acres of public use airport runway in the Potomac Basin of West Virginia. As runway application rates of these deicers are significantly higher than typical agricultural application rates of nitrogen, the potential impact of their use will be assessed for both public and private airports, and if deemed significant, appropriate nutrient management guidelines will be recommended.

Management of Septic Systems

Management of septic systems is a constant theme of discussion in West Virginia. Of particular concern are the effects of septic system discharges on water quality in the karst areas of the state. Another significant issue is that of residences and other facilities that have non-existent or failing septic systems. These sources should be assessed to determine whether they are a significant source of nutrients and if found to be so, a strategy should be developed to mitigate their impact. When maintained properly, septic tanks have their solids pumped out on a regular basis. These solids are often applied to land by designated permittees. A comprehensive assessment of this practice needs to be undertaken to ensure that it is being conducted in a fashion that will minimize the potential for these nutrients to leach back into waterways.

A homeowner education program to encourage proper maintenance of septic systems would provide benefits for nutrient reduction. While septic tank pumping does not significantly reduce release of nutrients, properly maintained septic systems last longer and have better removal efficiencies. Septic tank pumping prevents potential clogging and failure of drainfields that can result in a substantial increase in nutrient loading to groundwater. Implementation of a cost-share program for repair or replacement of failing/malfunctioning septic systems and for septic tank pump out is recommended.

The use of alternative on-site wastewater treatment systems for individual residences and clusters of residences has potential to alleviate many of the problems associated with conventional septic systems. Consideration should be given to developing processes to facilitate the installation of clustered decentralized wastewater system infrastructures, and advanced denitrification systems for individual residences. The optimal method for reducing pollutant loads from onsite denitrification and decentralized wastewater treatment systems would be through management by an entity such as a Public Service District in order to ensure proper operation and maintenance of these systems. However, management of on-site and decentralized wastewater treatment by Public Service Districts will require a substantial effort in education and capacity-building.

Development Practices

The impacts of new development on water quality can be reduced through the implementation of onsite measures and land use planning to manage overall development patterns. “Low-Impact Development” and “Smart Growth” principles rely on conservation of natural areas, lot development practices, and design of residential streets and parking lots to minimize impervious surfaces while preserving natural vegetation. Examples of development practices that minimize impacts of stormwater generated by new development are: the inclusion of buffers in subdivision design; greenways; riparian easements; and development of land management and planning tools that affect overall development patterns. Information will be provided to local governments and the development community on cost-effective ways to reduce the water quality impacts of new development. There are substantial existing resources available for guidance on Smart Growth and Low-Impact Development practices that address the impacts of development on water resources.

Opportunities for conservation of natural areas, improved lot design, and clustered development will be evaluated for application in the Potomac Basin. Impediments to the implementation of these principles will be identified, and consideration should be given to providing incentives for their implementation. Conservation development guidelines will be developed and distributed to counties and municipalities in the Potomac Basin. A more complete understanding of these practices within county and municipality offices, as well as within the development/design community will be promoted.

Effective land conservation is considered by many to be an essential component for offsetting future increases in loads caused by new development. Furthermore, incorporating land management into an integrated watershed management framework can also assist in reducing loads from both stormwater and point sources. To this end, comprehensive land management plans for watersheds within the Potomac Basin will be developed, creating a framework to balance environmental and economic goals. This plan could be used to identify sensitive lands and incorporate measures to protect or manage these lands relative to pollutant loads within a particular watershed. The plan should be prepared in concert with other county-wide planning needs.

In order for the urban strategy to be successful, pollutant loads from new development will need to be offset by decreases in loads from other sources or through the implementation of onsite BMP's. An "offset" program would allow economic development to continue while ensuring that there is no net increase in pollutant load to the Chesapeake Bay. An offset program works by setting a nutrient and sediment cap for all lands in a watershed which cannot be exceeded. Any changes to an existing land use which result in an increase in pollutant load will need to be offset by practices or mitigation either on or offsite that reduce pollutant loads in an equivalent amount resulting in no net increase in load.

Local ordinances can be an important mechanism for achieving many stormwater and non point source pollution control objectives such as offsets. They can include provisions for stormwater management that address water quantity and quality for development practices, protection of riparian zones, nutrient and sediment reduction, and other non point source pollution management measures.

Outreach and Public Education

Resolving stormwater management, nutrient management, septic system, and development concerns in a comprehensive, systematic manner will require a significant public education and outreach component to reach the multitude of residents, landowners, and land managers in the basin. As West Virginia is a popular recreational destination, effort will also be required to educate visitors, and non-resident landowners as to how they can help reduce the impact of their activities on local waterways and ultimately, the Chesapeake Bay. The sheer scope of urban strategies and the number of stakeholders involved will require promotion of individual responsibility and a conservation ethic. Implementation of a Community Environmental Management (CEM) program would facilitate community involvement in the implementation of tributary strategies.

Table 3. Urban and Mixed Open Implementation Strategy. See Appendix 3 for BMP definitions.

Land Use	Best Management Practice	Implementation Unit	Total Units
Pervious Urban			
	Stormwater Management		
	Wet Ponds and Wetlands	Acres Treated	16,000
	Dry Extended Detention Ponds	Acres Treated	20,000
	Infiltration Practices	Acres Treated	513
	Filtering Practices	Acres Treated	513
	Erosion and Sediment Control	Acres Treated	5,472
	Stream Restoration	Miles	18
	Forest Buffers	Acres	2,250
	Tree Planting	Acres	1,026
	Nutrient Management	Acres	24,000
Impervious Urban			
	Stormwater Management		
	Wet Ponds and Wetlands	Acres Treated	7,000
	Dry Extended Detention Ponds	Acres Treated	9,000
	Infiltration Practices	Acres Treated	234
	Filtering Practices	Acres Treated	234
	Erosion and Sediment Control	Acres Treated	4,597
	Stream Restoration	Miles	10
Mixed Open			
	Forest Buffers	Acres	9,000
	Wetland Restoration	Acres	1,000
	Tree Planting	Acres	5,000
	Nutrient Management	Acres	60,000
Septic Systems			
	Connections to Sewers	Systems	5,200
	Denitrification Systems	Systems	100
	Septic Tank Pumping	Systems	32,200

Community Environmental Management fosters stewardship by enabling community engagement and utilization of local knowledge and expertise to find solutions to community environmental issues. A voluntary, self-initiated process, CEM enhances community capacity to develop locally appropriate solutions to environmental problems through a self-guided process of assessment, planning, and implementation. The CEM process provides needed information and helps support informed, deliberative public decision processes by opening a dialogue with local leaders and the community at large. Thus, CEM can leverage many resources to guide the land use planning and implementation of best management practices necessary for meeting and maintaining CLA's. The Chesapeake Bay Program provides watershed planning assistance that could be used to enable the development of CEM groups throughout the Potomac basin in West Virginia.

Additional education programs are needed to raise awareness of such issues as karst geology, the use of BMP's, septic system maintenance, and lawn fertilization. In many ways, outreach and education efforts may have the most positive effect on reducing nutrients and sediment, and protecting and improving our streams, of all the practices implemented. In addition, where new modes of 'doing business' are identified, such as incorporating land conservation efforts with comprehensive planning, the need for technical assistance and outreach to county and local governments should not be overlooked. For example, WVCA has already developed some educational materials for homeowners in the areas of nutrient management and septic system maintenance. Outreach and education efforts will be evaluated to determine their effect on actual nutrient and sediment reductions.

Technical Assistance

Implementation of the Urban/Mixed Open Strategy will require significantly increased capacities at the local and county level. More importantly, this will entail a need for technical and financial assistance in the development of these capacities. Specific to stormwater management, counties and municipalities may need assistance in developing stormwater management plans and guidelines, training, and information on new technologies. Stormwater management in West Virginia would be greatly facilitated with the development of a statewide stormwater management design manual and improved regulations.

Implementation Strategy for Urban and Mixed Open Lands

Table 3 outlines BMP's that will need to be implemented on urban and mixed open lands, and septic systems. An explanation of the individual BMP's is included in Appendix 3. This implementation matrix attempts to reduce nutrient and sediment loads for both current and future growth. As it is impossible to accurately project future growth and land use changes in West Virginia's Potomac basin, the actual implementation strategy required to meet and maintain the CLA may substantially differ from the one outlined in Table 3.

Tracking Implementation Progress

In order to assess the impact of the implementation of nutrient and sediment reduction strategies, it will be necessary for everyone involved to track implementation efforts. These records, along with water quality monitoring, are used by the Chesapeake Bay Program to determine progress towards meeting the restoration goals outlined in the Chesapeake 2000 Agreement. Stakeholders will be assisted by WVCA and WVDEP in submitting information on the implementation of BMP's and other strategies related to nutrient and sediment reduction. Beginning in the fall of 2005, WVDEP will begin tracking permanent stormwater management practices submitted for sites greater than three acres. This will likely entail an increase in recordkeeping in order to record stormwater management plans submitted by developers, and implementation on existing urban lands and as such will require additional resources for the increased workload. A significant effort will be required to make the goals of the Chesapeake Bay Program relevant at county and local levels. Nutrient and sediment reductions accomplished through implementation of this Strategy will also serve to improve water quality and designated uses in local waterways.

Point Source Strategy

The Challenge

Historically, sewage treatment technology in West Virginia focused primarily on secondary treatment, principally removal of Biological Oxygen Demand (BOD), Total Suspended

Solids (TSS) and bacteria. Nutrients, although clearly parameters of concern associated with domestic wastewater treatment plants (WWTP's) as well as certain industrial categories, have only in recent years become a consideration nationally and more recently in West Virginia through the state's involvement in the Chesapeake Bay Program. To date, several WWTP's in the Potomac watershed have incorporated nutrient removal technologies to achieve compliance with West Virginia's current nitrate or ammonia criteria. Although some progress has been made with nitrogen, in order to achieve the nutrient loading reductions assigned to West Virginia from point sources, more work needs to be done. This strategy includes recommendations to begin the process of characterizing the nutrient loadings from point sources, applying annual loading limits to both domestic wastewater and industrial point sources for nitrogen and phosphorus, seeking funding to help municipalities and public service districts (PSD's) absorb the costs of additional treatment, and considering participating in in-state and/or cross-border trading scenarios. To better quantify the challenge, it is appropriate to understand the technologies needed to address nutrient reduction.

Nitrogen Removal

Nitrogen reduction technologies generally applied involve a succession of aerobic (containing oxygen) and anaerobic (without oxygen) tanks, and microorganisms such as bacteria to break down the organic material that contains nitrogen in wastewater. There are two primary components of this process. Nitrification occurs in the aerobic tanks as organic nitrogen and ammonia are broken down into nitrite/nitrate. Denitrification occurs in the anaerobic tanks as nitrite/nitrate is further broken down into elemental nitrogen gas. This gas then escapes into the atmosphere.

Phosphorus Removal

The primary technology available for phosphorus removal consists of chemical addition and flocculation, followed by tertiary clarifiers and separate sludge processing (plate and frame presses). Although the capital expenditures for chemical addition and settling are generally not excessive, the operation and maintenance of such systems can be significant. Phosphorus removal generally requires additional chemicals and results in additional sludge production. The required chemicals can contain metals and may also remove additional metals from the wastewater, concentrating them in the sludge. As a result, land application of sewage sludge generated from phosphorus removal could likely be prohibited under existing state regulations. An inability to land apply would increase costs by resulting in the need for this material to be landfilled or alternatively addressed.

In West Virginia's Potomac basin, treatment processes and effectiveness vary significantly from plant to plant. Those currently using lagoons would require a much more substantial investment to achieve nutrient removal than those operations using conventional activated sludge processes. Technologies need to be evaluated for each individual facility in order to truly determine feasibility and cost.

Point Source Nutrient Reduction Strategy

The following recommendations represent West Virginia's strategy for addressing its point source nutrient reductions:

1) Include monitoring for TN and TP in new permits and existing permits upon re-issuance.

Historically West Virginia has not required monitoring for total nitrogen and has only limited data on total phosphorus from point source dischargers. Beginning February 18, 2004, WVDEP began including requirements to monitor TN and TP for all domestic wastewater and applicable industrial permits issued or reissued in West Virginia.

2) Contingent upon affordable funding, work with local governments to achieve the following load goals for existing municipal facilities

and PSD's at permit reissuance:

For facilities 50,000 gallons per day (gpd) and greater, based on flow at design capacity, discharge an annual loading based on technologies capable of achieving average annual concentrations of 5 mg/l nitrogen and 0.5 mg/l phosphorus.

Expanding and new facilities will be advised by WVDEP to incorporate nutrient removal technologies. Facilities will be notified of the Chesapeake Bay Program goals and objectives, as well as the potential for a TMDL in the future, and advised to adopt nutrient removal technologies when undergoing plant upgrades or new plant construction. Offsets or additional load reductions from other sources will be evaluated and incorporated into permit requirements.

West Virginia, along with the Chesapeake Bay Program, is pursuing grant funding for assisting municipalities and PSD's in achieving these load goals. Only with some form of affordable federal or other non-state financial assistance can West Virginia achieve the reductions required to restore the Chesapeake Bay.

3) Work cooperatively with new and existing industrial and private domestic wastewater dischargers to achieve the following load goals:

For facilities 50,000 gallons per day (gpd) and greater, based on flow at design capacity (or an established nitrogen/phosphorus loading goal determined on a case-by-case basis), discharge an annual loading equivalent to loadings of municipalities and PSD's based on technologies capable of achieving annual average concentrations of 5 mg/l nitrogen and 0.5 mg/l phosphorus.

4) Seek funding for nutrient removal technologies (NRT) for upgrades and expansions. Again, in partnership with local governments, the state will actively seek and/or promote funding opportunities to assist in implementation.

5) Cooperate in nutrient trading.
West Virginia will consider initiating its own trading/offset process or participating with the other Bay jurisdictions in nutrient trading efforts that would lead to achieving Bay goals and objectives.

To facilitate the recommendations listed above, an implementation strategy will be developed incorporating more details and input from an advisory group composed of representatives from both domestic wastewater and industrial dischargers as well as environmental representation.

Costs

Success with point source nutrient reductions in West Virginia is contingent upon affordable funding. The capacity of most West Virginia communities to absorb the capital cost of implementing NRT would quickly be overwhelmed if financial assistance were not provided.   State agency low interest loans and other lending institutions do not, at this time, represent affordable financing alternatives to the municipal facility or PSD and its rate paying customers. It is hoped that actions initiated by the Chesapeake Bay Program will stimulate innovative funding opportunities, including federal appropriations, which would support a large percentage of the costs associated with NRT implementation.

Operation and maintenance costs for NRT at municipal waste water treatment facilities will be the responsibility of ratepayers. It is expected this will add \$7-\$17 per month per average customer to the \$25-\$50 rate already being paid.

The total cost for domestic wastewater facilities to meet the discharge loadings including engineering, legal, construction, and operation and maintenance from 2005 - 2010 is \$141,042,750. The total cost for all other facilities, excluding mining, for engineering, construction and operation and maintenance from 2005 - 2010 only is \$153,710,400. The total estimated cost to implement West Virginia's tributary strategy for point sources will be $294,753,150.

Capital costs for domestic wastewater facilities are based on estimates in 2004 dollars prepared by WVDEP's Engineering Section. These costs include upgrades for nearly all facilities and were based upon capital costs incurred on recent new plant construction in West Virginia. Nitrogen reduction technology costs were dependent upon flow and based upon the addition of a nitrification tower. For facilities currently meeting the nitrogen loads, costs were only included to add phosphorus reduction technology. Costs for phosphorus reduction technology for all facilities consisted of estimating the addition of a chemical feed unit, clarifiers and a sludge press. Costs for industrial facilities are based on an average derived from the Chesapeake Bay Program "NRT Capital Cost Summary for Point Sources by State and Category 1/27/04".

To calculate annual operation & maintenance costs for domestic wastewater facilities, it was assumed that the WWTP's would add liquid alum (aluminum sulfate) to the wastewater stream to remove phosphorus by chemical precipitation. Suppliers were contacted to receive actual costs to deliver the chemicals to the Bay area WWTP's. It was assumed that adequate alkalinity was available at each WWTP. Metcalf & Eddy's Wastewater Engineering Treatment Disposal Reuse (Third Edition) was used for the calculations. The gallons of alum solution that would be needed to remove a pound of phosphorus were calculated and then the cost prorated for each WWTP, based upon the amount of sludge in tons generated at each facility. Consistent with the 2002 report titled "Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed", $300/ton for sludge handling and disposal was added. No additional labor costs were incorporated and energy costs were considered negligible.

Mining

West Virginia has nine permitted nutrient related mining dischargers in the Potomac headwaters included as a result of their usage of anhydrous ammonia in the treatment process. As with other point sources, West Virginia has not required monitoring of TN and TP from these operations and has limited information on how much TN or TP they discharge. WVDEP will be further evaluating these potential sources, as well as associated mining activities that could contribute nutrients, such as blasting and reclamation, for their nutrient reduction potential.

Agricultural Strategy

Background Information

This narrative portion of the tributary strategy was developed by a variety of interests including agricultural representatives from West Virginia's Potomac watershed, the West Virginia Farm Bureau, commodity groups including the West Virginia Poultry Association and West Virginia Cattleman's Association, as well as government and non-government officials. A list of suggested BMP's that could meet the Cap Load Allocation was developed by agency staff and contractors.

The West Virginia agriculture community will continue implementation of a variety of practices that will reduce nutrients and sediment, to fulfill its obligations under the Chesapeake Bay Agreement and to protect the waters of West Virginia. However, the agricultural community is concerned that the Best Management Practice (BMP) implementation numbers that are developed and included within this document could become mandatory if the Cap Load Allocation (CLA) is not reached by 2010. Another concern of the agriculture community is that the numbers generated by the Chesapeake Bay model are inaccurate and do not represent the actual nutrient and sediment contribution being made by agriculture in West Virginia. Water quality and delivered loads must be verified by actual water quality monitoring.

An impressive voluntary, incentive based, agriculture nutrient management program is already well underway in West Virginia and should be encouraged to continue by providing additional funds. Incentive based (cost share) programs, while effective, continue to require substantial investment by the landowner. There are many cost share programs in the Potomac Headwaters Region that are not yet complete and have not been fully assessed in terms of water quality improvements and cost effectiveness. New cost share programs require a 50% contribution from the government and a 50% contribution from the farmer. In order to continue at the current rate of installation, West Virginia recommends a 75/25 cost share program for BMP's that have a direct positive effect on farm land and have the ability to increase farm profitability. If BMP installation only shows a downstream nutrient and sediment reduction and no positive effect on farm land, then West Virginia is requesting a grant based program to cover the full cost of implementation and maintenance.

Strategy

Installation of BMP's

The State of West Virginia will continue to encourage and support the installation of various agricultural BMP's and related programs in order to assist the state in meeting its CLA. The State will work with the Chesapeake Bay Program to promote the acceptance of all BMP's that have been implemented, even those installed under non-government programs. The following programs have proven to be effective in this area and will continue to be encouraged. (Please refer to Appendix 6 for BMP definitions).

Account & Report all BMP's

Farmers in West Virginia have historically worked to maintain and improve water quality on their operations. Many farmers also install practices without federal or state cost share dollars and these were unaccounted for by the state of West Virginia or the Chesapeake Bay Program. A priority of the State of West Virginia is to account for all previously installed BMP's, for inclusion into the phase 5 model run. West Virginia will provide data demonstrating the efficiencies of and accounting for BMP's that are not currently recognized by the Chesapeake Bay Program but have confirmed reductions of nutrients and sediment entering the stream. Unrecognized BMP's will be developed and proven by using data and research from NRCS, university and Extension scientists, and presented to the Chesapeake Bay Program Tributary Strategy Workgroup. There is an ongoing effort to develop better tracking mechanisms for all BMP installation.

Education

The size and scope of educational programs within the Chesapeake Bay Watershed areas are vast, but conducted by relatively few personnel within a limited number of producer and government organizations. By working together, farmers and support agencies enable agriculture to remain competitive, and profitable, thus ensuring the sustainability of the family farm and the rural way of life. West Virginia leads the nation in the percentage of family farms and recognizes the value of sustaining this tradition.

Through the efforts of the NRCS, Conservation Districts, WVCA, WVU Extension and producer organizations, West Virginia has had a very strong educational initiative for agriculture throughout the Potomac Headwaters region. Farmers have voluntarily participated in federal and state cost share programs that have been recognized as success stories both regionally and nationally. Educational outreach provided by the technical agencies was instrumental in the success of these programs.

The agricultural sector promotes increased educational opportunities for development and implementation of agriculture nutrient management plans and new BMP's. Therefore, support through additional financial resources for agencies developing nutrient management plans and encouraging BMP installation would help in reducing nutrients to the Chesapeake Bay. Continued outreach to producers with existing nutrient management plans on the importance of maintaining and following their plans will be invaluable in limiting the over-application of nutrients.

West Virginia can also turn to other states and organizations to find programs that are beneficial to the agriculture community and continue to educate them on the importance of being good stewards of the land. Programs such as Ohio's Livestock Environmental Assurance Program, The National Pork Producers and Cattleman's Association Programs and Grazing schools are all important tools that can be utilized for farmer education.

BMP Installation Program

Many farmers have received federal and state cost share money (see Appendix 5 for existing cost share programs) to reduce nutrient runoff from their farms. These cost share programs require significant matching funds as the agriculture producers' contribution to the BMP installation. Continued implementation of additional BMP's is needed to meet the CLA's. The administrating agencies will continue to encourage these programs. Therefore, in order to significantly increase BMP's on agricultural land, West Virginia will need to work with federal, state and county government and non-profit organizations to identify and create additional funding sources to encourage farmers to continue participation in cost share programs. In order to continue at the current rate of installation, West Virginia recommends a 75/25 cost share program for BMP's that have a direct positive effect on farm land and has the ability to increase farm profitability. The West Virginia State Revolving Fund (SRF) allows participating landowners to take advantage of low-interest loans for the required match associated with the installation of BMP's.

In order to meet the nutrient and sediment reductions to the Bay, the State will also seek additional funding to cover 100% of the costs associated with the implementation of new BMP's which have a positive effect on downstream waters but do not increase farm profitability. This would encourage past non-participants to take part in BMP installation programs as well as target farms with extreme agricultural/environmental issues. The goal is to improve these farming operations and substantially reduce the amount of sediment and nutrients entering the stream.

Alternative Uses of Poultry Litter

West Virginia will continue to explore alternative uses of poultry litter. Subsidies on litter transport out of the watershed have been effective in the past and funding will continue to be pursued to support similar programs. The Potomac Valley Conservation District (PVCD) is also in the process of working with sister conservation districts outside of the Bay drainage to set up central distribution sites for litter marketing.

The PVCD has strongly supported commercialized composting over the past ten years and has been successful in the start-up of two private composting businesses that are bagging and marketing the finished product out-of-state. The composting process significantly reduces the nitrogen content of the finished product. Well-over 50,000 tons of poultry litter have been processed and exported through these businesses over the past five years. Technical assistance and support will continue to be directed towards these efforts as well as expanding into other innovative areas of alternative uses - including pelletization and outside of the watershed marketing of poultry litter for fertilizer.

A litter transport program will enable the agriculture sector to more easily reach their goal. Litter transport out of the watershed is an extremely effective nutrient reducing BMP. In 2001 to 2002 a $75,000 pilot litter transport program, funded by the West Virginia Governor's office and Wampler Foods (now Pilgrim's Pride) was initiated. During this project, 7000 tons of litter was transported from the watershed giving West Virginia a very significant nutrient reduction. This program not only helped us move closer to meeting our CLA, but allowed farmers in the central part of West Virginia to improve their soil. If a litter transport program is not utilized yearly in West Virginia, a significant mix of BMP's that equals the effectiveness of a litter transport program would have to be installed in order to meet the CLA.

West Virginia Department of Agriculture Poultry Waste Energy Recovery (POWER) Project demonstrated that high-temperature, thermophilic anaerobic digestion is a technically sound and operationally reliable tool for waste management and resource recovery. During its five years of operation, the demonstration plant met or exceeded each objective set for the individual and combined treatment of various types of poultry litter, poultry mortality, process waste, municipal wastewater and municipal solid wastes. Anaerobic digestion was shown to be especially effective for the processing of mixed waste streams. This provides the opportunity to combine poultry waste (litter and mortality) with municipal wastewater in strategically located integrated facilities. These integrated facilities include anaerobic digestion systems and fertilizer plants which profitably and simultaneously serve the infrastructure needs of local municipalities and surrounding agricultural commu-

Table 4. Implementation plan for Agriculture. See Appendix 6 for definitions of agricultural BMP's.

Land Use	Best Management Practice	Implementation Units	Unit
Hi-Till	Conservation-Tillage	29,840	Acres/Year
	Forest Buffers	469	Acres
	Wetland Restoration	22	Acres
	Land Retirement	1,009	Acres
	Grass Buffers	3350	Acres
	Nutrient Management Plans	3,316	Acres
	Poultry Manure Transport	950,639	Pounds/Year
	Conservation Plans	3,316	Acres
	Cover Crops Early-Planting	3,316	Acres/Year
	Tree Planting	1,665	Acres
Low-Till	Forest Buffers	231	Acres
	Wetland Restoration	12	Acres
	Land Retirement	1,687	Acres
	Grass Buffers	1,650	Acres
	Nutrient Management Plans	29,840	Acres
	Poultry Manure Transport	8,554,606	Pounds/Year
	Conservation Plans	29,840	Acres
	Cover Crops Early-Planting	10,399	Acres
	Tree Planting	820	Acres
Hay	Forest Buffers	2,400	Acres
	Wetland Restoration	97	Acres
	Nutrient Management Plans	134,317	Acres
	Poultry Manure Transport	20,494,755	Pounds/Year
	Conservation Plans	134,317	Acres
Pasture	Forest Buffers	6,900	Acres
	Wetland Restoration	269	Acres
	Conservation Plans	355,791	Acres
	Off-Stream Watering With Fencing	290,000	Acres
Manure	Animal Waste Management	215	Manure Acres

nities. The demonstration project used one ton of litter per day to operate. A full scale digester has the ability to use 85 tons of poultry litter and 200,000 gallons of municipal wastewater per day. The cost of a full scale digester is approximately $12 million dollars. This technology will continue to be explored and promoted as an alternative to over application of litter and municipal wastewater disposal.

Poultry litter can be converted to highly usable biodiesel fuel using current technology. For example, the U.S. Department of Energy's Regional Biomass Energy Program helped fund a demonstration project to develop technology that can convert poultry litter into bio-fuel. In addition, West Virginia University has discovered a relatively simple chemical process for converting agricultural waste into liquid fuel. Testing has shown that this prototype biodiesel fuel compares favorably in all respects with petroleum based diesel fuel. The university hopes to commercialize this technology within the next decade and provide educational support for on-farm conversion of agricultural wastes. [27] The demonstration reactor is capable of converting 1-2 tons of poultry litter per day into biodiesel fuel. Continued support of this technology will be important both environmentally and economically to all poultry producers within the Bay drainage.

<u>Development of New BMP's</u>

Research on new and innovative BMP's will be pursued. Research should be initiated to develop BMP's that provide additional revenue to the producer through improved production and profit as well as substantial environmental efficiencies. West Virginia will also encourage the development and acceptance of BMP's that are currently not recognized by the Bay Program. Rip-rap is a practice not recognized by the Bay Program, yet installation reduces sediment and phosphorus loss by holding stream bank soil in place.

Research by universities, the NRCS and other resource agencies will continue to measure the effectiveness of current BMP's as well as develop area-specific BMP's. Emerging technologies, including genetic engineering, feed efficiency and new feed additives, have the potential to decrease supplementation of additional nutrients within livestock and poultry rations. Enhanced utilization of micro and macro mineral components and increased efficiencies of nutrient class conversions (protein, energy) could become prevalent in future BMP scenarios.

According to the Chesapeake Bay Program, stream buffers are the most effective tool available to reduce nutrient transport from agricultural lands. This requires converting row crop on prime agricultural land bordering streams to grass, shrub or forest. In West Virginia, where prime agricultural land occurs mostly in the alluvial soils of narrow river valleys, farmers are highly resistant to losing any of the limited land available for the production of high nutritional value livestock feeds, such as corn and corn silage.

<u>Natural Stream Restoration</u>

Natural Stream Restoration (NSR) is a new and evolving technology within West Virginia. The intent of NSR design is to restore conditions that will allow natural fluvial processes to create a stream bed that is both stable and complex. Natural Stream Design allows a stream system to naturally "heal" itself by allowing more efficient water and sediment transport within the channel to reduce bank erosion problems, and has the potential to provide a lower cost alternative to installation of rip-rap. The West Virginia Conservation Agency is a strong proponent of this emerging technology and has successfully installed three demonstration projects within the Bay drainage. Three additional projects are currently in the planning stages and will be implemented within the next year. Of these demonstrations, one particular project site was estimated, based upon bank pinnings, to be contributing 3000 tons of sediment to the Potomac River annually before installation. West Virginia will continue to support this technology and promote funding opportunities which will have a significant impact upon sediment loading to the Bay.

Farm Land Easements

Conservation easements will be used basin-wide to help prevent transition of agricultural land, with minimal impervious surfaces, to suburban or urban uses. A conservation easement is a flexible legal tool that enables landowners to permanently protect the natural, scenic, and historic values of their property from development and subdivision. Because an easement is perpetual, it is transferred with the property when it is sold, thereby protecting the land forever. While many easements are donated to county and state governments or qualified non-profit organizations, there are several programs in West Virginia that, if funded, could purchase conservation easements on important farmlands. The Federal Farm and Ranchland Protection Program (FRPP) coupled with the county-based Farmland Protection Boards springing up throughout West Virginia can work together to purchase development rights from farms, keep farmers working on their land, and provide money that may enable farmers to install more BMP's. Funding should be sought to match federal funding for agricultural easements and assistance and support should be made available to counties and local organizations wishing to accept conservation easements in West Virginia.

Trading

A trading program could be an important tool to help West Virginia meet its CLA. Point sources could pay farmers to continue to install agriculture BMP's at a fraction of what it would cost point sources to make upgrades. Another idea is the installation of new technology such as a poultry litter digester. The technology for a full scale digester costs approximately $12 million and a point source may be willing to finance such an operation in order to lower the amount of nutrients that they must reduce at a lower price.

Water Quality Testing

The West Virginia Department of Agriculture will continue to monitor and test the waters of the State that drain to the Chesapeake Bay. This will help to diminish the reliance on the model by providing actual water quality data. This monitoring may also serve to better determine the efficiencies of BMP's installed in the region and document the transport time of nutrients flowing to the Bay.

Implementation Strategy for Agricultural Lands

The implementation strategy for agriculture is provided in Table 4. This implementation strategy is subject to revision based on confirmation by the Chesapeake Bay Watershed Model, based on changes to required Cap Load reductions from water quality monitoring results, and based on other changes in understanding of "current status" in 2002.

Costs

Success in achieving agricultural nutrient and sediment reductions in West Virginia is contingent on funding. Table 5 provides an estimate of costs for the proposed strategy.

Forestry Strategy

Converting open and agricultural lands to forest is one of the most effective land management practices available for reducing nutrient and sediment loss from West Virginia lands. However, this strategy recognizes that proper management and use of forested lands will also play an essential role in West Virginia's comprehensive strategy for protecting both West Virginia waters and the Chesapeake Bay.

Introduction

West Virginia contains 24,640 square miles, of which approximately 19,200 square miles (78%) are forested, making West Virginia the third most heavily forested state in the nation. [28] Eighty-eight percent (88%) of West Virginia's timberland is held by private landowners, with the remaining 12% owned by local, state and federal governments.

Ninety-four percent (94%) of the State's forest is comprised of hardwoods. These forests contribute more than $3.2 billion annually to the State's economy and are the only natural resource industry found in every West Virginia county. The eastern panhandle's eight counties consist of 3,574 square miles, with roughly 1,600 square miles in the non-industrial forest land base. A study done by West Virginia University in 1995 indicated that the eastern panhandle's forest industry contributes $374 million (12%) to the economy and 3,562 jobs (12% of area's total).

Between 1993 and 2003, the average annual timber harvest in West Virginia's Potomac watershed was 22,643 acres per year. During that time, nine percent of the region's forested lands were harvested, 90% by selection cutting. A comparable harvest rate is anticipated from 2004 through 2010, with 136,000 acres harvest projected during that time, an average of 19,500 acres per year.

Forestry's approach towards minimizing pollution from forestry operations and, therefore, their method for developing a forestry Strategy, is best understood through a historical perspective.

Logging

Nearly all of West Virginia's forests had been harvested by 1930, and the logging practices in common use at that time caused substantial erosion of West Virginia's lands, which resulted in sedimentation problems for many West Virginia streams. As the forest renewed itself and began to mature, sustainability of West Virginia's forest resource became a concern. During the 1960's, Forest Practice Standards were adopted and generally agreed upon by industry, academia (colleges and universities), federal, and state agencies in order to ensure the forest's future. These Forest Practice Standards were designed to ensure clean water and a healthy productive forest. In 1972, the Forest Practice Standards were revised and voluntary compliance was implemented until 1992.

While cutting trees itself does not typically cause erosion, activities associated with logging, such as haul roads, skid trails, and log landings, as well as silvicultural activities such as site preparation and mechanical tree planting, can cause erosion and thus sedimentation if not done properly. In 1992, the West Virginia Legislature enacted the **Logging Sediment Control Act (LSCA) -WV Code 19-1B-12**. This measure was passed to control non point sources of sedimentation from logging operations. Public lands in the eastern panhandle, which include all State and Federal Forests, are also subject to the LSCA BMP's. The LSCA addresses these activities and is summarized as follows:

- **Best Management Practices (BMP's) <u>are required by law in West Virginia</u>** to be used by timber operators. BMP's are reviewed every three years by a panel of experts to ensure the latest technology is being utilized.
- Timber Operators are required to be licensed and have a certified logger on site. Small landowners who operate are not required to have a license but must file for an exemption. The exemption process only excludes the operator from the licensing and certification but they must comply with BMP's to the same degree as those licensed.
- Timber Operators are required to be trained every three years in BMP's, Chainsaw Safety, and First Aid. Recertification training covers subjects in reclamation, silviculture, business management, sustainable forestry, equipment safety, etc.
- Emphasis has been placed on Streamside Management Zones (SMZ) to prevent exposure of mineral soil and potential erosion. The minimum SMZ width for perennial or intermittent streams is 100 feet slope distance. On ephemeral streams the SMZ is 25 feet. Soil disturbance in these areas must be minimized.
- The WV Division of Forestry (WVDOF) is mandated to inspect and enforce regulations pertaining to logging operations. The law empowers the WVDOF to issue compliance orders, suspend logging activities, seek civil penalties to prevent sedimentation, and/or issues citations under 19-1B-12.

- BMP standards require roads to be seeded and mulched to control erosion once a logging operation has been completed.

Wildfires

Since 1949, approximately 3.5 million acres of West Virginia forest lands have burned. The destructive results of these fires include timber mortality and degraded value, wildlife habitat destruction and reduction of aesthetic appeal. Extensive erosion also results from these wildfires, caused by the loss of the forest understory and leaf litter that protects the underlying soil from rainfall. This results in a major avenue for sediment to enter stream channels following a rainfall event. Studies of stream sedimentation from non point sources in West Virginia indicate that wildfires on land with a history of repeated burns can have a greater impact on water quality than other potential sources, such as oil and gas, agriculture, construction and logging operations. W.Va. Code Chapter 20-3 empowers the WVDOF to write citations and impose fines on individuals who violate this section of the Code.

The potential for sedimentation due to forest fires is tremendous, with erosion rates ranging from 55 tons/acre to over 250 tons/acre per year following forest fires. In the West Virginia counties of concern to the WVPTS, 1020 fires burned 7265 acres of forested land over the past 5 years, an average of 204 fires and 1453 acres burned per year. The number and magnitude of fires varied greatly from year to year. The drought years of 2000 and 2002 had severe fires that burned many acres of land (3,199 and 2,769 acres, respectively), while during 2003 unusually wet conditions suppressed the potential for fires and only 89 acres burned. (See Appendix 7 for details.)

The WVDOF is mandated by law to enforce the State Code that relates to wildfires. WVDOF personnel work with the public to...

- prevent fires through the education of school children and landowners
- detect fires through aircraft detection and reporting by 911 centers
- suppress fires if they should occur
- investigate the cause of fires and
- enforce wildfire law violations; Chapter 20-3.

Through continued emphasis on the prevention of fires and landowner incentive practices, such as the fire line stabilization practice under the new Forest Land Enhancement Program (FLEP), the potential sediment from fires should decline.

Landowner Assistance Programs In West Virginia

For more details on landowner assistance programs in West Virginia, see Appendix 7. Nearly 80% of the private land holdings in West Virginia are owned by 260,000 non-industrial private woodland owners. Demographics indicate that ownership size is an average of less than 47 acres per parcel, many do not live on their property, and management objectives for the properties vary immensely.

The eastern counties of West Virginia in the Chesapeake Bay drainage have approximately 1 million acres of private non-industrial woodland. Landowners may choose from an offering of programs aimed as incentives for landowners wishing to manage their forest resources:

- **Forest Land Enhancement Program (FLEP)** – provides forestry incentives to carry out "on the ground" practices relating to water quality measures in riparian zones, forest stand improvement, tree planting, fish and wildlife habitat, reclamation of forest roads following a catastrophic event and fire line stabilization following a wildfire.
- **Forest Legacy** – provides federal cost-share dollars to the state for the purchase of, in fee or by easement, private properties that are environmentally significant. The program assures that the forest resource will continue as a "working forest" forever.
- **Sustainable Forestry Initiative** (SFI) - A sustainable forest management and certification standard administered by industry to demonstrate that foresters, landowners, loggers, and wood and paper producers can operate and be an economically viable

industry in an environmentally responsible manner.

- **Stewardship Program** – provides cost share assistance to non-industrial private woodland owners for preparation of a comprehensive management plan for their forest land acreage. The plan incorporates the objectives of the landowner and provides a ten- year cycle of recommendations for managing and protecting the woodland acres. The Stewardship Plan qualifies the landowner for forestry incentives for cultural and water quality based practices and the Managed Timberland initiative which includes a potential tax base reduction. Currently, 883 Stewardship Plans for 192,219 acres are in place in West Virginia's eastern panhandle counties.
- **Managed Timberland Program** – provides a tax reduction for landowners who properly plan and manage their forestland. (The properties are certified prior to placement in the Program and are monitored and inspected for retention in the Program.) There are currently 227,884 acres under certified Managed Timberland protection in West Virginia's eastern panhandle counties, representing a total of 930 landowner contracts.
- **Tree Farm Program** - comprised of industry, state agencies, consulting foresters, and landowners. Recognizes landowners' achievements to properly manage their forest land. Relies on training and education of the public to do responsible forest management.
- **Cooperative Forest Management (CFM) Programs** - are derived from major forest products industries that conduct forest management programs which include reforestation. Since 1985, CFM programs plus mining reclamation plantings have reforested over 6,400 acres.

Current Trends and Forestry Strategy

Within the context of existing legal requirements for forestry BMP's and wildfire prevention programs, the Forestry subcommittee proposes the following implementation strategy.

Harvesting Trends. The number of acres logged has been consistent over the past 20 years. However, trends indicate that logging averages approximately 22,000 acres but deviate roughly 3,000 acres annually and we see this trend maintaining consistency through 2010. Therefore, any potential influence that logging may have on the Bay will remain consistent assuming that present LSCA and other programs are maintained. Factors contributing to the decline are influence of urban sprawl, change in landowner attitudes, the prohibitive high cost of doing business, and increased environmental regulation.

Harvesting Improvement Strategy

- Maintain logger education regarding BMP standards and water quality.
- Maintain technical assistance to timber operators.
- Maintain current level of logging inspections by the WVDOF.
- Establish a toll free message center so loggers can easily and rapidly notify the WVDOF when they are within a week of completing a logging operation or are forced to move due to adverse weather conditions and/or equipment difficulties.

Wildfire Hazard. Acres burned are directly influenced by weather and season of the year. Trends indicate that with the increase of urban sprawl, the landscape is becoming more fragmented. Landowner attitudes in the eastern panhandle are shifting toward preservation rather than conservation of the resource, which will increase fuel loads leading to more hazardous situations. Even though acres burned in the Bay area are not significant, occurrence and risk are equal to or greater than any other part of the state. Therefore, the risk of a catastrophic conflagration cannot be ignored. (See WVDOF Wildfire Hazard Chart). Fire danger will also increase due to insect and disease influence that is persistent in the area.

Wildfire Containment Improvement Strategy

- **Fire Prevention -** to continue to contact every fourth grader to apprize them of the dangers of wildfire and its potential. Increase public awareness through Firewise West Virginia Initiative**.**

- **Fire Preparedness -** continue to train and equip volunteer fire departments (VFD). Continuing education for current staff in the fire sciences.
- **Fire Suppression -** Better initial attack and response times. We will strive to have fires under control within one burning period (12 hours).
- Reduce sediment potential from fire line construction via the stabilization practice under the new Forest Land Enhancement Program (FLEP). The sediment potential from fires should show a continuing decline.

Landowner Assistance Improvements

- Increase landowner education in regard to the management of their forest resource.
- Implementation of landowner practices to ensure protection of SMZ's, including tree planting initiative.
- Increase forest landowner awareness of cost-share programs that can be utilized on their property.

Costs

WVDOF will maintain present personnel, and increase staffing by one employee per county to increase water quality related landowner education, logging and fire enforcement activities. The estimated total cost for the eight affected counties will be $3,920,000

- One employee per county at $50,000/year including benefits and office space.
- Vehicles, equipment, miscellaneous materials at $20,000/year.
- Annual per county costs subtotal $70,000.
- 8 counties x 1 employee x $70,000/yr x 7 years = $3,920,000.

Wildlife Strategy

Some of West Virginia's Potomac Tributary stakeholders have expressed concerns over the potential for nutrient and sediment loads generated by over-abundant wildlife populations. While the possibility of significant loads from this source is highly speculative, the WV Division of Natural Resources (DNR) has responded by suggesting the following management actions related to white-tailed deer and Canada geese. An assessment will be made of the potential contribution of nutrients by wildlife. If this contribution is found to be a significant portion of the West Virginia nutrient load, additional measures to reduce these populations will be considered.

White-Tailed Deer

The Division of Natural Resources, Wildlife Resources Section (DNR-WRS) manages the State's white-tailed deer population using buck harvest trend data and the county as a management unit. A Buck Harvest Objective (BHO) is set for each county based on county variables as set forth in the "White-tailed Deer 5-Year Operational Plan." BHO's in the eight eastern counties range from two to four per square mile, with an average of 3.6. The annual buck harvest per square mile over time is reflective of the deer population in a given county.

The buck harvest per square mile for eight counties was 4.9 in 2002, and 3.9 in 2003. Continued liberalization of season lengths and bag limits on antlerless deer in the eight counties is an indication of the DNR's goal to bring populations in line with harvest objectives for this region of the State. The Agency is again recommending to the Natural Resources Commission a liberal antlerless deer season similar to that in 2003. Hunters and landowners have the opportunity to harvest a total of nine deer during the five weeks of deer hunting.

White-tailed Deer BMP's

- Meet Harvest Objectives: Landowners must facilitate the legal harvest of sufficient number of antlerless deer to achieve and maintain a BHO of 3.6 bucks harvested per square mile of deer range for the eight counties.
- Facilitate Harvest through Access: The agriculture communities and the DNR must work with landowners in the eastern panhandle to encourage hunter access for the harvest of deer. Only through a joint effort by the agriculture agencies, land-

owners/farmers and DNR will harvest objectives be met.
- Adjust Harvest Objectives: Once the objective is achieved, adjustments can be made to assure that over/under population is addressed.

Canada Geese

Canada geese (*Branta canadensis*) are highly mobile; therefore, it is inappropriate and impractical to address goose management issues on a county specific scale. The population appears stable, is well distributed throughout the region, and limited by available nesting habitat. Canada geese are migratory birds so the ultimate management authority is the U.S. Fish and Wildlife Service (USFWS).

Canada Goose BMP's

- Liberal Hunting Regulations: The DNR establishes hunting regulations within specific guidelines established by the USFWS. The DNR-WRS works with the USFWS to modify guidelines when appropriate, and West Virginia currently allows the maximum hunting opportunity available. Current seasons provide more than 70 days of hunting between September and January, and bag limits of five per day in September and three per day thereafter.
- Promote Goose Hunting and Hunter Access: Increase awareness of available goose hunting seasons. Encourage increased goose hunting. Increase hunter access to private land for goose hunters.
- Increase Utilization of Available Canada Goose Nuisance and Damage Control Programs: The U.S. Dept. of Agriculture – Wildlife Service (USDA-WS) is authorized by the USFWS to control Canada geese causing damage or nuisance problems. USDA-WS offers a variety of methods to control Canada goose problems, including habitat modification, exclusion, repellents, harassment, egg/nest destruction, and capture/euthanasia. Landowners/property managers with large concentrations of geese that cause property damage or nuisance problems should utilize the services of the USDA-WS.
- Creation/promotion of riparian buffers: Canada geese prefer open ground where visibility is good. Thick shrubs or tall grass on stream banks will deter geese from loafing directly on stream banks. Less fecal matter would be deposited directly on the stream bank, and the buffer strip would filter nutrient runoff from loafing areas outside the loafing zone.

Overall Cost of Implementation

The estimated total cost of implementing West Virginia's Potomac Tributary Strategy is $873,546,759 (Table 5). Costs are based on estimates in 2004 dollars. The "Total 2005-2010 Costs" column was obtained by adding capital costs and annual costs for six years. In order to put the cost for each load sector into perspective, Table 6 provides estimated nitrogen, phosphorus and sediment loads associated with each major source category.

Table 5. Estimated costs associated with implementing West Virginia's Potomac Tributary Strategy.

SECTOR	Capital Costs	Annual Costs	Total 2005-2010 Costs
Urban and Mixed Open			
BMP Implementation	$159,621,530	$23,904,599	$303,049,124
Technical Assistance, Outreach, and Administration	N/A	$488,847	$2,933,082
Urban and Mixed Open Total	**$159,621,530**	**$24,393,446**	**$305,982,206**
Point Source			
Domestic Wastewater Facilities	$125,988,750	$2,509,000	$141,042,750
Industrial Facilities	$138,720,000	$2,498,400	$153,710,400
Point Source Total	**$264,708,750**	**$5,007,400**	**$294,753,150**
Agriculture			
BMP Implementation	$178,747,525	$3,073,393	$197,187,883
Technical Assistance, Outreach, and Administration	N/A	$619,920	$3,719,520
Agriculture Total	**$178,747,525**	**$3,693,313**	**$200,907,403**
Forestry			
BMP Implementation	N/A	$11,424,000	$68,544,000
Technical Assistance, Outreach, and Administration	N/A	$560,000	$3,360,000
Forestry Total	**N/A**	**$11,984,000**	**$71,904,000**
Total Costs - WV Potomac Tributary Strategy	**$603,077,805**	**$45,078,159**	**$873,546,759**

Table 6. Estimated nitrogen, phosphorus and sediment loads in the year 2002 associated with each major source category. [29]

SOURCE	2002 Total Nitrogen Load (in million pounds per year)	2002 Total Phosphorus Load (in million pounds per year)	2002 Total Sediment Load (in million tons per year)
Agriculture	3.39	0.33	0.23
Forest	1.74	0.02	0.05
Urban & Mixed Open	1.56	0.08	0.05
Point Source	0.35	0.11	0.00
Atm Deposition over Water	0.06	0.00	0.00
Total	**7.11**	**0.55**	**0.33**

7. CHALLENGES TO IMPLEMENTATION

The actions that will be required to achieve the Cap Load Allocations for the Chesapeake Bay will have both financial and operational impacts on key sectors of the West Virginia Potomac community - chief among these are agriculture, industry, and the political jurisdictions. The West Virginia Tributary Strategy Stakeholder Group was convened to provide these communities, and others, with a seat at the table in deciding how to proceed and the opportunity to express their concerns about the process and changes that might be required.

Urban and Mixed Open

Reducing the loads from current urban and mixed open levels to meet the Cap Load Allocations will be a significant challenge on its own. Maintaining load caps in the face of certain growth will require concerted and genuine commitment to the strategy. Thus, regional planning and oversight is of paramount importance. This strategy relies heavily on implementation and enforcement of NPDES Phase II Stormwater Regulations, and counties, municipalities, and State agencies will most likely need increased capacity to carry out these requirements. Nutrient management for lawns and other managed grasslands will require a major paradigm shift in the way many of our lands are regarded and its successful implementation will be a major educational challenge. Outside of stormwater management implemented under the requirements of current stormwater regulations, significant funding for strategy implementation in the form of BMP installation, capacity-building and educational programs, and planning will need to be provided in the form of grants.

Point Sources

The budget for the State of West Virginia is extremely tight. There is little, if any hope for grant funding provided solely by the State. Federal grants must be available to West Virginia in order to meet the load goals outlined.

West Virginia currently has no water quality criteria for total nitrogen and total phosphorus. A committee has been assigned to recommend nutrient criteria and has projected a completion date of 2009. Until that time, and/or until the monitoring is implemented and accurate information is generated on discharges, WVDEP will pursue the strategy as outlined in Chapter 6 to address nutrient reductions.

Permitting of point sources in West Virginia is required to protect designated uses of local waters. West Virginia's distance from the Bay and lack of perceived benefits from the Bay cleanup make it a challenge to educate the affected regulated community on the need for these reductions and associated technology upgrades.

Agriculture

As noted in the introduction, West Virginia has been actively involved in pollution reduction programs for more than twenty years. Many of the region's farmers have participated in these voluntary programs, clear evidence of a grassroots movement to reduce the flow of agricultural pollutants into our waterways, including the nutrients and sediment that then flow downstream to the Chesapeake Bay.

A well recognized problem is that the tributary strategy process was set up on such a tight timeline that the final product may not be as desirable as some would like. The West Virginia Agricultural Subcommittee offers the following comments/concerns regarding the tributary strategy development process:

- **The loads that the Chesapeake Bay Watershed Model indicates as coming from West Virginia may be incorrect**. The farming community questions the assumption that the water quality in the Potomac Headwaters Region is poor. The agriculture community believes that actual numbers generated by the Chesapeake Bay model are inaccurate and unsubstantiated. The agriculture stakeholders believe that these numbers do not have validity or relationship to the actual nutrient and sediment contribution being made by agriculture in West Virginia. The WVDA has an aggressive sampling program in the area and is working to document actual water quality and capture load information on nutrients and sediment. This data will be used to check the modeled output and the associated Cap Loads should be modified if necessary.

- **Undue scrutiny has been placed upon the agricultural sector to reduce nutrients and sediment to the Chesapeake Bay**. Much effort and investment by the landowner and the government has been directed at agriculture over the past decade and much has been accomplished. It is the opinion of the farming community that the nutrient reductions have not been fairly proportioned with other sources of nutrients and sediment to the Chesapeake Bay.
- **The farming community believes that BMP's which farmers have been encouraged to install have not been given adequate efficiencies in the Chesapeake Bay Model.** These practices are now considered to be less efficient than at the time of installation. These reduced efficiencies now require additional BMP installation, and there is concern about the efficiencies not adequately reflecting the true BMP values.
- **West Virginia is not receiving any credit for past installation of non-cost-share BMP's.** Many local farmers opt out of government cost share programs due to the competitiveness of the cost share dollars and have installed land management practices without the benefit of government assistance. West Virginia has no system in place to track these BMP's due to lack of record keeping.
- **The expense of installing additional practices should come with stronger incentives.** Currently, landowner match is required for installation of additional BMP's, therefore reducing farm profitability and increasing tax burdens on some producers. Unlike private industry or municipal treatment plants, the farming community does not have the luxury of raising the price of the commodities produced to recover the costs of additional BMP's. It is the desire of the Agriculture Subcommittee to seek grant based funds for additional BMP installation as well as supplementary funds to cover maintenance and taxes.
- **Everyone should help clean up the Chesapeake Bay but not at the cost of farm families being forced out of business.** The nation's food supply relies upon the sustainability of the family farm. Installation of practices and the removal of prime farmland is expensive and affects the farmers' bottom line. The group feels that money should be spent on waterways that are firmly documented as impaired, rather than streams that exhibit minimal nutrient loads.

Wildlife Agencies

Several of the Potomac Tributary Stakeholders have voiced the concern that wildlife is contributing significant source of pollution in the Potomac watershed. The Division of Natural Resources, Wildlife Resources Section (WRS) does not consider white-tailed deer, Canada geese or any other free-roaming wildlife to be a source of pollution in West Virginia. Additionally, we are unaware of any other state, college or institution that has scientifically identified free-roaming wildlife as being significant contributors to water quality problems.

In most water quality discussions, wildlife contributions to nutrient loading are considered part of the normal background level. Wildlife are given this consideration because they are part of the natural system, have no alternative on selecting places to live and generally do not concentrate for long periods of time.

The WRS is tasked with managing the State's fish and wildlife resources for the benefit of its citizenry. Liberal hunting seasons and bag limits have been established that allow most landowners to manage wildlife populations on their property(ies) to remain within the carrying capacity of the land. Utilizing these liberal seasons and bag limits is the responsibility of the individual landowner. While the State can control harvest rates it cannot dictate hunter access. That is the landowner's responsibility.

The Best Management Practices (BMP's) developed for these species utilize harvest management objectives that have existed for many years. Directing landowner efforts toward meeting these objectives will benefit both the resource and the landowner. The WRS will continue to provide technical assistance to landowners; however, the landowner must be willing to provide the necessary access to their lands to effectively manage that population.

Managing Canada geese is a complex issue. They are migratory birds covered by the Migratory Bird Treaty Act. This act places ultimate regulatory authority with the U.S. Fish and Wildlife Service (USFWS). There are four distinct populations of Canada geese utilizing the Mid-Atlantic area of the United States at various times of the year and care must be taken to insure that management actions directed at one population do not adversely impact the other populations. Canada geese nesting in West Virginia's eastern panhandle are regularly observed and harvested in neighboring states which demonstrates the need for a regional approach to management. The various states, through the Atlantic Flyway Council, work with the USFWS to address harvest, management and regulatory issues.

Current hunting regulations are liberal and the U.S. Department of Agriculture's Wildlife Services (WS) has broad authority (and a variety of techniques) to address nuisance animals and damage complaints. Both hunting opportunity and WS assistance are underutilized. Goose hunting should be promoted to the general public, landowners, and nonresident hunters. Landowners in neighboring states have supplemented their incomes by providing goose hunting opportunities. Similar to deer management, access to private agricultural land is critical. Geese are very mobile and will move to escape hunting pressure, so hunters must have access over a broad area. The agricultural community must work cooperatively to address the access issue. Local governing bodies and/or landowners should fully utilize WS programs to address concentrations of geese in non-huntable areas and during periods when hunting is not allowed.

END NOTES

1. Compiled from U.S. Census 2000.
2. Compiled from WVU Bureau of Business & Economic Research. Year 2001.
3. 1997 Economic Census (www.census.gov/epcd/ec97/wv/); important sectors like mining, utilities, construction, agriculture and wholesale trade do not report on a county level. Farm products data from 1997 Census of Agriculture.
4. Percentages based on 1997 Census of Agriculture.
5. Compiled from U.S. Census 2000.
6. Compiled from WVU Bureau of Business & Economic Research. Year 2001.
7. 1997 Economic Census (www.census.gov/epcd/ec97/wv/); important sectors like mining, utilities, construction, agriculture and wholesale trade do not report on a county level. Farm products data from 1997 Census of Agriculture.
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9. Based on 1997 Census of Agricultural Data.
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