COMMONWEALTH of VIRGINIA

Shenandoah and Potomac River Basins Tributary Nutrient Reduction Strategy

Final Comment Draft

APPENDICES

October 1996

LIST OF APPENDICES TO VIRGINIA'S SHENANDOAH AND POTOMAC RIVER BASINS TRIBUTARY NUTRIENT REDUCTION STRATEGY

APPENDIX A

General Assembly House Bill 1411 and Associated Nutrient Reduction Strategy Elements

LIST OF ITEMS IN APPENDIX A

VIRGINIA ACTS OF ASSEMBLY -- 1996 RECONVENED SESSION

REENROLLED

CHAPTER 1031

An Act to amend the code of Virginia by adding in Chapter 5.1 of Title 2.1 an article numbered 2, consisting of sections numbered 2.1-51.12:1, 2.1-51.12:2 and 2.1-51.12:3, relating to restoration of the Chesapeake Bay and its tributaries.

[H 1411]

Approved April 17, 1996

Be it enacted by the General Assembly of Virginia:

1. That the Code of Virginia is amended by adding in Chapter 5.1 of Title 2.1 an article numbered 2, consisting of sections numbered 2.1-51.12:1, 2.1-51.12:2 and 2.1-51.12:3, as follows:

Article 2.

Tributary Plans.

§ 2.1-5.12:1. Development of strategies to restore the water quality and living resources of the Chesapeake Bay and its tributaries.

The Secretary of Natural Resources shall coordinate the development of tributary plans designed to improve water quality and restore the living resources of the Chesapeake Bay and its tributaries. Such plans shall be tributary specific in nature and prepared for the Potomac, Rappahannock, York, and James River Basins as well as the western coastal basins (comprising the small rivers on the western Virginia mainland that drain to the Chesapeake Bay, not including the Potomac, Rappahannock, York and James Rivers) and the eastern coastal basin (encompassing the creeks and rivers of the Eastern Shore of Virginia that are west of U.S. Route 13 and drain to the Chesapeake Bay). Each plan shall address the reduction of nutrient inputs to the chesapeake Bay and its tributaries. Each plan shall also summarize other existing programs, strategies, goals and commitments for reducing toxics; the preservation and protection of living resources; and the enhancement of the amount of submerged aquatic vegetation, for each tributary basin and the Bay. The plans shall be developed in consultation with affected stakeholders, including but not limited to local government officials; wastewater treatment operators; seafood industry representatives; commercial and recreational fishing interests; developers; farmers; local, regional and statewide conservation and environmental interests; the Virginia Chesapeake Bay Partnership Council; and the Virginia delegation to the Chesapeake Bay Commission.

§ 2.1-51.12:2. Tributary plan content; development timeliness.

A. Each tributary plan developed pursuant to § 2.1-51.12:1 shall include the following:

1. Recommended specific strategies, goals, commitments and methods of implementation designed to achieve the nutrient goals of the 1987 Chesapeake Bay Agreement and the 1992 amendments to that agreement signed by the Governors of Virginia, Maryland, and Pennsylvania, the Mayor of the District of Columbia, the Administrator of the United States Environmental Protection Agency and the Chairman of the Chesapeake Bay Commission, collectively known as the Chesapeake Executive Council.

2. A report on progress made pursuant to the "Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy" signed by the Chesapeake Executive Council on October 14, 1994, that is applicable to the tributary for which the plan is prepared.

3. A report on progress on the "Submerged Aquatic Vegetation Restoration Goals" signed by the Chesapeake Executive Council on September 15, 1993, that is applicable to the tributary for which the plan is prepared.

4. A report on progress related to the objectives of the "Local Government Partnership Initiative" signed by the Chesapeake Executive Council on November 30, 1995.

5. Specifically identified recommended state, local and private responsibilities and actions, with associated timetables, for implementation of the plan, to include the (i) person, official, governmental unit, organization or other responsible body; (ii) specific programmatic and environmental benchmarks and indicators for tracking and evaluating implementation and progress; (iii) opportunities, if appropriate, to achieve nutrient reduction goals through nutrient trading; (iv) estimated state and local benefits derived from implementation of the proposed alternatives in the plan; (v) state funding commitments and specifically identified sources of state funding as well as a method for considering alternative or additional funding mechanisms; (vi) state incentives for local and private bodies for assisting with implementation of the plans; and (vii) estimates and schedule of costs for the recommended alternatives in each plan.

6. Scientific documentation to support the recommended actions in a plan and an analysis supporting the documentation if it differs from the conclusions used by the Chesapeake Bay Program.

7. An analysis and explanation of how and when the plan is expected to achieve the element of subdivision 1.2 and 3 of this subsection.

8. A process for and schedule of adjustment of the plan if reevaluation concludes that the specific nutrient reduction goals will not be met.

9. An analysis of the cost effectiveness and equity of the recommended nutrient reduction alternatives.

10. An opportunity for public comment and a public education and information program that includes but is not limited to information on specific assignments of responsibility needed to execute the plan.

B. Tributary plans shall be developed by the following dates for the:

1. Potomac River Basin, January 1, 1997.

2. Rappahannock River Basin, January 1, 1998.

3. York River Basin, January 1, 1998.

4. James River Basin, January 1, 1998.

5. Eastern and western coastal basins, January 1, 1999.

§ 2.1-51.12:3. Annual reporting.

The Secretary of Natural Resources shall report by November 1 or each year to the House Committee on Chesapeake and Its Tributaries, the Senate Committee on Agriculture, Conservation and Natural Resources, the House Committee on Appropriations, the Senate Committee on Finance, the Virginia delegation to the Chesapeake Bay Commission and the Virginia Chesapeake Bay Partnership Council on progress made in the development and implementation of each plan. The annual report shall include, but not be limited to:

1. An analysis of actions taken and proposed and their relation to the timetables and programmatic and environmental benchmarks and indicators.

2. The results and analyses of quantitative or qualitative tests or studies, including but not limited to water quality monitoring and submerged aquatic vegetation surveys, which relate to actual resource improvements in each tributary. The results and analyses are to be clearly related to designated portions of each tributary.

3. A complete summary of public comments received on each plan.

4. The current or revised cost estimates for implementation of the plans.

5. The status of Virginia's strategies as compared to the development, content and implementation of tributary strategies by the other jurisdictions that are signatories to the Chesapeake Bay Agreement.

2. That a tributary plan developed pursuant to this act shall not be implemented without approval by an act of the General Assembly; provided, however, that any activity or program ongoing as of June 30, 1996, may be continued. This requirement shall not be construed as limiting in any manner the authority or ability of agencies of the Commonwealth to carry out their statutory or regulatory responsibilities.

Programmatic and Environmental Benchmarks and Indicators

HB 1411 requires that programmatic and environmental benchmarks and indicators be identified to track and evaluate implementation and progress. In other words, how will we measure the success of our efforts? To answer this question, we must first examine what the Commonwealth is already doing to monitor the health of the Potomac River. Next, we need to identify what additional benchmarks and indicators are needed. Finally, we need to determine cost and responsibility for the additional benchmarks and indicators.

Existing state agency efforts to track programmatic and environmental benchmarks and indicators are listed below:

Existing Programmatic Benchmarks/Indicators

- Annual reports on the status and trends of nutrient loads from point source discharges.
- Chesapeake Bay Preservation Act program implementation.
- Nutrient management plans completed and associated Nitrogen and Phosphate reduction estimates, and acreage covered by nutrient management plans.
- Virginia Agricultural BMP Cost Share program tracking, including BMP implementation, and Nitrogen and Phosphate reductions estimates.
- Erosion and Sediment Control program compliance tracking.
- Forestry BMP tracking and Silvicultural Water Quality Law compliance.
- Wetland and submerged land permit compliance tracking.

Existing Environmental Benchmarks/Indicators

- Periodic reporting of status and trends of nutrient loads at key locations in the Potomac River, such as, the fall line, and Shenandoah River.
- Periodic reporting of the status and trends of water quality in the Potomac River and the Chesapeake Bay relating to nutrient levels and their impacts on living resources and habitat (linkages to living resources include habitat requirements, dissolved oxygen monitoring, and plankton composition and benthic community monitoring).
- Distribution and changes in submerged aquatic vegetation coverage.
- Juvenile index for Striped Bass.
- Finfish and shellfish harvest data.
- Oyster spatset trends.

Federal programmatic indicators include tracking conservation tillage acres and highly erodible acres under the Conservation Reserve Program.

In addition to these existing efforts to track and evaluate implementation and progress, the actions listed below are recommended. These actions would help to promote greater local involvement and ensure the efficient and cost effective collection of programmatic and environmental data.

Recommended Programmatic Benchmarks/Indicators

- Identify and track point source discharges which have committed to install nutrient reduction, either voluntarily, by agreement, or by permit.
- Identify and track point source discharges which have installed and are operating nutrient reduction facilities.
- Expand existing efforts to track voluntary BMP installation.
- Encourage voluntary monitoring of Nitrogen and Phosphorous by wastewater Treatment plants using established protocols.

Recommended Environmental Benchmarks/Indicators

- Expand citizen monitoring efforts to ensure quality assurance and quality control and coordinate data collection and monitoring protocols for all tributaries.

The time and costs required to set up these additional monitoring and tracking programs is relatively minimal. Expanded citizen monitoring would require an additional staff position and modest training budget at an approximate cost of $75,000 per year.

Opportunities for Nutrient Trading

Introduction

An effluent trade involves an exchange of effluent control responsibility between discharge sources. Such an exchange creates opportunities to achieve water quality objectives in more cost-effective ways. The exchange of control responsibility is expressed in terms of an "allowance" or "credit" which specifies the quantity of effluent the discharger is allowed to release. The decision to trade is voluntary and sources engage in a trade only if both are better off following the trade. An exchange of allowances does not increase overall effluent discharge. An increase in discharges by one source is offset by a decrease in discharges by another source.

By purchasing additional allowances, a nutrient source that has a high cost of control can increase effluent discharge and avoid the installation of expensive pollution control measures. The source with the lower cost of nutrient control would agree to sell allowances only if fully compensated for assuming additional effluent control responsibilities. Total pollution control costs are reduced because the low-cost source is undertaking a greater share of pollution control.

To effectively achieve water quality objectives and lower effluent control costs, effluent trading systems rely on two elements found in any market -- financial incentives and individual choice. Consequently, effluent allowance trading is frequently referred to as a "market-based" environmental policy. The combination of financial incentives and decision-making flexibility provides regulated sources both the *reason* and the *means* for developing and implementing new low-cost ways of controlling pollution.

Market-based approaches place a cost or price on the source's decision to continue to discharge effluent. In a trading system, the cost is the price to purchase allowances from another source. Within a properly operating trading system, the financial incentives for dischargers to reduce costs drive the search for more effective effluent control strategies.

An effective trading system must also grant discharge sources the flexibility to respond to financial incentives. Flexibility means sources have discretion to choose how and at what level to control effluent discharge. Increasing decision flexibility may require a departure from the conventional way regulatory requirements are implemented.

Flexibility is facilitated in several ways. First, sources should be granted discretion on how best to control effluent discharges internally. Regulatory constraints on effluent control options dampen the source's willingness to seek low-cost control options. For instance, control technology requirements offer little opportunity for sources to explore alternative effluent reduction options. Likewise, regulated sources facing technology-based performance standards may view their control options as limited to the technology used to set the performance standard.[1]

Flexibility is also related to the number and type of potential trading opportunities.

Expanding the range of trading options for the regulated sources increases the possibility of finding low cost trading partners. The EPA estimated effluent allowance trading programs could reduce the costs of controlling effluent by billions of dollars.[2] By providing financial incentives and decision-making flexibility, however, trading systems create a pollution prevention dynamic that tends to *underestimate* actual cost savings. In order to avoid the cost of paying another source to reduce pollution, discharge sources first search for inexpensive ways to reduce discharges internally. Once a trading program is implemented, control costs are much less than originally predicted because sources actively seek and implement new, innovative discharge reduction strategies. In reviewing the air emission trading experience, one EPA source noted that control costs are typically "lower by a factor of two or less because the market is more clever than we are and technology marches on."[3]

Establishing an Effluent Allowance Trading System: Necessary Conditions

The establishment of an effluent allowance trading system requires the basic elements found in any market: a commodity to be traded, a demand for the commodity, and a structure in which people can trade the commodity. Unlike markets for most private goods and services, however, establishing a successful effluent allowance trading system requires active government administration and oversight. Some government entity must help define an effluent allowance. Government administration also structures and oversees the system of exchange between potential traders.

Defining an Allowance

An effluent allowance trading system starts by defining the commodity to be traded - an allowance. The task of defining the commodity, however, is contingent on being able to measure, monitor, and enforce effluent discharges.

The transfer of effluent discharge responsibility must be translated into common units of exchange. An allowance (or credit) specifies the quantity of an effluent a source may release into a body of water. To quantify an allowance, both the flow and concentration of effluent discharge must be measured. Once quantified, discharge can be expressed as total effluent (pounds, kilograms, tons, etc.) released per unit of time.

Because nonpoint source discharge enters water bodies over a wide area rather than an identifiable point, it is generally more expensive and more difficult to measure directly. If direct measurement of a discharge is prohibitively expensive, the total amount of allowances could be quantified indirectly based on the type of BMP *practice* implemented.[4] If this approach is followed, practices implemented will need to be translated into units of effluent reduced.

Translating control practices into effluent reductions may require additional information and research efforts. Computer models may be needed to estimate the total effluent load reductions achieved from the proper installation and maintenance of the practice. The accuracy and reliability of these estimates can be confirmed and refined through detailed field test research. After such computer models are developed, calculating effluent reductions from site-specific control practices would be more reliable and less expensive.

Effective monitoring also will be required to maintain both the economic and environmental integrity of the effluent allowance. Monitoring ensures the best possible quantification and reporting of effluent discharge sufficient for trading and provides safeguards against efforts to violate the established rules. Sources may need to install and maintain monitoring equipment, and regularly sample effluent. To facilitate the development of a trading system, monitoring cannot be prohibitively expensive, and must be reliable. If direct measurement of the discharge is not possible, monitoring will need to focus on the type of controls implemented. Thus, monitoring could involve some inspections into the proper implementation and maintenance of BMPs. Finally, some governmental unit will be needed to oversee the installation and operation of the monitoring program.

Water quality monitoring provides important effluent tracking information. In-stream monitoring provides valuable information linking changes in point and nonpoint discharges brought about by the trading system to the distribution and concentration of effluent through the watershed. Also, in-stream monitoring would function as a check to ensure that point and nonpoint control practices are implemented and operating properly.

An effluent allowance is worthless unless enforced. Effective enforcement motivates the discharger to seek alternative cost-control strategies rather than to discharge illegally.[5]

Creating the Demand for Allowances

In order for the effluent allowance to be valuable, the demand for pollution control methods must be created. Demand is created when sources are assigned or accept responsibility to limit discharges. Once effluent control responsibility is established, control responsibility must translate into meaningful, measurable limitations on discharge. Without a constraining discharge limit, there is no financial incentive to trade allowances or search for less expensive pollution reducing measures. A condition common to all environmental trading programs, "quantitative restrictions must be established before markets can operate"[6].

Creating a System of Exchange

For the exchange of allowances to occur, trading rules need to be clearly established. The trading environment specifies when and under what conditions trades take place. Government is responsible for the establishment and oversight of the system of exchange.

Effluent allowances trading systems can take three general forms - *open trading, closed trading,* and *full'closed trading*. An *open trading system* allows regulated sources to modify their permits to reflect an exchange of pollution control requirements. Open trading systems are common in the air pollution control program.[7]

A *closed* trading system sets a limitation or "cap" on effluent discharge for a geographical area and for a specified group of dischargers. The system allocates effluent control responsibility to individual group members in the form of allowances. Once allowances are distributed, discharge sources can trade as long as total effluent discharge within the system does not exceed the pollution cap.[8] The cap may be exceeded only if offset by effluent reductions from sources not under the cap.

A *full closed* trading system takes the closed trading concept and applies it to all effluent discharge sources in a given watershed. This approach sets the number of effluent allowances equal to the total permissible discharge load. *All* point and nonpoint source dischargers are then assigned an initial allocation of allowances. By including all sources under the effluent cap, a full closed trading system is the most comprehensive application of the trading concept.

Closed trading systems differ from open systems in a number of ways. In the closed trading system, a regulatory agency such as creates all effluent allowances. Closed trading is an explicit way to manage total effluent discharge for a group of dischargers. Since the number of allowances in the system is fixed, new or expanding sources may increase discharges only by acquiring existing allowances. In an open system, discharge limitations are imposed on individual sources and effluent allowances are only created when a source discharges less than the amount allowed under a permit. Arguably, an open system requires more regulatory oversight to confirm allowance creation, approve trades, and ensure that total discharges in the watershed do not increase over time.

Closed trading systems may require significant changes in the way regulatory agencies operate. Agency resources and attention may need to be directed away from devising BAT performance standards and requiring specific control technologies and toward discharge measurement, monitoring, and enforcement. Such a change will put less attention on how effluent is reduced and more emphasis on outcomes. By comparison, open systems represent a more incremental departure from the conventional permit process.

While trading can take a variety of forms, all trading systems require that government agencies create systems of exchange. A system of exchange should both facilitate and structure the interaction between trading participants. Defining a trading environment that provides ample trading opportunities and decision-making flexibility enhances the cost-saving potential of the trading system. Trading rules must facilitate exchange and assure that water quality goals are met.

Creation of an effluent trading system requires a careful delineation of rights and responsibilities among trading participants. An allowance trade should involve a clear transfer of financial and legal obligations for effluent control between traders. *Any ambiguity or impartial transfer of effluent control obligations reduces the willingness of sources to trade.*

The exchange of pollution control obligations should occur regardless of whether the trade is between regulated sources or regulated and unregulated sources.[9] For example, suppose a regulated point source pays a unregulated farm operation to install a BMP to reduce nitrogen discharge. In exchange for accepting the payment, the previously unregulated farmer accepts some nitrogen control responsibilities. In the event that the farmer does not properly maintain the approved BMP, noncompliance penalties should apply to the source responsible for the failure to control discharge - in this case, the farmer. Otherwise, if the point source can be found liable for the farmer's failure to control discharge, the point source will avoid trading opportunities with the agricultural sector.

Often specific terms of trade are established between traders. Trading ratios are frequently recommended for point-nonpoint trades. A 2:1 trading ratio, for instance, would require a two unit reduction in nonpoint source discharges for one point source allowance. The point-nonpoint nutrient trading ratio is usually greater than one to compensate for perceived uncertainty in nonpoint source control.[10] In setting the trading ratio, a balance must be struck between lowering pollution abatement costs and protecting water quality. If the ratio is set too high, reducing nonpoint nutrient loadings may no longer be the most cost-effective means for point sources to reduce nutrient discharges. On the other hand, if the ratio is set too low and uncertainty is great, there is a potential that water quality objectives could be jeopardized. Also, the ratio may change due to location. Those sources nearest the impact zone would have more weight than those farther away.

The establishment of an effluent allowance trading system also creates a number of administrative and organizational requirements. At a minimum, an administrative system must track the exchanges of effluent control responsibility. Effluent allowance trades alter the distribution of effluent in a watershed. As distance between trading partners increases, the probability that local ambient water quality will be impacted also increases. A government administrative mechanism may be needed to define the geographic range of permissible trades within the watershed, develop trade approval criteria, and oversee and monitor the distribution of effluent discharge in the watershed.[11] However, if the standards for an acceptable trade are too stringent or the trading area too limited, fewer trades will occur and the cost-saving potential of an effluent trading system diminishes.

The physical conditions surrounding nonpoint discharge sources also may require active government management oversight and assistance. If nonpoint discharges are not directly measured, effluent reductions (and thus the number of effluent allowances) associated with a given nonpoint source control practice (BMP) will have to be established. Reliance on point and nonpoint negotiating parties to establish effluent reductions from BMPs would introduce obvious incentives to overstate the effectiveness of a proposed nonpoint control practice, thus jeopardizing overall water quality.

In any market, traders will incur search and negotiation costs. Dischargers may also incur costs to gain administrative approval of a trade. Trade is facilitated by designing trading rules that reduce the costs of conducting a transaction. Trading costs can be reduced by the presence of a "broker" organization(s). Typically, effluent discharges arise from a variety of sources engaged in many different types of production activities. A broker coordinates trading between these different parties. Private entrepreneurs or public agencies can fill the broker role.

Finally, the trading participants must be certain that regulatory rules will not be subject to rapid or significant changes. Trading participants will be unwilling to pursue trades or low cost control measures if substantial risk exists that their effluent control investments will be devalued or undermined by rule changes. Regulatory and trading rule stability is an essential condition of a successful trading program.

Conclusion

Effluent allowance trading offers new opportunities to achieve more effluent reductions for every dollar spent. Trading provides regulated sources a reason to reduce discharges. In order to tap the cost-saving potential of a trading system, however, a successful trading program also must provide regulated discharge sources with decision-making flexibility in deciding how to manage effluent discharges.

The implementation of a system of tradable effluent allowances requires a government commitment of resources and effort. Successful trading systems require that government provide three basic conditions: the creation and definition of an allowance, a quantitative restriction on effluent discharge, and the creation and administration of a system of allowance exchange.

Endnotes

[1] Ackerman, Bruce A. and Richard Stewart. "Reforming Environmental Law: The Democratic Case for Market Incentives." *Columbia Journal of Environmental Law* 13 (1988): 171-199.

[2] USEPA. "President Clinton's Clean Water Initiative: Analysis of Benefits and Costs" EPA 800-R-94-02. Office of Water, Washington DC, 1994.

[3] *Compliance Options Report*, February 29, 1996, p. 4.

[4] Letson, D. "Point/Nonpoint Source Pollution Reduction Trading: An Interpretive Survey." *Natural Resources Journal* 32:219-232; Crutchfield, S.R., D. Letson, and A.S. Malik. "Feasibility of Point-Nonpoint Source Trading for Managing Agricultural Pollutant Loadings to Coastal Waters." *Water Resources Research* 30 (October 1994) 10: 2825-2836; Malik, A.S., B.A. Larson, and M. Ribaudo. "Economic Incentives for Agricultural Nonpoint Source Pollution Control." *Water Resources Bulletin* 30 (June 1994) 3: 471-479.

[5] Bartfeld, E. "Point-Nonpoint Source Trading: Looking Beyond Potential Cost Savings." *Environmental Law* 23 (1993): 43-106.

[6] Braden, J.B., N.R. Netusil, and R.F. Kosobud. "Incentive-Based Nonpoint Source Pollution Abatement in a Reauthorized Clean Water Act." Water Resources Bulletin 30 (October 1994): 781-791.

[8] Closed systems are often called "cap-and-trade" systems.

[9] Under the EPA's draft guidelines, the exchange of responsibility may not occur in a trade between regulated and unregulated sources. In some circumstances, the EPA guidelines suggest that regulated sources can be held accountable for the failure of a former trading partner to control discharges. EPA *supra* note 2 at 7-4.

[10] Bartfeld *supra* note 5.

State and Local Benefits

Following the 1983 Chesapeake Bay Agreement, substantial resources were devoted to the study of the causes of the Bay's deterioration and the effectiveness of different measures in restoring its ecosystem. Monitoring of the Bay indicated that certain areas, particularly the mainstem, suffered from acute anoxia, which had adverse consequences for fish and shellfish. Research established that this condition resulted primarily from nutrient enrichment in the form of phosphorus and nitrogen loading. A comprehensive model simulating the Bay's ecosystem attributed the loading to both point and nonpoint discharges throughout the watershed. The original model was capable of projecting dissolved oxygen levels for critical areas in the Bay during the average summer. Simulations showed that a reduction of 1985 nitrogen and phosphorus discharges in the range of 40 percent would restore the oxygen levels in the mainstem to a minimum level of 1 milligram per liter, a level shown by research to eliminate the anoxia problem.

In response to these studies and the continued need to protect and rebuild the Bay's natural environment, the signatory states signed the second Chesapeake Bay Agreement in 1987. The 1987 agreement established a concrete commitment to a 40 percent reduction in controllable nitrogen and phosphorus loads entering the mainstem of the Bay from 1985 point source and nonpoint source levels. Since the 40 percent reduction was based on achieving target oxygen levels in the mainstem of the Bay, the reduction goal implies a cap on discharges that should not be exceeded. The implied cap on nutrient loads was judged to yield benefits in excess of the costs of achieving the controls necessary to close the gap *and* then stay under the cap.

The signatory states agreed to encourage nutrient discharge controls on contributing sources. This agreement to strive for the 40% reduction by the year 2000 was to be reviewed at 5 year intervals. Each review was to consider the costs and the benefits to be achieved by the cap and the most effective means to secure the needed reductions. The next evaluation of the benefits of the cap will be part of the 1997 re-evaluation.

The 1992 amendments to the 1987 agreement have maintained the 40% reduction goal despite new models estimating that the 40% reduction in nutrient discharges would not completely solve the anoxia problem in the Bay's mainstem. The amendments have also suggest that a change of focus was needed to most efficiently address the anoxia problem. Monitoring, research and modeling all indicate that the lower tributaries, the James, the York and the Rappahannock, have little or no effect on anoxia in the main trench of the Bay. Each tributary will be examined to determine its contribution to anoxia in the Bay. The parties are expected to reconvene in 1997 to reevaluate the results of the tributary analysis and further refine their plan.

Since the computer models are designed to simulate water quality changes in the mainstem of the Bay, the program has not developed the necessary technical support to ascribe benefits from nutrient reductions for other the areas of Bay watershed. Monitoring efforts continue to document the changes in water quality (nutrient concentrations) and trends in indicators of living resources. The correlation between nutrient reduction trends, measures of ambient water quality, and indicators of living resources are positive. The causal elements responsible for these correlations, however, are not completely understood and more careful modeling is needed to establish a more precise link between control efforts and outcomes. Therefore, the request for assessments of the state and local benefits called for in HB1411 cannot be addressed without more extensive study and literature synthesis than were possible with the resource and time available. Furthermore, the consequences in the tributaries - the more localized effects - are even less easily documented.

When costs for making load reductions are modest there is little demand for documenting water quality benefits. The plans, and the process of plan development, for the Potomac strategy reflect a concern over the rising costs of achieving the cap as the final increments of reduction are approached.

As the costs of achieving the 40 percent goal rise, affected stakeholders are seeking confirmation of the water quality and living resource gains from these expenditures. In the coming years, the Commonwealth plan needs to be proactive in addressing the benefits throughout the watershed. *The state will assure that the 1997 reevaluation provides the best available and most compelling evidence of the effects of past and prospective spending on nutrient reductions and their contributions to living resource goals. This evidence will need to be developed for the individual tributaries as well as the mainstem of the Bay.*

Cost Effectiveness and Equity of Proposed Actions

The Potomac River Tributary Strategy planning process accepts that the nutrient cap (and associated reductions required to meet the cap) is justified by the benefits realized. It also seeks to achieve the cap. Given the acceptance of the cap, the Potomac River Tributary Strategy is expected to reflect the following principles:

- voluntary acceptance by discharge sources of the reduction practices needed to meet the cap;
- implementation of discharge reduction practices motivated by education, technical assistance, tax write-offs and cost-share incentives;
- selection of practices and recommended cost responsibility governed by local preferences guided by state technical support;
- a commitment to cost effectiveness (a cost effective strategy will meet the cap, and then accommodate economic and population growth under the cap, with policies and actions that minimize the total costs to the private economy and the taxpayer); and
- equitable distribution of cost (the costs of the strategy will be distributed in a manner judged to be equitable by the citizens and political leaders of the Commonwealth).

The Potomac River Tributary Strategy: Information and Decision Making

The Potomac River Tributary Strategy was assembled from four regional assessments. The regions were the Southern Shenandoah, Northern Shenandoah, Northern Virginia, and Lower Potomac. These assessments were based upon a further disaggregation to the county level. Technical assessments for each area were provided by DCR and DEQ of 1) current loads from the sub-areas, 2) effectiveness of control practices, and 3) costs of control practices. This information drew from readily-available information on loadings, costs and effectiveness. The primary source of information was the technical studies and estimates developed for the Bay Watershed Model. That model's resolution is quite coarse, with the sub-watersheds in the model averaging about 1000 square miles in size. Also the data are provided by hydrologic and not political boundaries. The loads from land uses, the possible control practices, the effectiveness of practices, and their costs are often site-specific. However, due to its course resolution the watershed model provides average loads over a limited classification of land uses. A limited number of BMPs and point source control practices are represented in the model and costs for a practice are admitted to reflect only some of the financial outlays made for implementation.

The regions had the opportunity to refine loading, cost or effectiveness estimates if there was credible, technical information from other sources. However, the information needed to be consistent with the approaches used in the models for the Bay Program. For example, monitoring studies that were offered as evidence of significant load reductions since 1985 might not be accepted as evidence of progress in load controls if the monitoring could not be reconciled with the modeling results or if the practices that were claimed to be implemented could not be evaluated within the modeling framework.

In addition to technical studies, each sub-area was provided information on the conditions necessary for the implementation of institutional reforms that would encourage cost effectiveness in meeting the cap. These included possible modifications in delivery of cost-sharing, adoption of nutrient allowance trading and methods of creative program financing. Each region was offered the opportunity to develop plans that included not only a desired set of practices for discharge control, but also recommendations for financing methods and institutions that could motivate cost effectiveness.

The opportunity for extensive and equal stakeholder participation was offered in each region. A stakeholder consensus was sought for any practice or institutional element that might be included in each regional plan. However, the individual assessments were developed with different degrees of stakeholder involvement and in the end, stakeholders had different commitments to, and agreements on, some of the findings and recommendations. These differences occurred within all regions, but were more pronounced in some regions than in others.

The Potomac River Tributary Strategy: A Summary Characterization

A strategy document was developed with the technical information and process described above. In that document possible nutrient discharge control practices for each region are described. In some regions, the practices and processes suggested for implementation were agreed upon by consensus of the involved groups. Those recommendations for action were conditioned by expectations for cost-sharing dollars for BMPs and financial support for technical assistance staff. However not all regions achieved consensus about the actions to be taken. Disagreements were based on a variety of considerations. These included questions about the additional load reduction needed to meet the 40% goal, questions about the types or practices that would be best suited to reduce loads and questions about who should (and would) pay for a control practice.

Some of the regional assessments provide suggestions for financing (e.g., preferred revenue tools), program administration (e.g., cost-share targeting), broader institutional reforms (e.g., nutrient allowance trading), and calls for enhanced technical support for long term plan implementation (e.g, more monitoring, cost studies, effectiveness studies). Unlike the lists of practices for controlling nutrient loads, these topics often are briefly alluded to, and the suggestion is for further study and discussion rather than for immediate implementation.

Evaluating the Technical Information for Cost Effectiveness

Total costs for implementation are computed as the cost per unit of nutrient discharge reduction times the number of units to be reduced. In turn, the cost per unit of reduction is determined by the cost of employing a practice (for example, cost per acre for conservation tillage or the cost for a BNR upgrade at a POTW) divided by the reductions achieved (for example, discharge reduction per acre with, versus without, conservation tillage). The reduction in nutrient discharges resulting from a practice is called "effectiveness" of the practice.

The total costs incurred may not be borne by the discharger. Costs to a discharger may be reduced by cost-share assistance from public or private sources or by the offer of tax advantages for adoption of certain nutrient discharge control practices. A redistribution of costs is made for equity reasons, but the total costs to the economy are unaffected.

Costs of Practices

Implementation of control practices in response to the Potomac River Tributary Strategy will result in five categories of costs. The following costs arise in both the public and private sectors:

- costs (charges) for capital investments such as BNR upgrades or conservation tillage equipment;
- annual operation and maintenance outlays for equipment, labor and materials necessary to limit discharge (These costs might be for the use of the capital equipment or might be for such annually recurring expense as soil and manure testing.);
- effects on profits from practices necessary to limit discharge (For example, there might be a reduction (or increase) in crop yields from a nutrient control practice.);
- discharger's legal and administrative costs to be in compliance with a regulation or incentive program (For example, a farm land owner may have to demonstrate that implementation of a control practice on their land warrants cost-share funding.); and
- public agency costs for education and technical assistance to administer financial incentives and to develop and enforce requirements for discharge reduction (These include expenses for staff, data gathering (e.g., water quality monitoring, cost estimation, etc.), technical and modeling analyses, and defining and enforcing program rules.).

The costs for practices and for the program, as reported in the Strategy, do not include all the cost categories listed above. For example, only capital costs may be included for some practices. Agency staff may account for the significant cost for some practices (for example, nutrient management plans), but staff costs are not included. The regional assessment processes identified the need for increased data, monitoring and modeling in order to better judge the progress, target cost-share funds and support use of nutrient trading. However, modeling and monitoring costs are not part of the cost estimates. In addition, costs for some practices (including BNR) can be site specific and vary over a broad range.

The agencies developing the strategy document were well aware of these limitations and point them out in the written materials. Unfortunately there are no readily available alternative estimates of costs. The absence of alternative estimates for costs of best management practices was confirmed after the DCR asked Virginia Tech to help improve the estimates. Also, the costs of point source controls can only be approximated pending more detailed studies of POTWs. However, no matter how refined the cost estimates they must be seen as best approximations. Experience has shown that actual costs differ from estimated costs once nutrient control operations begin.

Effectiveness and Types of Practices

Estimates of the effectiveness of control practices were drawn, initially, from the Bay watershed model for selected non-point source practices and from engineering studies that are not case-specific (e.g, BNR). These effectiveness estimates are recognized as approximations that will be improved upon implementation. This possibility was a matter of significant discussion in the regions where point source controls were expected to be a significant cost. In those areas, the possible effectiveness of BNR control was going to be judged after pending studies by Dr. Clifford Randall at Virginia Tech.

A second gap in the strategy's representation of effectiveness was highlighted by a disagreement over the use of monitoring data to document regional progress on load reduction. One jurisdiction wanted to refer to a stream monitoring study to show that they had reduced their loads since 1985. As several considerations enter into establishing the quality of a monitoring study, one of the issues raised in the discussion was that a jurisdiction might only receive reduction credits for practices that are capable of being evaluated by the watershed model. Unfortunately the model does not include a comprehensive list of practices (for example, cluster development can not be assessed).

Required Load Reduction

Working backwards from the 40% reduction goal, based on 1985 base load, a total cap on P and N discharge was calculated. The gap to be closed is computed as the current load estimate minus the cap. The gap will be closed whenever loads are reduced from the adoption of best management practices and point source controls. Of course, economic change and population growth has occurred since 1985. Increased economic activity and changes in the type and location of such activity may increase loads, working in the direction of increasing the gap.

The technical assessments in the strategy adjust the gap by acknowledging control practices put in place since 1985 that apply to the 1985 economic activities. Increased population since 1985 was accounted for only as it increased flows to POTWs. Currently, changes in the agricultural economy, in urban settlement patterns and the like have been considered as affecting loads within the Bay Watershed Model. In the regional assessments developed during the summer of 1996, some adjustments were made to recognize land-use changes. For example, the substitution of housing units for cropland was represented as reducing loads in Virginia assessment. However, because of model limitations and the way in which the data were interpreted the reduction credits associated with urbanization may not be fully realized. Only additional analysis can address that possibility.

Cost Implications

The analysis that was completed was the best possible given time and model limitations. Improved evaluations are possible with modest increases in analytical resources. However, given the discussion above it appears at this time the gap to be closed is uncertain, that the effectiveness of some practices remains to be established, and the costs of the practices that are described are incomplete. Also the costs will depend on the institutional forms for implementation and for the opportunities dischargers have to be creative in their efforts to reduce discharges. The result is that total costs are highly uncertain.

Nonetheless, implementation of practices to meet the cap will impose costs on dischargers. While the final public sector cost can not be estimated, the costs are significantly above the amounts currently allocated for nutrient discharge reduction from state appropriations. The strategy anticipates cost-sharing, more monitoring, improved modeling and evaluation, technical assistance, and new institutions that will increase costs for the public sector.

Evaluating the Plans for Cost Effectiveness and Equity

Equity of the Strategy

All costs are divided between those who create the discharge (discharger pays) and those who benefit from the improved water quality (beneficiary pays). If a discharger pays all costs, there would be no cost-share (or tax incentive) assistance offered and there would be an assessment made for the public cost of water quality program administration. On the other hand, beneficiaries may offer cash assistance to offset some of a discharger's costs. Beneficiaries may be defined as the directly identifiable individuals and groups (e.g., trout anglers) or the society at large. These beneficiaries help to pay whenever special user fees or general tax revenues collected by local, state or federal government fund cost-sharing subsidies or offset revenue losses from tax deductions and credits. Cash subsidies from beneficiaries for certain practices also may be available from non-government organizations such as Ducks Unlimited, Trout Unlimited or the Nature Conservancy. Also, one discharger may benefit when it is allowed to continue its discharge if it pays other sources to reduce theirs.

Stakeholders often make equity arguments about what they describe as the proper distribution of costs. However, there is no formula for determining a proper distribution of costs. Decisions about cost distribution rest on social judgments about matters such as the priority of private land rights, the nature of the damages caused by the nutrient discharge, and the discharge sources' financial ability to pay. It is not possible to measure the equity of cost distribution among beneficiaries and dischargers against some standard. It is only possible to describe the distribution of costs associated with different policies to facilitate the social judgments that must be made when defining the proper cost distribution. The level and allocation of cost share funds is a matter of equity that needs to be addressed if there are no currently existing programs. However, because the strategy is still emerging in terms of acceptance of responsibility and means of financing, it is not possible to provide the descriptive information needed for making equity judgments.

Cost Effectiveness of the Strategy

Efforts to be equitable without cash transfers can lead to cost ineffectiveness. Concerns for equity and acceptability have lead to some expectations of equal acceptance of responsibility of 40 % across the regions of the basin, within the regions, and (sometimes) between sources. The result may be higher costs than would be realized by reallocation of control points for non-uniform reduction. Equity could be addressed by cash transfer payments. Equity issues remain in the form of who should pay and whether localized water quality effects could occur. Cost effectiveness will be advanced by flexibility on where in the basin nutrient reductions can occur. This flexibility could be provided through implementation of nutrient allowance trading, changes in cost-share incentives, better analytical support, and improved inter-regional cooperation.

The combined cost effectiveness of the recommended practices cannot be judged with precision because of the cost estimation uncertainty noted above and the failure to reach a consensus on practices to employ in all the regions. However, where there is consensus among the stakeholders, where there is less than 100% cost-sharing so the stakeholders bear some cost, and where the control costs are modest and the effectiveness is clear, it would be reasonable to conclude that the recommended practices would come to an optimum solution that might be discovered with more complete data and analysis.

Where consensus was reached, the practices recommended for implementation would, in all likelihood, represent a good first step toward the implementation of a cost effective plan. However, a consensus was not reached in all localities about the best or least-cost way to achieve nutrient reduction. However, it is clear that to close the nutrient gap in a cost effective manner will require additional understanding and information about: a) the linkages between changes in nutrient loads and in-stream water quality, b) the nutrient load consequences from changes in land use patterns, and c) the costs and effectiveness of new nutrient reducing practices.

The cost effectiveness of the plan could be improved by development of an overarching program structure that would stimulate the search and discovery of future low cost nutrient control practices. Such a structure would rely less on targeting of specific practices for implementation and more on creating a incentive structure for individuals to decide what is the least-cost way to control nutrient discharges. Examples of such program structures include nutrient allowance trading, reforms to cost share distribution, and targeted fee systems. For example, Maryland implemented a cost-share program to encourage the installation of biological nutrient removal technology at POTWs. An alternative plan, however, would result in significant cost savings by allowing POTWs the flexibility to use private and public (e.g., cost-share) funds to implement alternative nutrient control technologies or to pay others to implement lower cost means. The state should devote energies to studying and developing what administrative program changes can be made to increase cost reducing incentives.

APPENDIX B

Chesapeake Bay Modeling Program

CHESAPEAKE BAY MODELING PROGRAM

Background

The 1987 Chesapeake Bay Agreement commits the signatories to develop and implement a basin-wide strategy to achieve a 40 percent reduction of nitrogen and phosphorus entering the mainstem of Chesapeake Bay by the year 2000. The Chesapeake Bay Modeling Program represents the tools through which management actions can be tested allowing for a more cost-effective selection of appropriate nutrient reduction strategies.

The objective of the Modeling Program is to determine the relationship between nutrient loads from both watershed and airshed and the control of eutrophication and anoxia in the Bay. As a result, emphasis is placed on mainstem water quality conditions, particularly dissolved oxygen in the Bay trench, with ancillary information about related water quality variables that influence the Bay's living resources such as dissolved nutrients and light attenuation.

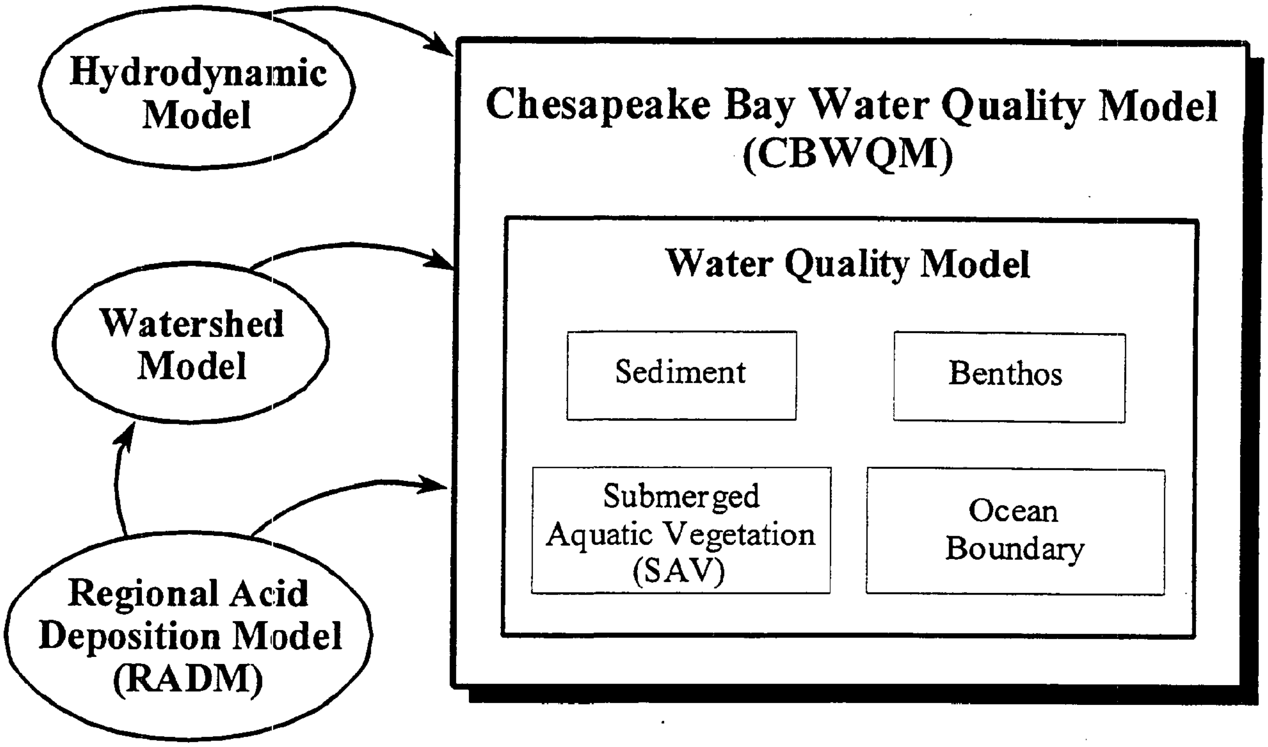
Development of the Chesapeake Bay Modeling Program began in 1987. Since then, the models that make up the Program have been updated several times to accommodate higher levels of resolution and a greater number of parameters. The following text describes the most recent versions of the models that make up the Program.

Modeling Program Structure

The Program is composed of four separate but linked models (Figure 1). They are as follows: 1) a Watershed Model that delivers point and nonpoint source nutrient loads from the 64,000 square mile watershed of Chesapeake Bay; 2) a Hydrodynamic Model that simulates movement of water via tides and currents; 3) a Regional Acid Deposition Model (RADM) which simulates conditions in the Bay airshed and assesses the role of atmospheric nitrogen to the Bay watershed itself; 4) a Water Quality Model that simulates the relationships between nutrients and primary production, as well as chemical processes in the water column affecting water quality. The Water Quality Model is built on the framework of five modules: a) submerged aquatic vegetation (SAV), b) sediment, c) ocean boundary, and d) benthos.

The Watershed (WS) Model includes three interfaced modules: a hydrology component, simulating runoff and subsurface flow for varying annual rainfall conditions (dry, average, wet); a nonpoint source component, in addition to atmospheric deposition and point source loads; and a transport component, simulating the movement and cycling of edge-of-stream loads to the tidal Bay. Output from this module includes such useful information as nutrient loads for each land use by model segment and river basin. The watershed model output provides the link between Best Management Practices (BMPs) and the water quality response of the Bay. More detailed discussion of this model follows later in this document.

The Hydrodynamic Model simulates the advective, dispersive, and tidal movements of water in the Bay, providing year round simulation. It has been improved to represent 1,973 cells in the surface layer and up to 15 vertical cells depending on depth in the Bay. This represents a substantial improvement over



characterizing the Bay's hydrodynamics with the previous Summer Average Water Quality Model that used

Figure 1. Chesapeake Bay Modeling Program Air - Watershed - Tributary Model

a total of only 584 cells, and only covered the period from March through October.

The Regional Acid Deposition Model (RADM) serves as link to both the Water Quality Model and the Watershed Model to evaluate the impact of atmospheric nitrogen to the Bay watershed. RADM has the capability of calculating annual atmospheric nitrogen oxide deposition amounts to 20-kilometer grid cells.

The Water Quality Model is able to simulate the water quality response in the Bay to nutrient controls throughout the watershed. It provides detailed simulation of the interactions among nutrients, light, algae, benthos, SAV, plankton, and sediments throughout the Bay and its major tidal tributaries. Output from the hydrodynamic submodel is used to simulate the movement of water and transport of material in the water quality submodel. Other inputs to the water quality model include nutrient loads from the watershed model, loads from point sources discharging directly to the Bay and tidal tributaries, and atmospheric deposition to the water surface, ocean boundary influences and interaction with the bottom (benthos).

Watershed Model

Since 1985, the Chesapeake Bay Program (CBP) has sponsored a series of projects to develop and improve a Watershed (WS) Model that could be used effectively to estimate nutrient loadings to the Bay and to evaluate the impacts of Best Management Practices (BMPs). A comprehensive work plan developed in September 1987 proposed a phased approach in the development and improvement of the WS Model. The first phase was designed to improve the nonpoint loading representation, refine and reevaluate the data input to the WS Model, and perform a preliminary recalibration to available water quality data for the 1984-85 period. This was used as the basis for the 40 percent nutrient loading reduction goal defined by the Chesapeake Bay Agreement.

The second phase was designed to focus on a better representation of the effects of BMPs that allow a more deterministic, process-oriented approach to BMP analysis and evaluation. In addition, WS Model enhancements were done to allow specific consideration of sediment-nutrient and bed interactions within the stream channel so that runoff, and subsequent delivery to the Bay, of dissolved and sorbed nutrient forms can be more accurately modeled. The second phase WS Model was then applied to the Bay drainage area to include sediment erosion, sediment transport, and associated nutrients, in addition to the current modeled water quality constituents, to provide input to the CBWQ Model.

The WS Model represents the entire drainage area to the Chesapeake Bay as a series of land segments each with relatively uniform climatic and soil conditions. Within each model segment a variety of land use categories are each modeled with its own parameter values, and each land use provides surface and subsurface nonpoint loadings to the stream draining that model segment. Each model segment also corresponds to a single channel reach that is then linked sequentially with other channel reaches in other segments to represent the major and minor river systems that comprise the Bay drainage. Figure 2 shows the model segments that make up the Potomac River Basin portion of the Chesapeake Bay.

Additional improvements to the WS Model are currently underway. The simulation period data have been updated through 1994. The number of model segments has been increased to improve overall resolution, an improved GIS scale has been utilized, and separate models have been developed for each land use. In addition, an improved reservoir water quality simulation plus inclusion of sediment/river bottom scouring will be included in the updated simulation. Despite these changes, it is expected that overall nutrient loading rates generated by the Program will remain relatively the same.

Land Use Data

This section documents the methods used to provide a 1985 base year land use data set for use in the WS Model. The 1985 base year was chosen to be consistent with the 1987 Bay Agreement, and because it was a recent year that had sufficient land use information coverage from the different sources used. The WS Model land uses are forest, conventional till cropland, conservation till cropland, cropland in hay, pasture land, animal waste or manure acres, urban and water areas (Table 1).

A consistent methodology of determining land use for the entire Bay basin was developed which obtained particularly detailed information on agricultural cropland. The principal sources of information provided data on land use at a county level throughout the basin. Principal sources were the U.S. Census Bureau, the U.S. Forestry Service, and the U.S. Department of Agriculture. Also used to advantage was the U.S. Geological Survey Land Use and Land Cover data for areas of water (rivers, lakes, and reservoirs) and urban land.

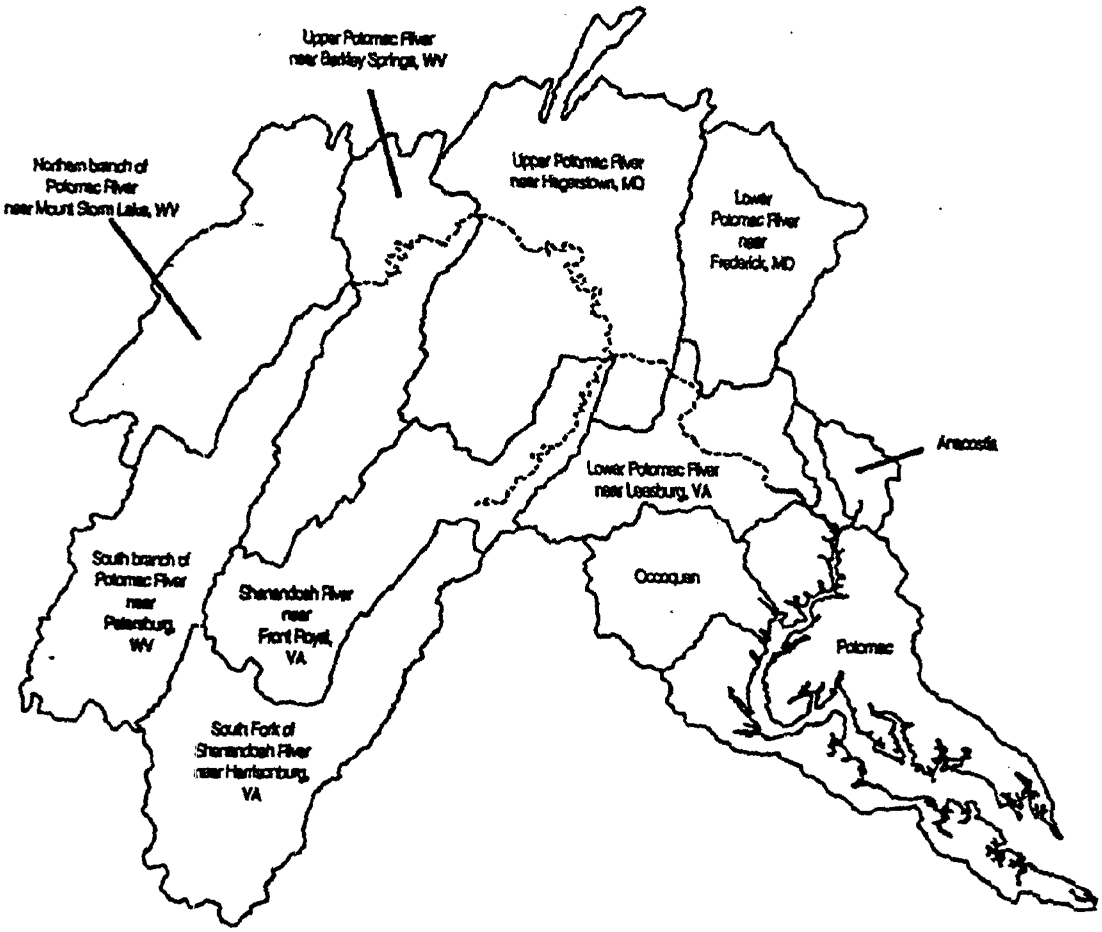


Figure 2. Watershed Model Segments in the Potomac River Basin.

Table 1. Land-Use Categories Used in the Watershed Model

Land Use	Percent (%) Of Watershed
Forest	59.46
Conventional Tillage	5.81
Conservation Tillage	6.14
Hayland	8.08
Pasture	9.09
Animal Waste	0.03
Urban	10.11
Water Surface	1.28

Cropland Tillage

The WS Model has three categories of cropland - conventional tillage, conservation tillage, and hayland. Conventional tillage represents fall and/or spring-plowed conventionally tilled cropland. Conservation tillage represents those tillage practices that result in a residue cover of at least 30 percent at the time of planting.

Tillage information on a county level for the 1985 data input base was obtained from the Conservation Technology Information Center (CTIC), West Lafayette, Indiana. The CTIC is a clearinghouse for information on soil conservation and, in particular, cropland tillage practices. The CTIC conducts an annual survey by county of acres of crops grown under different tillage systems.

Hay acres were compiled from the 1982 Census of Agriculture from the category of harvested, "hay, alfalfa, and other tame, small grain, wild, grass silage, or green chop." The hay acres were transformed to a percentage of the Census of Agriculture total harvested crop acres, and the area of hay acres were determined by this proportion applied to total model cropland area.

Water Acres

Water acres are defined as the area in rivers, creeks, streams, canals, lakes, and reservoirs. Only non-tidal waters of the basin are considered in this land use category. Tidal waters are included in the hydrodynamic and water quality model components of the CBWQ Model.

Manure Acres

Manure acres is a derived land use that represents the production of nutrients from manure produced in a segment. These acres do not represent acres of concentrated animals, nor do they represent manure piles or manure stacking facilities, rather the manure acres are use to represent the aggregate of all these activities.

Tons of manure produced were estimated from the livestock numbers in the 1982 Census of Agriculture. This tonnage was divided by a "composite animal unit" representing the annual production of 15 wet tons of manure, per animal unit. An animal unit is defined as 1000 pounds of animal weight. Manure in this context is defined as including voided material, spilled feed, soil and bedding material.

Animal units of poultry, swine, beef, and dairy were adjusted to account for the predominant manure handling practices. The total adjusted animal units were divided by a "composite animal density" of 145 animal units per acre, yielding the number of manure acres.

Urban Land Subcategories

A GIS system was used to differentiate the urban land into five subcategories. These are as follows: 1) Residential - ranging in density from very high in urban cores to low density with units on more then one acre. (With an average impervious value set at 30% for the WS Model.); 2) Commercial - including urban central business districts, shopping centers, commercial strip developments, warehouses, etc. (Impervious value set at 75%.); 3) Industrial - including light and heavy manufacturing plus mining operations, stockpiles, and spoil areas. (Impervious value set at 80%.); 4) Transportation - roads, railroads, airports, seaports, and facilities associated with the transportation of water, gas, oil, electricity, and communications. (Impervious value set at 10%.); and 5) Institutional - urban parks, cemeteries, open land, playgrounds, golf courses, zoos, and undeveloped urban land in an urban setting. (Impervious value set at 50%.).

Urban land imperviousness was determined for each model segment based on the five subcategories of urban land. Imperious values were derived from the EPA 1982 report, National Urban Runoff Program except for transportation which was provided by Federal Highway Administration. The model simulates one urban land use based on the area-weighted parameter of imperviousness of the above five subcategories. Using the proportion of the total urban area in the different subcategories and the value of imperviousness described above, a single area-weighted imperviousness value was determined for the single aggregate urban land use modeled.

Crop distribution for Conventional and Conservation Tillage

Due to computational limitations for modeling at the scale of the Bay drainage, the WS Model required the development of a "composite crop" to represent the cropland tillage categories in order to evaluate land cover, nutrient application rates, and expected plant uptake rates. To develop a "composite crop" for each cropland model segment, the crop distribution was needed. These distributions were developed as follows:

1. The 1987 Agricultural Census information was used to develop the crop distributions (for the cropland total) for the following aggregated crop categories for each model segment: a) soybeans; b) corn-grain, corn-silage, sorghum, and other miscellaneous crops; and c) small

grains.

2. Multiplying the total cropland by the crop category percentages in the above step produced the total acreage for each crop category.

3. The CTIC 1985 Survey reports for each state provided statewide values for the percentage of each crop in conservation tillage. These percentages were used to distribute the total acres in each crop into conventional and conservation categories in each model segment. The percentages used in Virginia were 66.0% for soybeans, 67.4% for corn, and 50.0% for small grains.

4. The Agricultural Census information was then used to determine the breakdown of corn-grain and corn-silage acres so that separate parameter values could be used for each, (see later discussion under land surface cover and erodibility parameters).

Watershed Model Segment Assignment of Land Use

The county land-use data were converted to a model segment basis. Consistent with the level of spatial detail of the model, it is assumed that all land uses are evenly distributed within a county. Land uses by county are proportioned by percent of the county in each model segment. The percent of county area in each segment was determined by GIS.

Atmospheric Sources

The WS Model accounts for the atmospheric of nitrogen and phosphorus directly onto water surfaces for the 1984-87 period of simulation. Deposition of water surfaces is explicitly modeled. Deposition of inorganic nitrogen to land surfaces is explicitly included in the agriculture production land uses (conventional cropland, conservation cropland, and hayland) through the inclusion of atmospheric loads with nutrient applications of fertilizer and manure. Atmospheric deposition to remaining land uses (forest, urban, pasture) is implicitly included by calibration to the annual loads observed in field measurements.

The ammonia and nitrate loads for each model segment were determined by using annual isopleths produced by the National Atmospheric Deposition Program (NADP). The nitrate and ammonia loads vary spatially by model segment with the highest deposition generally in the northwest areas of the bay basin and the lowest deposition in the southeast area of the basin. Orthophosphate, organic nitrogen and organic phosphorus are not typically monitored by NADP, therefore annual loads of these constituents were developed by EPA. Their data does not show year-to-year or spatial variation of these parameters, so constant loads are used for all years. The data was reformatted as a monthly load to the total model segment water area. The data is input to the model in the same manner as the point source inputs, i.e., the monthly totals are divided evenly over each hour of the month.

Point Sources

Point-source input to the WS Model were developed for the 1984-87 period. These data represent all loadings from municipal wastewater and industrial facilities that discharge to channel reaches in the basin. Point sources discharging below the Fall Line were considered to be a direct discharge to the tidal Bay and were not included as part of the WS Model input data.

Municipal dischargers were selected based on a flow of 0.5 million gallons per day (mgd) or greater. This criterion captured more than 96 percent of the municipal point source flow. The remaining (approximately) 4 percent of point source flow was from numerous small discharges. Industrial dischargers were included in the point source data set if the load from the industrial source was equivalent to the total nitrogen, total phosphorus, or biological oxygen demand load of a 0.5 mgd municipal point source with secondary treatment.

Data for all facilities that discharge to streams within a model segment were aggregated to obtain a single set of point source loads for the corresponding model reach. The data sets consist of monthly total loads for each reach for the 1984-87 period. It was determined that monthly values represented the most appropriate resolution for the available data.

Loads and other related parameters for point sources were derived in the following manner. If state National Pollution Discharge Elimination System, (NPDES) data were available, they were used preferentially. When no state NPDES data were available, data from the 1985 Point Source Atlas were used. As a last resort, defaults were calculated for missing data. Defaults for municipal dischargers were based on default concentrations applied to the municipal flows.

Development of Model Segment Nutrient Application Rates

The key element in the application of the WS Model to the cropland areas of the model segments was the development of the nutrient (fertilizer and manure) application rates used as input to the model. Development of the model input application rates involved aggregating input from Virginia, Maryland, and Pennsylvania, developing assumptions appropriate to the scale of the Bay drainage, and calculating rates corresponding to the "composite crop." The major data needs and issues involved in these calculations included the following: a) fertilizer and manure application rates, procedures, and timing for each major crop, and atmospheric deposition estimates; b) crop distributions for conventional and conservation tillage; c) composition (i.e., organic and inorganic fractions) of fertilizer and manure nutrients; d) application/volatilization losses of manure nitrogen; and e) model representation of application procedures and timing.

The initial fertilizer application rates for each major crop category for each model segment were developed by each of the individual states. These were then refined in order to clarify how the rates (and percentages) would be used and interpreted within the framework of the modeling calculations. Much of the information was extracted from county-level SCS or Extension Service data, supplemented by best professional judgement estimates when information was not available. Estimates were used when a particular crop represented a minor fraction of the cropland in a specific model segment.

For model segments that crossed state boundaries, a weighting procedure was used to estimate application rates when the appropriate information was available from the adjoining states and the areas were significant (e.g., more than 10 percent of the model segment). The weighting was done for each crop application rate before calculating the model segment composite rate for the composite crop. The percentages of croplands receiving fertilizer, manure, and both were usually consistent and values for one state were adopted.

Land Surface Cover and Erodibility Parameters

The first parameter of this category represents the fraction of the land surface that is covered by canopy, crop residue, leaf litter, etc. and is subsequently protected from raindrop erosion. Cover is one of the primary determinates of the generation of sediment fines that can be transported by runoff as part of the erosion process. The twelve monthly values used in the model represent the land cover on the first day of the month. Cover is interpolated daily in the model between the monthly cover values. Values for conventional cropland and conservation cropland are based on the crop types grown in the segment. Major crop types aggregated from harvested acres in the 1987 Agricultural Census was used to obtain unique cover values for conventional and conservation cropland in each model segment.

The second parameter represents the slope for overland flow. This parameter influences the simulation of hydrology and sediment erosion. Land slope data were derived from the National Resources Inventory (NRI) data base. The county-based NRI distribution of slopes was combined with the proportion of different county land uses to develop an average slope for cropland, woodland and pasture in each segment. Urban data were not available from this data set. The slope of the urban land was set equal to that of cropland.

The third parameter represents a coefficient in the model soil fines detachment equation. This parameter in conjunction with the cover parameter controls the amount of fine sediment detached by raindrop impact and is then available to be transported by overland flow. It is usually estimated by assuming it is equal to the erodibility factor, K, in the Universal Soil Loss Equation.

Hydrologic, Sediment Loading, Dissolved Oxygen, and Water Temperature Simulation

The hydrology, sediment, dissolved oxygen, and runoff water temperature simulations are based on the same procedures for all pervious land use categories. The hydrology for impervious land use categories (i.e., urban impervious and manure acres) uses a different submodel of the WS Model. Since these submodels are common to all the land uses, a brief overview of the simulation approaches is provided below.

The hydrologic submodel calculates a complete water balance for each land use category within the watershed, or model segment, by converting input rainfall and evaporation data into the resulting surface runoff, changes in soil moisture storage for various portions of the soil profile, infiltration of water, actual evapotranspiration, and subsequent discharge of subsurface flow (both interflow and baseflow) to the stream channel. During storm events, rainfall is distributed between surface runoff and soil moisture storage compartments based on nominal storage capacitates and adjusted infiltration rates. Between storm events, water storage in the soil profile is depleted by evapotranspiration and subsurface recharge, thereby freeing up soil moisture capacity for rainfall inputs from the next storm.

For impervious land surfaces, the hydrologic simulation includes only the processes of detention or retention of incident rainfall, evaporation from retention storage, and overland flow routing of the rainfall excess.

The sediment loading simulation performs for all pervious land use categories, i.e., all land uses except urban-impervious and manure acres. The sediment processes and fluxes simulated by WS Model including detachment of sediment particles by raindrop impact, net vertical sediment input (or export), attachment or aggregation of fine sediment particles and wash-off of detached sediment.

Water temperature of runoff and the dissolved oxygen concentration are calculated for the pervious land categories. Actually, the WS model calculates soil temperatures for each of the defined soil layers - surface, upper zone, lower zone, and groundwater zone - and the flow component originating from that zone is assumed to be at the calculated soil temperature, except that the water temperature cannot be less than freezing. The surface soil temperature and surface runoff temperature is then used to calculate the dissolved oxygen concentration of the overland flow, which is assumed to be at saturation.

For impervious surfaces, the procedures for runoff water temperature and dissolved oxygen are identical to those used for pervious surfaces; the submodel uses a linear regression to calculate impervious overland flow temperature, which is then used to calculate the dissolved oxygen concentration.

Comparison of Expected and Simulated Nonpoint Loading Rates

How nonpoint nutrient loading rates change as a function of land use, climate, soil characteristics, topography, management practices, and other human activities has been a major topic of environmental concern and investigation for more than twenty years. However, in spite of this concern, exact quantitative predictions of expected loading rates for site specific conditions are difficult to derive from available field monitoring due to the wide variations observed even within a specific land use under similar soils, topographic, and climatic. Nonpoint nutrient loadings are notorious for their large range of potential values.

The first steps in the nonpoint calibration effort involved a review and evaluation of nonpoint loading rates associated with individual land uses and nonpoint parameters used in the WS Model. The goal was to define the expected range of loading rates from the available literature, as a basis for evaluating and calibrating the model predicted loading rates, and determine if any changes or adjustments to the original nonpoint parameters could be justified. State representatives on the Chesapeake Bay Program Nonpoint Source Workgroup provided data summaries of monitoring projects and studies conducted in their respective regions to supplement the efforts of EPA on this task.

The rates are quite variable with cropland showing the greatest variability and forest the least variation. For urban pervious and impervious areas, the average annual National Urban Runoff Program (NURP) loads were used to supplement the information and guide the calibration adjustments. Selected parameter values were then adjusted as needed during the calibration process based on the observed data and model predictions for the calibration sites throughout the drainage area. Comparing the mean annual loading rates with the expected means and ranges suggests the following general conclusions:

1. Generally the simulated annual loading rates are within the range of expected values with some deviations. Annual rates for orthophosphorus (PO_4) from forest and pasture, and ammonium (NH_4) from forest occasionally tend to be toward the lower end of the defined range. Annual PO_4 rates from the cropland areas are somewhat higher than the defined range.

2. For non-cropland categories, the total nitrogen and total phosphorus simulated values compare favorably with both the expected means and ranges.

3. For the cropland categories of conventional tillage, conservation tillage, and hay, the total nitrogen and total phosphorus simulated values are generally close to the mean, while the tillage categories are usually greater than the mean but well within the observed range.

4. Comparing conventional and conservation tillage segments, conventional produces higher loading rates for most model segments for all pollutants except nitrate (NO_3), where conservation is sometimes the higher rate.

5. The highest rates for total nitrogen and total phosphorus are for the manure segment, followed by conventional tillage, conservation tillage, urban, hay land, pasture, and forest. The order changes slightly for individual pollutants.

6. The manure segment loading rates are the most uncertain since there is very little information on which to assess their validity.

7. For ammonia (NH_3) and PO_4 from cropland, the simulated ranges are generally 0.5 to 4.0 lb/ac and 0.2 to 2.0 lb/ac, respectively; these ranges are generally higher than the limited observed data for these forms, but they are not unrealistic based on the general literature.

8. Urban pervious and impervious areas provide loadings that are comparable to the hay and pasture categories, and for some nutrient species (e.g., NH_3) the loadings are similar to the tillage categories. Thus, urban land can be a significant source of total nonpoint loadings in urbanized model segments.

APPENDIX C

Methodology of Nutrient Reduction Calculations

METHODOLOGY OF NUTRIENT REDUCTION CALCULATIONS

Introduction

Developing the nutrient reduction options presented throughout this appendix and its associated documents required the use of a broad assortment of data and reference sources. These include discharge monitoring and treatment plant performance data, monitoring and research literature, census and land use data, and the results of water quality monitoring and watershed modeling efforts. Given the intrinsic diversity of nutrient pollution sources and control measures, there is a wide range in the estimates for nutrient reduction effectiveness of various best management practices (BMPs). Consequently, the reduction efficiencies given for the measures described here and elsewhere are based on best available information as it applies to each of the specific nutrient reduction measures. Furthermore, these reduction efficiencies have been agreed to by all the signatories of the Chesapeake Bay Agreement.

Nutrient Base Loads for Virginia's Potomac River Basin

Before determining which measures could work toward meeting the 40% reduction in nutrients (nitrogen and phosphorus) in Virginia's Potomac Basin by the year 2000, it is necessary to identify the base nutrient loads by source, including land-use category or discharge point. (It should be noted that, as a result of the issues discussed below, some changes were made to the data that was cited in the August 1995 document, Virginia's Potomac Basin Tributary Nutrient Reduction Strategy.)

Nonpoint Source Nutrient Loads

To develop the nutrient base loads for each locality, calculations had to start with the full Potomac River basin nonpoint source loads by Chesapeake Bay Watershed (WS) Model segment and land use category. In developing the Watershed Model, the Chesapeake Bay Program collected land-use information on a county level, including any cities and towns that fall within, fully or partially, a county's boundary. Specifics of the development of the land use inputs can be found in Appendix B: "Chesapeake Bay Modeling Program." Due to computational limitations for modeling at the scale of the Bay drainage, the WS Model assumed all land uses are evenly distributed within a county. This land-use cover was converted to one based on WS Model segments by the percentage of each county found within each model segment. The resulting land-use breakdown by county and model segment permits one to use the corresponding nutrient loading rates and transport factors determined in the WS Model by segment to be used within this county-segment land-use breakdown to calculate nutrient loads by locality.

Nutrient loads from above the fall line are "delivered" to the tidal tributary using transport factors derived from the WS Model. Due to in-stream chemical and biological cycling, only part of the load coming from above the fall line reaches the tidal portion of the river. These factors vary by river basin, and reflect such differences as distance to the fall line and scouring rates. For the Potomac basin, the delivery factors that apply in Virginia range from 69% to 91% for nitrogen, and 80% to 91% for phosphorus.

Use of the land is not static in nature and therefore it is susceptible to change over time. As the land cover changes, so does its nutrient load. The primary land use changes having an impact in nutrient loads in the Potomac River basin are in two significantly different areas. The first is the shift of type and distribution of agricultural activities found in most of the Potomac basin. The second is the large population increase seen in portions of the basin and its associated urbanization. The following paragraphs discuss the methods used to determine these land use changes and their associated nutrient load changes.

Shifts in Agricultural Production. The agricultural community within the Potomac River basin has undergone significant changes in the extent and type of agricultural activities it engages in throughout the basin. Except for a few localized areas, most of the basin has seen a shift from the more nutrient load intensive row crop production to hayland or pasture. Land has also been taken out of agricultural use altogether and is accounted for in the next section on urbanization. In addition, except for poultry, the number of animals found in the basin has seen a drop over time. Several factors could account for these agricultural shifts and determining those causes goes beyond the scope of this discussion. However, this shift in agricultural activities has been commented on by numerous knowledgeable sources including members of local soil & water conservation districts, Department of Conservation & Recreation (DCR) staff, Cooperative Extension staff, various local governmental agencies, etc., and is documented in the last several federal agricultural censuses conducted in the state.

The basic methodology used to calculate this shift in agricultural activities is as follows:

1. The Agricultural Censuses of 1982, 1987 and 1992 were used to determine the rate of change over time for land under cultivated crops, hayland, and pasture for each county having any portion of its land area within the Potomac River basin.

2. The rate of change was then applied to the number of acres under these land uses by county as found in their 1985 base land use breakdown to determine the land use distribution for 1994.

3. The number and type of animals for each county were also reviewed for any change over time in the Agricultural Censuses. By using the same method as used in the WS Model, the number and type of animals were converted to manure acres and the rate of change was determined and applied against each county's 1985 manure acres to find its 1994 value.

4. To determine the year 2000 land use changes, the rates of change determined above for each county where used in a straight line progression except those counties where agricultural preservation measures are in place or land where an adjustment factor was introduced based on discussion with local and/or state staff having expertise in these activities.

Population Increases and Urbanization. Increases in population in the Bay watershed and their corresponding impact on land cover since 1985 can have significant impacts to nutrient loads. Calculations have been completed to determine the magnitude of these changes throughout the Potomac River basin.

The basic methodology used in these calculations is as follows:

1. Assume the vast majority of population increases since 1985 results in urbanization. Therefore, increase population results in a corresponding increase in urban land area.

2. Data sources include U.S. Census Bureau for historic population data and geographic boundaries by census tract and/or similar area; Weldon Cooper Center for Public Service (University of Virginia) for recent population estimates by county; and, Virginia Employment Commission for future population projections by county.

3. Assign census tract or similar census-based geographic boundaries to its corresponding county and WS Model segment by use of a geographic information system (GIS).

4. Relative population changes and annual growth rates since 1985 were determined for 1990, 1994, and 2000.

5. Use the population annual growth rates to calculate the increase in urban land by county-segment area. Proportionally adjust areas of remaining land use categories to reflect the reduction of non-urban land use.

Point Source Nutrient Loads

Information used to develop the baseline point source nutrient loading estimates include the monthly discharge monitoring report (DMR) flow values for 1985, and nutrient concentration data from a variety of sources. Nutrient concentrations for publicly owned treatment works (POTWs) were either reported values or flow-weighted defaults that were computed using information on typical nutrient levels discharged by secondary treatment plants. These defaults are 6.4 mg/l for total phosphorus and 18.7 mg/l for total nitrogen. Since implementing the phosphate detergent ban in 1988, the default for phosphorus has dropped to 2.5 mg/l.

Sources of reported values used to develop annual load updates include DMRs, Voluntary Nutrient Monitoring Program (VNMP) data, owner-generated data, compliance monitoring, special monitoring, and permit files. Industrial nutrient concentrations came only from these reporting sources. No default values were developed for the industrial dischargers.

Owner-furnished discharge data provided during the assessment process have been used in the most recent load estimates and projections for future load figures. Work continues to verify sampling and analytical methods, and although the period of record may be less than a full year's data, the information has been used to characterize the discharge, especially to replace the use of default values. It has been generally agreed that monitoring must continue as plant flows increase in order to document whether or not current performance levels are maintained.

Annual discharged loads for each plant were calculated using the equation:

ANNLD = AVGFLOW x AVGCONC x 8.34 x 365

where: ANNLD is annual load in pounds per year
AVGFLOW is average of 12 monthly DMR flow values
AVGCONC is average of reported nutrient concentrations or default value
8.34 is a conversion factor to translate mg/l per MGD into lbs/day
365 is number of days per year

As with nonpoint source loads, nutrient loads discharged from point sources above the fall line are "delivered" to the tidal tributary using transport factors derived from the WS Model. Due to in-stream chemical and biological cycling, only part of the load coming from a plant above the fall line reaches the tidal portion of the river. These factors vary by river basin, and reflect such differences as distance to the fall line and scouring rates.

Controllable Load and Nutrient Reduction Target

The first step in developing the controllable nutrient loads for each locality requires determining the nutrient loads within each county as if their land use cover was 100% forest. These values were determined through specific model runs of the WS Model. As stated previously, these load values were calculated and assigned to their respective county -segment combination by analogous methods as used for base loads determinations. These forest load values represent the portion of the nutrient load that is uncontrollable and would occur no matter what reduction strategy is carried out. The difference between this uncontrollable load and the total nutrient load, both nonpoint and point sources, for each county is the controllable load that a reduction strategy can act upon to achieve the 40% reduction goal for the Potomac River. The last step in developing the reduction target is applying the 40% goal to each county's controllable load. The remaining nutrient load is now the reduction target and becomes the nutrient cap to be maintained from the year 2000 and into the foreseeable future.

Nutrient Reduction Measures

The best management practices and their nutrient reduction capabilities presented here are organized into four broad categories. The first group focuses on those practices used to reduce point source nutrient loads from wastewater treatment facilities. The second two groups describe practices and/or measures employed on nonpoint source loads from either developed or agricultural land. The fourth group looks at measures to protect land and/or water resources. The following discussion outlines the calculations done to quantified the various nutrient reductions taken within the Potomac River basin. Only those reduction practices known to be in widespread use and to have the potential for significant reductions are taken into consideration in the calculations. Additionally, if a practice is not currently accepted by the Chesapeake Bay Program participants as having quantifiable characteristics, it is also not considered in the reductions at this time.

Wastewater Treatment Plants

Point Source Nutrient Reduction. Nutrient reductions from point sources may be achieved by such measures as biological nutrient removal, chemical phosphorus precipitation, or wastewater irrigation. Virginia, along with the other jurisdictions, is actively exploring the use of biological nutrient removal (BNR), especially for those publicly-owned wastewater treatment plants located in the more densely populated areas of the watershed. Reductions are calculated based on the difference between nitrogen and phosphorus concentrations in the treatment plant discharge before and after implementing the specific reduction measure. Preliminary values for probable nutrient reductions and costs to execute have been tailored for each individual plant. As systems become operational, nutrient reductions will be better refined based on operational data.

The basis for the cost estimates are fully explained in a report produced for the Bay Program by the Interstate Commission on the Potomac River Basin (ICPRB): Financial Cost Effectiveness of Point and Nonpoint Source Nutrient Reduction Technologies in the Chesapeake Bay Basin (December 1992). ICPRB's report compiled information from two other studies on the costs to retrofit plants in Virginia for nutrient removal:

- POTW Nutrient Removal Retrofit Study, CH2M Hill Engineers (October 1989). Cost opinions in this report were developed for the major POTWs discharging to Nutrient Enriched Waters, under the seasonal and year-round BNR scenarios.

- Assessment of Cost and Effectiveness of BNR Technologies in the Chesapeake Bay Drainage Basin, Hazen and Sawyer Engineers, and J. M. Smith & Associates (October 1988). Unit costs were developed in this report for a variety of plant types and design capacities, at two levels of seasonal nutrient removal -- high level (nitrogen = 8 mg/l; phosphorus = 2 mg/l), and low level (nitrogen = 3 mg/l; phosphorus = 0.5 mg/l).

In addition to the ICPRB Report, a May 1993 report by Engineering-Science, Inc. for the Metropolitan Washington Council of Governments, contributed information used in the cost estimates. This report, Study of the Cost of Reducing Nitrogen at Metropolitan Washington Wastewater Plants, provided more recent data on future design capacities, daily flow projections, and retrofit options for four large Virginia Potomac Embayment facilities -- Alexandria STP, Arlington STP, Lower Potomac STP in Fairfax, and Mooney STP in Prince William.

It is important to note that as a result of discussions with the plant owners involved in the study, it was decided to exclude the costs associated with operation and maintenance of the phosphorus removal systems from the scenario analyses. Therefore, the cost estimates reflect only the expense of the additional treatment components needed to achieve **nitrogen** removal (nitrification and denitrification stages), but the load reductions depend on the continued operation of the phosphorus removal systems now in place. Using information contained in the CH2M Hill report, this procedure was also applied to the other Potomac Embayment plants in the nutrient load estimate (Aquia STP, Dale City #1 STP, Dale City #8 STP, Quantico STP, and Upper Occoquan STP) that were not included in the Engineering-Science study.

Figures are presented in January 1996 dollars, and costs reported earlier were updated using the appropriate ENR index. Each plant in the Potomac load estimate was evaluated regarding requirements to meet Virginia's ammonia water quality standard, and a determination made about the nitrification capabilities that have been, or will be, installed to meet that need regardless of the Bay Program goal. A major difference between the figures in this strategy and all previous discussion documents and drafts is that the capital costs are only for treatment systems needed above and beyond current (or pending) permit requirements. They reflect the additional, incremental cost associated with the BNR components (principally denitrification) necessary to aid in meeting the Bay Program nutrient reduction goal.

Developed Land

Erosion & Sediment Control. This control measure has been carried out throughout the Chesapeake Bay watershed and uses various practices such as silt fences, sediment basins, check dams, diversions, etc. to reduce sediment and nutrient runoff during construction activities associated with land development. Sediment reductions are based on monitoring data that provided expected sediment yields from development activities and the performance standards of various erosion and sediment control practices. Sediment nutrient content data provided values to determine nutrient reductions. The cost of implementing these practices has been accepted and borne completely by the development industry as a cost of doing business. The reduction achieved by these various practices is counted in only the year in which the construction activity occurs.

Acreage having the potential for being under erosion and sediment control practices, (i.e., disturbed acres), are reported to DCR each year by county and state hydrologic unit. It is assumed that the acreage is nearly constant in the short term for each given year. The average sediment erosion rate has been set at 45 tons per acre disturbed with, on average, 0.0005 pounds of nitrogen per pound of soil and 0.0002 pounds of phosphorus per pound of soil. Full compliance with the current state's erosion and sediment control regulations requires holding all sediment onsite during land disturbance activities. On average in the basin, effective compliance with the regulations is set at 25% for 1985, 52% for 1994, and 100% for the year 2000. Nutrient reductions were then calculated based on these values and delivered per the corresponding transport factor derived for each model segment.

Septic System Management. Septic system management includes three specific practices to reduce nutrient losses from septic systems. They include regular pumping of the system, installation of nitrogen removing (i.e., denitrification) components, and bypassing a septic system by connecting to a sanitary sewer. Currently, regular pumping of septic systems is the only practice in widespread use. Reductions are limited to nitrogen and are estimated from limited available literature and best professional judgement. Additional research is needed to quantify reductions better as that very limited data exist on delivery of nitrogen from drain fields to surface waters and on nutrient reductions from regular pumping of septic systems.

The practice of septic pumping is applied, at a minimum, to all jurisdictions that fall within the Chesapeake Bay Preservation Act (CBPA) and was initiated, on average, in 1990. A limited number of localities outside of the CBPA jurisdictions have expressed a willingness to adopt provisions to require periodic pumping of septic systems, and future nutrient reductions have been calculated for those localities. The number of septic systems currently in place was taken from the U.S. Census and a 1994 study conducted by the Chesapeake Bay Local Assistance Department. It is assumed that septic pumping prevents septic system failure at a rate of 8% per 25 years. Based on research conducted by others, it is estimated that 24 pounds of nitrogen per failed system could enter the natural water system if not prevented through some method. Nutrient reduction loads were calculated based on these values and delivered per the corresponding transport factor derived for each model segment.

Urban Nutrient Management. Reductions due to urban nutrient management are dependent on efficiency of educational efforts to modify lawn fertilizer use by homeowners and others. Current reduction estimates are based on very limited research and survey data and are tentative at best. Urban nutrient management is currently being researched under the direction of the Chesapeake Bay Program Office. This management measure is critical to prevent and/or reduce nonpoint nutrient runoff in the urban/suburban areas of the Chesapeake Bay watershed and to maintain the nutrient cap load after the reduction goals are met.

A preliminary study in 1994 shows minimal consistency in the current application of this practice, primarily due to lack of knowledge of the users of lawn fertilizers and other chemicals. Education methods are being evaluated and it is assumed that by the year 2000 these efforts will cover a minimum of 10% of all urban lands within the Potomac River basin. In addition, a few localities have in recent years implemented, through educational or other methods, measures to promote urban nutrient management. Therefore, adjustments in the percentage of urban land covered have been made based on discussions with technical staff in those localities. Chesapeake Bay Program participants have agreed to a reduction rate for urban nutrient management. Nutrient reduction loads were calculated based on these values and delivered per the corresponding transport factor derived for each model segment.

Retrofits for Urban Best Management Practices (BMPs). Modifying existing stormwater management (SWM) facilities to enhance water quality and/or retrofitting stormwater drainage systems to add water quality components in already developed areas can slow runoff, remove sediment and nutrients, and provide a basis in restoring eroded stream channels. A review of studies to date indicates that, on average, retrofitting is the most expensive reduction option per pound of nutrient removed when looking specifically at nutrient removal. The other benefits of these structures, though, such as flood and erosion control, can justifiably offset some of these costs. To determine a typical cost/benefit is difficult, as both the cost and efficiency of these modifications and retrofits vary greatly due to their site-specific nature.

The Northern Virginia Planning District Commission (NVPDC) conducted a study in 1994 gauging the level of SWM/BMP retrofits, and their corresponding current reduction rates for those jurisdictions that fall within the Chesapeake Bay Preservation Act. Based on this study, acreage and reduction-rate estimates were derived for those localities within the Potomac River basin. Due to current and expected population distribution patterns, it was assumed that 95% of the SWM/BMP retrofits in the Potomac River basin are and will take place in the Northern Virginia region, with the remainder occurring in the Lower Potomac region. Nutrient reduction loads were then calculated based on these values and delivered per the corresponding transport factor derived for each model segment.

Agricultural Land

Animal Confinement Runoff Management. The measure includes the use of roof runoff control, diversions, grass filters, etc. to reduce nutrient loss from water flowing through animal confinement operations. These practices are employed on farms throughout Maryland, Pennsylvania, and Virginia. Nutrient reductions achieved by this measure vary greatly and are dependent on various factors, including the specific practices employed, the topography of the area, distance to receiving waters, and whether combined with other measures such as animal waste management systems. Research is being conducted under the direction of the Chesapeake Bay Program to contend for the inconsistencies in applying these measures and better refine the nutrient reduction typically achieved. Costs for nutrient reductions vary, contingent on the specific practices used and their corresponding installation and maintenance costs.

Conservation Tillage. This method of crop production can be achieved by either planting crops into existing cover without tillage (no-till) or by utilizing tillage implements that leave most crop residue on the soil (minimum tillage). Nutrient reductions are calculated based on the difference (found in the Chesapeake Bay WS Model) between loading rates for cropland under conventional tillage practices and those for conservation tillage practices. Costs associated with implementing conservation tillage on an individual farm varies based on numerous factors including equipment costs, topography, types and percentage of crops produced, rotation practices used, etc.

Changes over time in cropland acres under conventional and conservation tillage were derived, in general, from a trend analysis of each county's crop practice statistics gathered by the federal Conservation Tillage Information Center. Total cropland nutrient loads were then calculated using loading factors, efficiencies, and transport factors derived for each model segment. These loads were compared with those under the 1985 base year and the differences are the reported reductions for each county.

Cover Crops. Planting of cover crops, such as rye, wheat, or barley, without fertilizer in the early fall traps leftover nitrogen so it will not leach into the soil and groundwater. It also reduces winter time erosion of the soil. Reductions of nutrient into receiving waters are derived from research conducted in the Bay area that has been corrected for differences in efficiencies associated with operational rather than research systems. Efficiency also varies across the watershed based on climatic suitability for cover crops and hydrology. Costs to implement this practice includes seed, equipment usage, and other typical planting costs except fertilizer application.

Cover crops and several other agricultural conservation practices, such as grazing land protection, stream protection, grassed or wooded buffers and animal waste control facilities, are tracked under the State Agricultural Cost-Share Program. Acres, or number of facilities, covered by each of these practices are based, at a minimum, on historic reported figures and projected to the year 2000 based on historic implementation patterns. Chesapeake Bay Program participants have agreed to accepted reduction rates for most of these practices.

Livestock Waste Management. Through the use of storage structures or lagoons to store animal waste, the waste can be used as a fertilizer source in crop production. This process reduces nutrient loads that would otherwise enter the landscape without an opportunity for further and more efficient plant uptake of the nutrient source. Nutrient reductions for this management system were determined from animal waste scenario model runs of the WS Model. Costs of implementation vary based on the number and type of animals on the farm, soil conditions of the storage facility location, nutrient needs of the crop fields, etc.

Nutrient Management Planning. Nutrient management involves a comprehensive plan to manage the amount, placement, timing, and application of animal wastes, fertilizer, sludge, or residual soil nutrients to minimize nutrient-loss potential while maintaining farm productivity. Nutrient reductions for this management practice were determined from nutrient management scenario model runs of the WS Model. (Nutrient management plans are tailored to each individual farm and require analysis of the farm's crop production operation by a specialist versed in the development of these types of plans. Currently, one of the major limiting factors in increasing the application of nutrient management plans on agricultural lands is the shortage of qualified plan writers. In response to this need, Virginia has recently developed a program to certify private consultants to write nutrient management plans.) Nutrient load reductions were then calculated by applying loading factors derived for each model segment, removal rates as agreed to by Chesapeake Bay Program participants, and delivering the reductions per the corresponding transport factors derived for each model segment.

Poultry Waste Management. This measure uses storage sheds to stockpile poultry litter from partial cleanouts required after each flock of birds is removed. Based on limited data and best professional judgement, nutrient reduction due to poultry waste storage structures is set at 30% of the Chesapeake Bay WS Model reduction for livestock waste management systems (see separate heading) for the same number of animal equivalent units (i.e., thousands of pounds of live weight). Cost to implement is dependent on similar variables as those discussed under Livestock Waste Management.

Land Retirement. Land retirement of either highly erodible or other sensitive lands is the practice of taking agricultural land out of crop production and/or grazing and converting it by planting with a permanent vegetative cover such as grasses, shrubs, and/or trees. This practice stabilizes the soil and reduces the movement of sediment and nutrients from the land. The nutrient reduction is the difference between the previous land-use loading rate and that rate associated with the newly established vegetative cover. Costs to implement include the initial cost to plant the new vegetation and the loss of revenue for the former crop and/or grazing.

Land retirement, at a minimum, includes acreage found in WS Model that correspond to the federal Conservation Reserve Program and additional acres taken out of farm production since 1985 under the State Agricultural Cost-Share Program, (e.g., reforestation and permanent vegetative cover). The acreage under the cost-share program are based on historic reported values and projected to the year 2000 based on their historic implementation pattern.

Soil Conservation & Water Quality Planning. These plans, also known as farm plans, are comprehensive natural resource management plans, but the focus is typically on the use of erosion and sediment control practices to reduce sediment loss from cropland. Nutrient reductions for this measure were determined by an inter-jurisdictional workgroup to minimize any possible inconsistencies among the Chesapeake Bay jurisdictions and confirmed through conservation planning scenario model runs of the WS Model. Costs of implementation are variable and highly dependent on the topography and production goals of the farm. However, average cost per acre to implement has been assigned for the areas within the Potomac River basin by the same inter-jurisdictional workgroup noted above.

Percentages of farm land under soil conservation and water quality plans was reported by a survey conducted by DCR and VPI in 1994/5. The percentages were applied against the cropland and hayland acreage as developed for conservation tillage calculations. For the year 2000, an assumption was made that, at a minimum, the acreage under these plans would increase to a total of 80% for those jurisdictions that fall under the Chesapeake Bay Preservation Act and the remaining jurisdictions outside of this area would have a 5% increase of the acreage from those in 1994. Nutrient load reductions were then calculated by applying loading factors derived for each model segment, removal rates as agreed to by Chesapeake Bay Program participants, and delivering the reductions per the corresponding transport factors derived for each model segment.

Stream Protection from Livestock. This measure requires excluding livestock from streams using fencing or other devices and providing remote watering facilities and stream crossings. The magnitude of nutrient reductions resulting from the implementation of this measure is still being debated by an inter-jurisdictional workgroup due to inconsistencies among the Chesapeake Bay jurisdictions. Costs of implementation are variable and highly dependent on the topography of the farm and grazing fields.

Resource Protection & Watershed Planning

Forest Harvesting Best Management Practices (BMPs). This measure uses erosion and sediment control measures during forest harvesting activities. It is assumed that under proper implementation of this measure all eroding sediment is stopped and stabilized before reaching any receiving surface waters. Nutrient load reductions are estimated from data on average soil loss during harvesting activities and average nutrient content of forest soils. Typical costs of implementing these practices have been accepted and borne completely by the silvicultural industry as a cost of doing business.

It is estimated that in any given year, 1% of the state's forest land is undergoing harvesting activities. The assumption is that these harvesting activities generate ten times the nutrient loads than those of undisturbed forest lands. Furthermore, it has been agreed to by the Bay participates that BMPs for forest harvesting can achieve, on average, a 50% reduction of the nutrient loads generated during harvesting. Based on discussions with the state's silvicultural industry representative, it is expected that the industry will have 100% compliance in properly implementing BMPs for all forest harvesting acreage in Virginia by the year 2000. For 1994, it is estimated that there is 61% compliance. Nutrient reduction loads were calculated based on these values and delivered per the corresponding transport factor derived for each model segment.

Grassed or Wooded Buffers. Vegetative buffers are established, typically 50 to 150 feet wide, adjacent to streams and other receiving waters to filter runoff of sediment and nutrients from adjacent land. Nutrient reduction estimates, developed in Maryland and applied throughout the Bay, are based on available research on buffer efficiency and vary due to physiographic province and hydrology. Further research is being conducted under the direction of the Chesapeake Bay Program Forest Buffer Synthesis Project to refine nutrient reduction values. Grassed buffers are estimated to be 75% as efficient as forest buffers. Costs to implement vary based on such variables as current condition of the stream corridor and the adjacent land uses.

Shoreline Erosion Control. This control measure uses structural (e.g., riprap, revetments, etc.) and/or nonstructural (e.g., marsh grass, vegetative buffers, etc.) components to reduce the direct loss of sediment into tidal waters. Reductions are based on research conducted and published by Virginia Institute of Marine Sciences in 1992. Cost to implement is dependent on the component(s) used and length of shoreline protected.

Based this study, and accepted by the Chesapeake Bay Program participants, the Potomac River shoreline experiences an average shore erosion rate of 1.7 cubic yards per foot of shoreline per year. The study also established the loading rates of 0.93 pounds of nitrogen per cubic yard of shore and 0.61 pounds of phosphorus per cubic yard of shore. Feet of shoreline defended from erosion were determined for 1985 through 1990. It is assumed that the rate of shoreline protection seen from 1985 to 1990 has and will continue at the same rate for the foreseeable future though the year 2000. Nutrient reduction loads were then calculated based on these values and delivered per the corresponding transport factor derived for each model segment.

APPENDIX D

Description of Water Quality Modeling Scenarios

Scenario	Description
40% Controllable	40% reduction of controllable loads in "Agreement" states only and without air reductions
40% + CAA	40% reduction of controllable loads in "Agreement" states with Clean Air Act atmospheric reductions
40%+CAA+ Basin	40% plus Clean Air Act for the entire basin including DE, NY, and WV
LOT	Limit of technology (LOT) for nutrient reductions in the "Agreement" states
LOT-Upper	Loads from the Susquehanna basin and upper Bay coastal basins below the fall line down to, but not including Back River, were reduced to the Limit of Technology (LOT) and the most comprehensive best management practices for NPS controls. All other areas of the watershed were at base loads.
LOT-Middle	Loads from the Potomac basin and mid-Bay coastal basins below the fall line from Back River down to, but not including the Rappahannock River, were reduced to the Limit of Technology (LOT) and the most comprehensive best management practices for NPS controls. All other areas of the watershed were at base loads.
LOT-Mid(A)	Used to investigate Potomac basins impact on Bay dissolved oxygen levels. Same as above except fall line and below fall line PS and NPS loads within Potomac River and basin were left at base case levels as were upper and lower regions of Bay.
LOT-lower	All basin loads from Rappahannock down to the Bay mouth, were reduced to the Limit of Technology (LOT) and the most comprehensive best management practices for NPS controls. All other areas of the watershed were at base loads.
LOT-N Only	Limit of technology for nitrogen controls throughout the watershed with PS @ 3.0 mg/l while phosphorus and atmospheric levels were left at Base Case levels
LOT-P Only	Limit of technology for phosphorus controls throughout the watershed with PS @ 0.075 mg/l while nitrogen and atmospheric levels were left at Base Case levels
90% Reduction	90% load reduction of 1985 nitrogen and phosphorus levels to the Bay. Atmospheric loads to all water surfaces were eliminated.

APPENDIX E

Chesapeake Bay Basinwide Toxics
Reduction and Prevention Strategy --Progress Report

CHESAPEAKE BAY BASINWIDE TOXICS REDUCTION AND PREVENTION STRATEGY -- PROGRESS REPORT

The Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy was adopted by the Chesapeake Bay Executive Council in 1994. The Strategy addresses topics through four areas of emphasis: regional focus, directed assessments and research, regulatory programs, and pollution prevention. This report describes how these strategy areas are being implemented in the Potomac River Basin.

Regional Focus

The approach to toxics reduction, unlike the more generally applicable nutrient reduction strategy, recognizes that toxics substances are generally more closely associated with urbanized and industrialized areas resulting in more localized and regionalized patterns of distribution. As part of this emphasis on a regional focus to reduce the impact of toxic chemicals on the Bay, the toxics strategy requires the development of regional action plans for watersheds which have been identified as regions of concern. In the Potomac River Basin, the Anacostia River has been identified as one such area of concern. The District of Columbia's Chesapeake Bay Restoration Program, in conjunction with the interested and affected industries, individuals, and organizations, developed the *Anacostia River Toxics Management Action Plan.* This plan, finalized in the summer of 1996, establishes the series of actions designed to address five major areas of toxic management: coordination and funding, public awareness, research and monitoring, source control and sediment remediation.

In order to provide a consistent means of focusing future regional toxic chemical reduction and prevention efforts, the Chesapeake Bay Program's Toxics Subcommittee developed the *Chesapeake Bay Chemical Contaminant Geographic Targeting Protocol.* This protocol provides a five step approach for classifying regions into one of four categories: 1) areas with insufficient data for classification, 2) areas with low probability for adverse effects, 3) areas of emphasis, and 4) regions of concern. Classification is made based upon a review of all evidence which may support the presence or absence of a toxic contaminant within an area, in conjunction with two categories of geographic targeting criteria to determine existing or potential toxic effects. The evaluation of the data against the criteria is designed to assist in the determination of whether there is evidence of a causal relationship between the observed concentrations of chemical contaminants and observed adverse effects within a given region. The Toxics Subcommittee documents all classification determinations and forwards recommendations for those to be classified as regions of concern to the Chesapeake Executive Council for formal designation. As of the date of this report no additional areas of concern had been identified, or approved.

Directed Assessments and Research

The data needs of the geographical targeting protocol are being served through DEQ ambient toxics monitoring and targeted United States Geological Survey (USGS) contaminant monitoring. The USGS, as part of its National Water Quality Assessment Program, has undertaken a water quality characterization study of the Potomac River Basin. As part of this effort, the USGS completed a report on the occurrence of two selected trace-elements, mercury and lead, as well as three organic contaminants, chlordane, DDT and PCB's. These compounds were selected because they tend to collect in, and be transported with, the sediments as well as accumulating in biological tissues. The study examined stream bed sediments at 22 sites throughout the basin for the presence or absence of these compounds. Lead, mercury and DDT were detected at all sites, chlordane and PCB's at most sites, with six sites exhibiting concentrations with the potential to cause frequent adverse effects on aquatic organisms. Of these six sites, five are located in the Virginia portion of the Potomac Drainage. Mercury contamination occurs at sites on the South River and the South Fork of the Shenandoah River, polychlorinated biphenyls at an additional site on the South Fork of the Shenandoah River, and chlordane, at Bull Run and Accotink Creek in northern Virginia.

DEQ has maintained a statewide ambient monitoring network since 1969. Currently, DEQ maintains 180 ambient monitoring stations in the Virginia tributaries to the Potomac River. Of these 78 stations are monitored for toxic metals in sediments and selected organic chemicals. Raw data developed through this monitoring network is maintained in the Environmental Protection Agency's STORET database. Results and analysis of DEQ's water quality monitoring network which are required under the Clean Water Act are published in the biennial 305(b) Water Quality Inventory and Assessment Report.

As part of its overall effort to achieve a greater understanding of the type and amount of toxic substances entering the Chesapeake Bay ecosystem from the surrounding drainages, the Chesapeake Bay Program developed the *Chesapeake Bay Basin Toxics Loading and Release Inventory* in March of 1994. The Toxics Loading Inventory is divided into three broad categories; 1) Loadings, which includes point sources, stormwater, atmospheric deposition and shipping, 2) Fall line Loadings, which includes tributary fall line estimates of annual toxic pollutant loads, and 3) Releases, which includes data from agricultural pesticide and industrial releases into the air, water and land reported under the Superfund Amendment and Reauthorization Act (SARA Title III). Due to the variability of data quality, broad nature of the report, and multiple data bases, the use of this reports findings are limited to generalized comparisons within the broader Chesapeake Bay.

The toxics loading and release inventory has established that 30% (32,000 lbs) of the total copper entering the Chesapeake Bay enters via the Potomac River. Lead and copper are toxic metals of concern which have a history of introduction through atmospheric deposition. The Potomac River is also identified as providing 130 pounds of polychlorinated biphenyls, and 1,300 pounds of poly aromatic hydrocarbons, mostly in the form of flouranthene. The Potomac River drainage has a high urban land-use proportion compared to that of the overall Bay drainage. The Potomac River represents 22% of the watershed area of the Chesapeake Bay and 26% of the urban land-use area. The report also identifies four point source discharges as priority discharges within the Virginia Potomac river drainage. Of these, one (AVTEX Fibers) no longer discharges but remains an eligible Superfund clean-up site.

Regulatory Programs

Within its Virginia Pollution Discharge Elimination System (VPDES) regulatory program, DEQ operates a toxic reduction initiative which is comprised of two phases. The Toxics Management Program

(TMP), requires point source discharges to monitor their effluent for toxic constituents. The results are compared against two levels of toxicity, acute or chronic, to which six criteria are applied. The standard of measurement is dependent upon the type of facility, flow and concentration. Failure to meet these criteria results in a facility being placed in the Toxicity Reduction Evaluation Program (TRE).Under the TRE program a facility must develop and implement a plan to eliminate the toxic component of its discharge.

Of the 85 facilities within the Virginia Potomac drainage 67 are either in the TMP phase, or have completed the TMP phase and been adjudged non-toxic discharges. Of the remaining 18 facilities, 4 no longer discharge either as the result of past enforcement action or business closure of the facility, 2 have approved TRE plans, 3 have completed the TRE process, 7 others are actively involved in the TRE process, and 2 should be in TRE based upon the results of the TMP analysis. A list of these 18 facilities is provided in Table 1. The proportion of facilities in the Virginia Potomac Basin by discharge type is shown in Figure 1.

Table 1. List of the treatment plants in Virginia' Potomac River Basin that are either 1) not in TMP phase or, 2) have completed the TMP phase and been adjusted non-toxic discharges.

Involved in TRE	Valley Milk Products Virginia Metal Crafters Wampler Longacre - Bradbury Waynetex Leesburg POTW Rocco Quality Foods Shenandoah STP
TRE Completed	Wampler Longacre - Hinton Wampler Longacre - Alma Lorton Prison
TRE Approved	Quarles Petroleum - Newington Star Enterprise - Fairfax
Needs TRE	Crown Central USMC- Combat Dev.
Discharge ceased	AVTEX Hoechst-Celenese Corp. O'Sullivan Corp. Snyder General Corp.- Verona

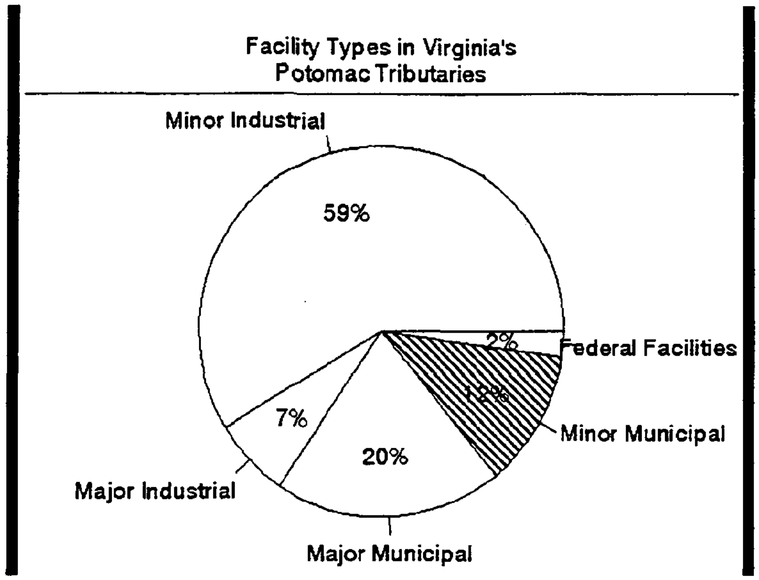


Figure 1. Proportion of the 85 Treatment Facilities in Virginia's Potomac Basin by Discharge Type.

Pollution Prevention

DEQ, wherever possible, seeks opportunities to encourage non-regulatory solutions to environmental issues. One such non-regulatory approach is Businesses for the Bay, a voluntary effort on the part of forward looking industries, commercial establishments and small businesses. The members of this organization are committed to implementing pollution prevention measures in their daily business operations and reducing chemical releases to the Chesapeake Bay. This initiative has the following goals: 1) achieving 75% participation of businesses in the Chesapeake Bay watershed, 2) achieving an aggregate reduction in the amount of chemical releases across the watershed, 3) increasing the number of businesses participating in the pollution prevention program, and 4) increasing the number of members involved in pollution prevention mentoring. Industries may receive recognition for their achievement through receipt of the Chesapeake Bay Executive Council Business for the Bay Excellence Award.

APPENDIX F

Progress Report on Submerged Aquatic Vegetation and Description of Preservation and Protection Programs for Living Resources

PROGRESS REPORT ON SUBMERGED AQUATIC VEGETATION AND DESCRIPTION OF PRESERVATION AND PROTECTION PROGRAMS FOR LIVING RESOURCES

SUBMERGED AQUATIC VEGETATION

The inventory of submerged aquatic vegetation in the Potomac River is divided into three regions: an upper region (extending from Loudon County downstream along Fairfax County and Prince William County shorelines), a middle region (extending downstream along the Stafford County and most of the King George County shoreline), and a lower region (extending along the Westmoreland County and Northumberland County shorelines). The inventory includes the entire river and thus incorporates all of the Maryland portion of the river in addition to the Virginia embayments. The area of SAV (in hectares) in each river segment since 1991 is shown in Table 1.

Also shown are the restoration targets for SAV in the Potomac River. Three target levels of restoration have been established. They are defined as follows. Tier I Target: Restoration of SAV to areas currently or previously inhabited by SAV as mapped through regional and baywide aerial surveys from 1971 through 1990. Tier II Target: Restoration of SAV to all shallow water areas delineated as existing or potential SAV habitat down to the one meter depth contour. Tier III Goal: Restoration of SAV to all shallow water areas delineated as existing or potential SAV habitat down to the two meter depth contour. (Tier I Target and Tier III Goal have been mapped for the Bay. The Tier II Target has not yet been mapped, due to incomplete bathymetric survey data.) The Tier I and Tier III areas (in hectares) for the Potomac River are shown in Table 1.

Table 1. SAV Inventory (hectares, 1991-1995) and Restoration Targets (hectares) for the Potomac River.

	1991	1992	1993	1994	1995	Tier I	Tier III
Upper Segment	2044	1412	1413	982	644	3098	8304
Middle Segment	1468	1552	1349	1310	1078	1847	7443
Lower Segment	83	46	58	139	185	1714	9342
TOTAL	3595	3010	2820	2431	1907	6659	25089

DESCRIPTION OF PRESERVATION AND PROTECTION PROGRAMS FOR LIVING RESOURCES

Within Virginia, and the Potomac watershed, numerous programs exist to preserve, protect, and enhance the living resources and habitats of the Potomac and the Chesapeake Bay. These management and landowner assistance programs, described below, range from the protection and enhancement of habitat, such as wetlands, riparian zones, submerged lands, and oyster reefs to the management of both freshwater and marine fishery stocks. Furthermore these programs help to address Bay Program commitments to achieve the goal of living resource restoration and protection. While these programs are essential to this effort, along with nutrient reduction strategies, it should be noted that successful restoration of living resources and their habitats is dependent on many factors. However, the successful implementation of the tributary strategies, and the achievement of its goals, will go a long ways towards the protection and enhancement of the Bay's living resources.

Fisheries Management Program - VMRC

The Fisheries Management Program of the Virginia Marine Resources Commission is responsible for the conservation and protection of the marine fisheries of the Commonwealth for present and future generations. Management measures are based upon the best available scientific, biological, social and economic information, and are designed to prevent overfishing while achieving an optimum yield from each fishery. Species specific management plans are developed and implemented. Each plan contains goals, objectives and strategies which account for variations among, and contingencies in fisheries, fishery resource, and catches. Where practicable, the plans promote efficiency in the utilization of the resource, minimize regulatory burdens which inhibit innovation, expansion, and normal business operations.

Fisheries Management Plans (FMP's) are adopted on an as-needed basis, and are amended periodically as stock status changes or the information base improves. Currently, there are 14 FMP's in place or in preparation which cover 20 species of importance to Virginia's commercial and recreational fishermen. Presented below is a brief summary of each plan.

Shad and River Herring

The Shad and River Herring Fishery Management Plan is designed to protect and restore Chesapeake Bay-wide populations of these species to generate the greatest long term ecological, economic and social benefits from these resources. The objectives of the plan include reductions in fishing effort and a maintenance of sufficient spawning stock to reduce the probabilities of low reproductive potential. The Plan supports the existing bay-wide moratorium on American shad harvest and recommends a continuation of current programs to restock these species into areas which historically supported natural populations.

Striped Bass

Coordinated, inter-jurisdictional management efforts have restored coastal striped bass to historic levels (as of January 1, 1995). The spawning stock biomass of mature Chesapeake Bay striped bass now exceeds the historical high average set from 1960-1972, and fishing mortality rates are below current target levels. Under the FMP, Virginia is committed to allowing harvests which maintain the spawning stock in a condition which perpetuates the populations of striped bass along the Atlantic Coast. Under the current plan, fishing quotas and seasons have expanded significantly and will continue to be modified to meet the needs of the naturally fluctuating resource.

Blue Crab

The goal of the 1996 FMP is to manage blue crabs in the Chesapeake Bay to conserve the stock, protect its ecological value, and optimize the long-term utilization of the resource. The plan specifies that the spawning stock must be maintained to minimize poor spawning success and allocation among user groups must be fair and equitable. The plan further calls for the maintenance of existing regulations to stabilize the fishery, limit access to prevent overcapitalization, increase productivity and lower costs.

The blue crab stock behaves as one unit throughout Chesapeake Bay and its protection is dependent upon a unified, though not necessarily identical, management approach throughout the Bay jurisdictions.

Virginia will continue its management program initiated in October, 1994 and expanded in 1996. These measures included expansion of existing spawning sanctuaries, creation of new over-wintering sanctuaries, license caps, gear limits, escape rings in crab pots, and shortened crabbing seasons.

Virginia Oyster

The Chesapeake Bay Oyster FMP promotes the enhancement of oyster production in the Chesapeake Bay ecosystem by restoring habitat, controlling fishing mortality, promoting aquaculture and continuing replenishment efforts. Management strategies include continued monitoring of the prevalence and intensity of the parasitic oyster diseases, MSX and Dermo, modification of oyster replenishment efforts to include construction of artificial reefs and to set them aside as spawning sanctuaries, and evaluation of the feasibility of utilizing alternative non-native oyster species.

Weakfish/Speckled Trout

The goal of this FMP is to protect the reproductive capability of the resource while providing for its optimal use. Objectives include maintenance of spawning stocks at a size which minimizes the possibility of recruitment failure. Currently a combination of closed fishing seasons, gear mesh restrictions, quotas and recreational bag limits are utilized.

Weakfish stocks are severely overfished along the entire Atlantic Coast. The current plan contemplates modification of the present regulation regime over a period of the next three years to achieve stock recovery.

Croaker/Spot

Both of these species represent some of the most popular saltwater commercial and recreational fishes landed in Virginia. Each species is relatively healthy and consequently management measures are not contemplated by the fishery management plan. The plan instead focuses on the research and monitoring needs for both species. Information on recruitment, size composition and migratory patterns are needed to assess the impact of fishing activities.

Summer Flounder

Summer flounder is the most valuable commercial finfish landed in Virginia. It is a popular recreational species as well. Coast-wide landings have shown a declining trend since 1980. The current management plan promotes a rebuilding of the stocks over the next five years. A combination of commercial quotas, minimum size limits and recreational bag limits is utilized to reduce fishing mortality and improve stock biomass.

Black Drum/Red Drum

Popular as trophy sport catches, recreational landings of red and black drum account for up to 90 percent of total landings. While trends in landings are not discernable, catches of large mature fish have shown signs of decline. Assessments made during the late 1980's indicate that red drum spawning stocks are overfished despite the adoption of regulations on harvest at that time. Currently,.the fishery management plan promotes the use of small daily catch limits of five fish for both commercial and recreational fishermen. Additionally, only one fish greater than 27 inches may be taken daily.

By contrast, black drum, whose stocks are not overfished, are pro-actively managed by a commercial quota, limited entry to the commercial fishing and a recreational bag limit of one fish per day. Additional management strategies include closure of historically recreational fishing areas to mobile commercial fishing gear. Avoidance of conflicts in high use recreational fishing areas is a key objective of the current plan.

Bluefish

Bluefish represent one of the most significant species taken by the recreational fishery, and in particular by the charter boat and head boat fisheries. Recreational fishermen along the

Atlantic Coast have accounted for up to 90 percent of total landings.

Bluefish have experienced declines since the late 1980's partly because of overfishing and partly due to changes in the migratory nature of the species. The management plan is currently being reviewed for potential amendments. The key objective of the current plan is to allocate the recreational fishery 80 percent of the total landings. This is achieved by restricting commercial landings through a quota based system and controlling recreational harvest through a daily possession limit.

Black Sea Bass

The objectives of the Black Sea Bass FMP are to reduce fishing mortality to increase spawning stock biomass and to improve yield in the fishery. The recovery strategy calls for minimum fish sizes and commercial gear regulations in the first two years of the plan. Additional regulations will be added in years three through seven with maximum sustainable yield achieved in year eight.

Primarily an offshore commercial fishery, the commercial limits focus on minimum escape vents for fish pots and minimum mesh sizes for trawl nets. Commercial quotas and recreational fishing seasons will likely be needed in the near future to achieve a substantial fishery.

Tautog

The goals of the Tautog FMP are to perpetuate and enhance stocks of tautog so as to allow a recreational and commercial harvest consistent with long-term maintenance of self-sustaining spawning stocks and to maintain recent (1982-1992) utilization patterns and proportions of catch taken by commercial and recreational harvesters. The plan utilizes restrictions on fish size and gear to achieve its objectives. Initial regulations must be implemented by April 1997 and will be modified through 1999 based upon the response of the stock. Biologically safe levels of fishing mortality are to be achieved by the year 2000.

American Eel

The American Eel FMP is designed to manage the fishery so its harvest does not exceed the reproductive capacity of the population. A minimum size limit of 6 inches and mesh requirements for eel pots, the primary means of harvest, currently are in place to meet these objectives.

Spanish and King Mackerel

Recent stock assessments indicate that management measures have been effective in rebuilding stocks. Mackerel stocks have been expanding their range and increasing in areas, like

Virginia, where they historically occurred but had declined or disappeared. Size limits, creel limits, and commercial quotas currently provide protection for the stocks. Compatible regulations throughout the south Atlantic states are responsible for stock recovery. Future measures will be designed to continue stock improvements.

Catfish

Limited data are currently available to describe the status of the Bay's blue catfish, channel catfish, white catfish, flathead catfish, and bullhead populations. These species are both harvested recreationally and commercially and are becoming a major component of the Bay's ecosystem. The channel, blue, and flathead catfish are all non-native species to the Bay and are experiencing range expansions. It is the goal of the Bay states to document the current distributions, relative abundance, life history, and ecology of these species prior to establishing management recommendations.

Fisheries Management and Non-Game Programs - VDGIF

The Fisheries Management and the Non-Game Sections of the Department of Game and Inland Fisheries conduct aquatic community and species specific surveys throughout the Bay watershed. The Warmwater Streams Project is an effort to survey existing aquatic resources, enhance gamefish populations, improve recreational access and opportunities, and protect critical habitat. A part of this project involves detailed surveys of the Bay's tidal and freshwater tributary resources and provides information to assist the Chesapeake Bay Program in drafting fisheries management plans and species restoration target documents. The Coldwater Streams Project manages Virginia's coldwater stream habitats, through research, habitat development and surveys, and recreational species management. The Non-Game Program researches the life history, habitat associations, and current distributions and abundances of our non-game species. Information from each of these programs is used to manage Virginia's fish populations through both non-regulatory and when necessary regulatory approaches so as to maintain optimum populations of all species to serve the needs of the Commonwealth.

As part of the Virginia Department of Game and Inland Fisheries' aquatic management programs, the Department coordinates an American Shad Restoration Program in conjunction with various federal and state agencies and Virginia's inland commercial watermen. The current focus of the project targets the restoration of the American shad stocks in the James River, and to a lesser extent the York River watershed. The production and stocking of millions of fry into these systems since 1994 is hoped to lead to the restoration of this species. Similar restoration efforts are occurring on the Potomac River via the cooperative efforts of the USFWS and the Potomac River Fisheries Commission. Once restored, the American shad fishery will again be a valuable component of Virginia's fishing-related economy and will provide a valuable resource for anglers.

The Virginia Department of Game and Inland Fisheries' Fish Passage Program has been established to identify fish blockages to fish migration and to facilitate the design and construction of the fishways. A major component of restoring migratory fish populations to historic levels, includes providing passageways allowing fish to reach their historic spawning grounds. In addition to providing fish passage this program's staff participates in the trap, transport, and stocking of migrating adult blueback herring, the evaluation of potential shad and herring habitat through juvenile and adult monitoring, and the development of public relations and educational materials.

HABITAT MANAGEMENT AND LAND-USE MANAGEMENT PROGRAMS

Wetlands Management Programs

Tidal Wetlands Management

The use and development of vegetated and non-vegetated tidal wetlands throughout Virginia is managed by the Marine Resources Commission (Commission) and Local Wetlands Boards. Chapter 13 of Title 28.2 of the Code of Virginia provides this authority and authorizes the adoption of the Wetlands Zoning Ordinance and appointment of a wetlands board by each tidewater locality. If the ordinance is not adopted by the locality the Commission retains original jurisdiction. In all cases, however, the Commission must review each local decision. In either case it is the duty of the Commission to preserve and prevent the despoliation and destruction of wetlands while accommodating necessary economic development in a manner consistent with wetlands preservation.

In order to administer this program and assist tidewater localities, Wetlands Guidelines have been promulgated which were last reprinted in 1993. These guidelines have been developed with the assistance of the Virginia Institute of Marine Science (VIMS). In addition VIMS maintains and updates an inventory of vegetated wetlands within each Jurisdiction in Tidewater Virginia (Table 3).

Anyone who wishes to use or develop tidal wetlands in Virginia must submit an application to the Commission. Through a Joint Permit review process the application is forwarded to the local wetlands board for action as well as to other State agencies for comment and review. All applications requiring a wetlands permit are considered at a public hearing before the local wetlands board or the Commission. For each wetland project VIMS provides an assessment of impacts through a Shoreline Permit Application Report. The same application is also provided to the U. S. Army Corps of Engineers for review under the requirements of the Rivers and Harbors Act and the Clean Water Act. In addition the application is considered by the Department of Environmental Quality (DEQ) under the Virginia Water Protection Permit Program.

Nontidal Wetland Management

Nontidal wetlands in Virginia are managed by the Commonwealth through the Virginia Water Protection (VWP) permit program. The VWP permit replaced the former 401 Certification program which prevented an applicant from receiving any federal permits prior to certification by the state that the proposed activities were consistent with state water quality objectives. Application for the VWP permit is automatic when an application is submitted to the U. S. Army Corps of Engineers (either directly or through the Joint Permit program).

Some nontidal wetlands are also subject to local regulation under the Chesapeake Bay Preservation Act (CBPA). The CBPA requires that riparian nontidal wetlands be included within a Resource Protection Area (RPA) designated by each locality within the Virginia coastal zone. Local regulations, adopted pursuant to the CBPA, restrict activities within the RPA usually as part of local zoning and sediment/erosion control ordinances.

As part of the non-tidal wetland management programs in Virginia, the Virginia Department of Game and Inland Fisheries administers a Wetland Technical Assistance Program. This voluntary program, targets farm landowners with prior converted wetlands, sportsman's clubs, and a few corporate landowners, and offers them technical expertise to restore wetland areas for wildlife.

Waterfowl Management Programs

As a member of the Atlantic Flyway Council, the Virginia Department of Game and Inland Fisheries manages waterfowl populations in concert with other eastern states in the Flyway. A waterfowl survey is conducted by all states during the first two weeks of January to provide a mid-winter index to bird numbers in the flyway. From the numbers that are collected in each flyway nationwide and annual breeding bird surveys in the prairies, sufficient information is available for the federal government to establish a hunting framework that will not jeopardize waterfowl populations. In Virginia, survey results have indicated that over the last ten years, waterfowl populations in the Bay have been fairly stable with perhaps modest improvements in the last three years. In the Potomac, waterfowl numbers have been up over the last five years. This increase may be attributed to increased submerged aquatic vegetation, primarily *Hydrilla*, in this watershed. The species that have responded most to this increase in aquatic vegetation have been the canvasback, the scaup, and the ring-neck duck.

The Department also offers a technical assistance program to landowners wanting to improve waterfowl habitat on their property. These improvements may involve habitat creation or enhancement, or the installation of wood duck nest boxes or goose nesting platforms.

Submerged Lands Management

All submerged lands channelward of the mean low water line in tidal areas and the ordinary high water line in nontidal areas are considered State-owned pursuant to Chapter 12 of Title 28.2 of the Code of Virginia. Any encroachment in, on or over these submerged lands is regulated by the Marine Resources Commission (Commission). Any activity, not authorized by statute, must be permitted by the Commission. When reviewing any project for permit the Commission is guided by Article XI, Section 1 of the Constitution of Virginia and must consider the effect of the project on the following:

- Other reasonable and permissible uses of state waters and state-owned bottomlands;
- Marine and fisheries resources of the Commonwealth;
- Tidal wetlands, except when this has or will be determined under the provisions of Chapter 13 of Title 28.2;
- Adjacent and Nearby properties;
- Water quality; and
- Submerged Aquatic Vegetation (SAV).

When considering a project for permit the Commission consults with other state agencies and considers any potential project impacts reported by VIMS through their preparation of a Shoreline Permit Application Report. Subaqueous Guidelines have also been promulgated by the Commission which are considered for each project. These guidelines were last reprinted in 1993. Through these review procedures impacts to both living resources themselves and their habitats are evaluated.

Request for permits are submitted through a Joint Permit review process requiring the use of only one application that is submitted to the Commission. The application is forwarded to other agencies for review and action. This includes review by the U.S. Army Corps of Engineers under the Rivers and Harbors Act and the Clean Water Act. In addition the application is considered by the Department of Environmental Quality (DEQ) under the Virginia Water Protection Permit Program.

Virginia Water Protection Permit Program

Any project that requires federal permits for discharge of dredge material or fill in a waterway or wetland (U. S. Clean Water Act, Section 404), work or construction in a navigable waterway (U. S. Rivers and Harbors Act, Section 10), or water withdrawal will be reviewed by the Virginia Department of Environmental Quality for issuance of a Virginia Water Protection permit. Without the VWP permit (formerly called the 401 Certification) the federal permits will not be issued. Application for the VWP permit is accomplished through the Joint Permit review process and is thus simultaneous with other required federal and state permits.

<u>Dunes Management Programs</u> (This may only apply to Coastal Basin strategies.)

Use or development of coastal primary dunes is regulated under the Coastal Primary Sand Dune Zoning Ordinance. This act is patterned after the Wetlands Zoning Ordinance and administered in the same manner. It applies, however, to only eight political subdivisions known to have coastal dunes along the Atlantic Ocean and the Chesapeake Bay Shoreline. These jurisdictions are: the Counties of Accomack, Lancaster, Mathews, Northampton and Northumberland, and the Cities of Hampton, Norfolk and Virginia Beach.

As with the Wetlands Zoning Ordinance the localities are authorized to adopt the model ordinance and utilize their wetlands board to evaluate each project. For those localities that have not adopted the dunes ordinance the Commission retains original jurisdiction. In all cases, however, the Commission must review each local decision.

In order to administer the program and assist the local boards in their review of projects Coastal Primary Sand Dunes/Beaches Guidelines have been promulgated which were last reprinted in 1993. These guidelines have been developed with the assistance of VIMS. In addition, VIMS prepares a Shoreline Permit Application report for each proposed dune project.

Anyone who wishes to build in or encroach on a coastal primary dune must submit an application to the jurisdiction or the Marine Resources Commission. All applications requiring a dunes permit are considered at a public hearing before the local board or the Commission.

Reefs

Virginia has been the leader in implementing the Bay Program, Aquatic Reef Habitat Plan. Efforts are directed at restoring the historic, 3-dimensional reef habitat which should increase the reproductive success and survival of the beleagured oyster. Oysters and other reef dwelling species are filter-feeders that consume large quantities of suspended organic particles through biofiltration. Nutrients that are consumed and recycled contribute to the overall nutrient reduction strategies. Currently, nine reef projects have been completed in optimal locations in the James, York, Piankatank, and Great Wicomico Rivers and at Fishermen's Island in the Chesapeake Bay. All reefs have been colonized with oysters and other reef dwelling species and some have already shown evidence of contributing to an increase in oyster stocks in the local area. In addition to the construction of new reefs, MRC is also restoring natural oyster reefs throughout the Bay and tributaries where oysters still reside, but where the reefs are in critical need of habitat renovation. All efforts at reef restoration contribute to an overall strategy of increasing the stocks of oysters in Virginia, and thereby increasing the ecological and commercial value of the oyster resource.

Upland Technical Assistance Program

The Upland Technical Assistance Program, administered by the Department of Game and Inland Fisheries, provides landowners with information to help enhance wildlife populations on their properties. Many of the habitat improvements may also serve to stabilize soil and reduce nutrient inputs to nearby waterways.

Forest Stewardship Program

The Forest Stewardship Program is a cooperative effort between the Department of Game and Inland Fisheries and the Department of Forestry and seeks to incorporate ecologically sound wildlife management techniques into forestry management plans and practices. Whenever it is appropriate, the activities of this program incorporate the concepts of the Chesapeake Bay Program's Riparian Forest Buffers initiative into their plans.

APPENDIX G

Local Government Partnership Initiative -- Progress Report

LOCAL GOVERNMENT PARTNERSHIP INITIATIVE -- PROGRESS REPORT

In an effort to facilitate local involvement in the Chesapeake Bay Program (CBP), the "Local Government Partnership Initiative" was adopted by the Chesapeake Executive Council in November 1995. The Initiative directed the CBP partners to create a Local Government Task Force to develop recommendations to promote local capacity to manage land uses and facilitate local participation in the CBP. The Task Force focused on three key areas of restoration and enhancement of the Bay: land use management, stream corridor management, and infrastructure improvements. The Action Plan that resulted from the Task Force's efforts states that the CBP will "work with local governments during the next year to seek review and comment on these themes, to request commitments to carry out these or revised themes, to solicit local government priorities for their achievement, and to report the results of these efforts with local governments to the 1997 meeting of the Executive Council."

The Task Force's Action Plan, which outlines their recommendations, was signed by the Executive Council on October 10, 1996. A copy of this Adoption Statement is attached.

Chesapeake Bay Program

ADOPTION STATEMENT
LOCAL GOVERNMENT PARTICIPATION ACTION PLAN

Based on the Local Government Task Force's recommendations in the Participation Action Plan and in accordance with the Local Government Partnership Initiative adopted by the Chesapeake Executive Council in November of 1995, we reaffirm the Bay Program's commitment to strengthening its partnership with local governments.

The recommendations encourage local governments throughout the watershed to take or continue to take the following actions in three theme areas that represent local government initiatives to protect local and regional natural resources and contribute to the restoration and sustained health of the Chesapeake Bay and its tributaries. The theme areas and specific actions are:

Land Use Management
- Implement measures that reduce resource consumptive and costly sprawl patterns of development by encouraging the revitalization of existing communities and promoting sustainable development patterns.
- Implement and support measures to protect resource lands such as agricultural and forested lands to conserve the countryside and protect water quality and wildlife habitat.

Stream Corridor Protection
- Establish protective measures for the preservation and conservation of stream corridors.
- Implement measures to coordinate and support individuals, community associations, watershed organizations and nonprofit private interests to protect, enhance, and restore wetlands, forest buffers and stream corridors important to water quality and plant, fish and wildlife habitat.

Infrastructure Improvements
- Implement measures to upgrade sewage treatment plant facilities to improve water quality through the implementation of nutrient removal technologies.
- Implement measures to upgrade, maintain and inspect stormwater management infrastructure to protect water quality.
- Implement measures to encourage the proper use and periodic maintenance of septic systems to protect water quality and plant, fish and wildlife habitat.
- Implement measures to provide public access to the Chesapeake Bay, its tributaries and streams and other parks and green spaces.
- Operate, enhance, and facilitate recycling, household hazardous waste collection, small business pollution prevention and solid waste management programs, in support of Bay Program pollution prevention objectives.

We commit the Chesapeake Bay Program through the States and the Local Government Advisory Committee to work with local governments during the next year to seek review and comment on these themes, to request commitments to carry out these or revised themes, to solicit local government priorities for their achievement, and to report the results of these efforts with local governments to the 1997 meeting of the Executive Council.

We further commit the Chesapeake Bay Program and its partners to take the following immediate actions that will assist local governments in implementing activities that support the protection of the Chesapeake Bay and its tributaries:

Broaden Outreach Efforts and Improve Communications
- Support efforts by local watershed organizations, civic associations, and land conservancies/trusts to build constituencies that would support local government decisions or investments in protecting or restoring the Bay, its rivers and streams.
- Disseminate regional updates on the progress being made in protecting and restoring local rivers and streams and actions that can be taken to improve their health to local governments.
- Participate in annual local government association meetings/conferences to inform local governments how local actions contribute to the protection and restoration of streams, rivers and the Chesapeake Bay.

- Utilize existing local government technical and informational assistance providers as vehicles to distribute information and outreach on issues related to the protection and restoration of the Bay, its rivers, and streams.
- Develop concise informational materials that are tailored to the local government audience in order to better communicate and share information with local government officials and staff regarding the Chesapeake Bay effort.
- Produce *Bay Currents* quarterly newsletter to share local "models" and facilitate the exchange of information between and among local governments in the watershed. Also, broaden its distribution to both elected officials and staff persons in each Bay Program jurisdiction, make it accessible on the Internet, and announce its availability to local governments in non-signatory states.
- Broaden the utilization of the Internet and facsimile broadcasts to better communicate with local government officials and staff.

Recognize Local Government Efforts

- Identify and catalogue restoration and protection success stories that can serve as models to assist other local governments in their efforts to protect stream corridors, improve infrastructure and manage land use.
- Initiate the Chesapeake Bay Partner Communities Program as a mechanism to provide recognition and support to local governments protecting the Chesapeake Bay.
- Continue to support the Local Government Advisory Committee's *Community Innovation* Awards Program.
- Utilize *Bay Currents* newsletter to promote local government accomplishments.

Strengthen the Voice of Local Government in the Development of Bay Program Policy

- Convene periodic local government roundtable meetings in each of the jurisdictions.
- Create a network of local officials and staff with specific expertise in dealing with resource protection issues.
- Identify local officials with appropriate expertise to serve on Bay Program technical subcommittees and workgroups.

Provide Technical and Financial Support to Local Governments

- Chesapeake Bay Program will target Bay Program funding to assist local government Bay restoration efforts.
- Investigate the feasibility of developing a "Voluntary Community Audits Program" designed to help communities identify sources of pollution entering local streams and rivers and recommend actions, in the form of tools and techniques, to reduce and prevent pollution, and protect water quality and fish and wildlife habitat.
- Investigate the feasibility of establishing a non-profit entity to further assist local government implementation of Chesapeake Bay protection and restoration activities.
- Develop a compendium of Federal, State, non-profit and private assistance programs that provide local governments with resources to implement Bay protection activities, as well as establish a local to local mentoring program.
- Plan for and provide financial assistance for a representative number of local governments to attend functions of the Program, such as conferences, workshops, meetings, whenever the main objectives or topics are relevant to authorities or interests of local governments.
- Explore proposals for Clean Water Act authority (through reauthorization of the Act) for a Challenge Grants program dedicated to small watershed organizations and local governments to supplement state implementation grants in this area.
- Seek funding from EPA's Sustainable Development Challenge Grant program to assist in the implementation of this Action Plan.
- Identify and publicize single points of contact for local governments to obtain "how to" information related to the protection and restoration of natural resources. The single point of contact should provide local governments with technical support, financing options, and a compendium of technical and financial assistance programs that are available to local government officials and support Bay protection efforts.
- Examine alternative financing solutions that will assist local government efforts to restore stream corridors, implement land use management measures, and improve infrastructure. A compendium of financing options will be developed by September 1997 for distribution by signatory states to local governments.

Provide Scientific Data to Local Governments

- Broaden the scope of the Chesapeake Bay Program Data Center to meet local government informational needs through the implementation of Chesapeake Information Management System.
- Prepare information on the impacts of septic systems on local resources and the Chesapeake Bay.
- Identify models, technologies, and practices that can be used to assess and minimize the impacts of different development patterns on water quality.
- Prepare and distribute technical information on the costs and benefits of implementing environmentally sensitive land use management measures, stream corridor protection initiatives, and infrastructure improvements.
- Provide periodic technical exchanges with local government officials on alternative stormwater management practices, Biological Nutrient Removal techniques, and other emerging technologies that help protect water quality.

The Local Government Advisory Committee will monitor and track the progress of the Action Plan recommendations, provide guidance to the implementation process when called upon, and report on its progress to the Implementation Committee and the Principals' Staff Committee.

We the undersigned, adopt the Local Government Task Force recommendations directed to the Chesapeake Bay Program, and endorse the Local Government Participation Action Plan to strengthen our partnership with local governments in the protection and restoration of the Chesapeake Bay, its rivers and streams.

DATE____________________

CHESAPEAKE EXECUTIVE COUNCIL

FOR THE UNITED STATES OF AMERICA ______________________________

FOR THE STATE OF MARYLAND ______________________________

FOR THE COMMONWEALTH OF PENNSYLVANIA ______________________________

FOR THE COMMONWEALTH OF VIRGINIA ______________________________

FOR THE DISTRICT OF COLUMBIA ______________________________

FOR THE CHESAPEAKE BAY COMMISSION ______________________________

APPENDIX H

Southern Shenandoah Region:
Tributary Assessment

POTOMAC TRIBUTARY STRATEGY

Southern Shenandoah Region

Augusta County
Highland County
Page County
Rockingham County
City of Harrisonburg
City of Staunton
City of Waynesboro

August 27, 1996

DRAFT REGIONAL TRIBUTARY STRATEGY

Southern Shenandoah Region - 8/27/96

APPENDICES:
A. Agricultural BMPs by County
B. Point Source Information Sheets
C. Detailed Reduction Charts by County and Region
1. Current/Projected Activities
2. Current/Projected Activities Plus Proposed Strategy
D. List of Participants in Strategy Development

EXECUTIVE SUMMARY

Regional Goal:
As part of its responsibility under the multi-state Chesapeake Bay Agreement to reduce nutrient pollution 40% by the year 2000, the Commonwealth is now developing a nutrient reduction strategy for the Potomac Basin. The Southern Shenandoah Region is committed to reducing nutrient loads by 40%, given appropriate resources. This Draft Regional Strategy lays out the ways that the localities in the region feel that this can best be accomplished and how much these efforts would cost.

Non-Point Sources (NPS):
Approximately 75% of the region's nutrient loads are estimated to come from NPS, with farming being the largest component. Urban NPS loads are fairly small. Urban acres make up only a few percent of the land area. However, urban pollution control measures will be increasingly critical in the future in order to maintain the cap at 40%.

The agricultural community has been very active in implementing nutrient management practices and additional improvements are projected under current programs and policies. Without additional funding, and even accounting for increases in growth in the poultry industry, the NPS sector is projected to come close to achieving 40% reductions within the sector.

It is important to note, however, the current severe economic crisis in the Valley's top agricultural sectors, poultry and beef. These two industries are not in the expansion mode and farmers cannot afford costly mandates.

Point Sources:
Ten treatment plants in the region are included in the Strategy as meeting the criteria of discharging in 1985 at least 0.5 million gallons per day of sewage or, for industries, the equivalent nutrient load. Appendix B contains detailed information on each plant.

Publicly Owned Treatment Works - The region is fortunate that two of the largest plants, Harrisonburg-Rockingham Regional Sewer Authority's (HRRSA) North River plant and the Augusta County Service Authority's (ACSA) Middle River Regional plant were recently redesigned and can be adapted to biological nutrient removal (BNR) fairly cost effectively. HRRSA will install BNR at one of its basins (20% of its current flow) in fall 1996. ACSA is already showing extremely good reduction numbers on its Middle River and Stuarts Draft plants, but it is likely that these plants would have to be upgraded to BNR in order to sustain these low concentrations as flows increase and the chemistry changes within the oxidation ditches. ACSA's Fishersville plant also is achieving significant nitrogen reductions but would be more costly to upgrade than the oxidation-ditch designs. For Waynesboro in particular and other smaller, older plants, conversion to BNR would be prohibitively expensive at the existing facilities. However, in conjunction with expansions or upgrades, and with grant funding, conversion to BNR could be feasible.

Industries - Several of the plants in the region are under study; results will not be available until late summer 1996 at the earliest. Industries cannot predict future flows and processes. However, without exception in the region, the participating industrial plants already have achieved reduced nutrient discharges compared to the baselines in the state's August 1995 draft. This is due to unique factors in each plant.

Status Towards the 40% Reduction Goal:
On the current course (current and planned programs), total projected 2000 reductions for the region would be 31.9% for nitrogen and 32.6% for phosphorus.

Under this Draft Regional Strategy, the 2000 reductions would be estimated at 43.5% percent for nitrogen and 40.4% for phosphorus. The total cost is estimated at approximately $6.8 million, with $5.4 million proposed to be paid by the state. Local costs are expected to exceed $1.3 million.

Summary of Recommended Strategy Actions:
The Strategy relies primarily on additional agricultural measures implemented through the state's voluntary cost-share program as the most cost-effective means of achieving the goal. The Draft Strategy assumes outside funding and that additional resources would be available by the end of 1997.

1) Nutrient Management Plans (NMPs) would be required by local ordinance on all intensive agricultural operations.
2) Additional state staff would be provided to write these NMPs.
3) Increased cost-share funding for Best Management Practices (BMPs) would be provided to the Soil and Water Conservation Districts (SWCDs).
4) Additional staff would be provided to the three SWCDs to oversee increased BMP activity. It is anticipated that the major additional activities would be in the areas of stream fencing, grazing land protection, stream protection, and animal waste control facilities (poultry litter sheds, dairy pits and loafing lot systems).
5) Seventy-five percent (75%) cost-share funding would be offered on all animal waste control facilities (removing the cost-share funding cap on these practices). The impact would be greatest on dairy pits, which cost an average of $100,000 each. Additional cost-share funding would have to be provided to cover this extra cost without drawing resources from other practices.
6) Biological Nutrient Removal (BNR) technology would be installed at one basin of HRRSA's North River treatment plant.

Additional Recommendations:
7) Voluntary monitoring for total nitrogen and phosphorus concentrations should be undertaken at all point source plants in the basin with flows of 0.5 mgd or the equivalent.
8) The state needs to continue to improve its efforts to verify the loadings from the Southern Shenandoah region; monitoring data and modeling information should be distributed more widely.
9) Grant funding for BNR should be included for future point source facility upgrades and expansions.

I. GENERAL POLICY STATEMENTS

1) <u>No Unfunded Mandates</u> - The Southern Shenandoah region supports the state's partnership approach as expressed on p.2 of the August 1995 Draft Potomac Basin Strategy: *"To achieve our goal, the Commonwealth will not establish any unfunded mandates nor will any requirements unfairly place responsibility for nutrient reduction on limited segments of citizens or businesses."*

2) <u>Voluntary Methods</u> - Localities in the region support voluntary efforts to achieve the reductions in both point-source and non-point source sectors. Good examples are the recently signed bills that expand tax credits for agricultural BMPs and the Agricultural Stewardship Act, which puts resources towards correcting "bad actors" rather than encumbering all farmers unnecessarily. For the point sources, it is particularly important that the tributary strategy be kept apart from the state's regulatory function and remain a voluntary program with state support.

3) <u>Regional Participation</u> - All localities in the region are critically evaluating their programs and policies that affect nutrient pollution and plan to develop strategies toward reaching the 40% reduction levels. However, elected bodies have not had the opportunity to address the issue thoroughly.

4) <u>Efficiency</u> - The most cost-effective and achievable options overall should be sought.

5) <u>Research</u> - More needs to be known about the transport of nutrients from upland streams to the Bay. Increased understanding of these complex relationships is needed, to be confident that resources are spent on the best actions to improve conditions in the Bay. There should be continual effort to justify costs and prove benefits (i.e., that the millions of dollars spent will have positive effects).

6) <u>Expanded Monitoring</u> - Monitoring above the fall line and in this region is needed in order to make a stronger link between efforts and results.

7) <u>Point Sources</u>
   a) Do not target 40% reductions from each plant individually.
   b) Use annual average performance levels, not monthly permit limits.
   c) Recognize that existing treatment plants were not designed to remove nutrients. Plant operators have been frustrated in the past by new goals requiring expensive new processes, with little coordination or flexibility.
   d) Plant operators intend to cooperate and work together within the region.
   e) Plan must be cost effective; timing is part of cost effectiveness.

II. BACKGROUND

A. PROCESS

Participants in the Southern Shenandoah Region (listed in Appendix D) have worked throughout the spring and summer of 1996 to review the status of nutrient reduction efforts and to identify ways to meet the 40% goal. The Central Shenandoah Planning District Commission has coordinated meetings calling together representatives from all localities in the Southern Shenandoah (locality staff, soil and water conservation district representatives, extension agents, and public and private treatment plant operators). This report is the culmination of discussions among these sectors.

These meetings within the region have raised the level of understanding and encouraged participation among those who can contribute to the strategy. Having all sectors represented has resulted in greater awareness as a group of the different perspectives on what is currently being done and the factors involved in undertaking additional efforts.

Every attempt was made to gather information to verify the numbers presented in the state's 1995 draft. Each locality identified staff to assist with this task, the three SWCDs and extension offices provided information, and each point source was contacted individually.

The data from these local sources are presented in the Appendices. Appendix A shows the agricultural practices in place now, those planned under current programs, and what could be achieved with greater resources. Appendix B gives information on each individual treatment plant. Together this information from the local sources was put into the state model (Appendix C) in order to estimate reductions.

More data could always be gained, but this draft does represent the best available local review at this time. The most important remaining gaps in information are on the point source side. Researchers are working with a number of the treatment plants in the Southern Shenandoah region but study results will not be available until late summer 1996 at the earliest.

The participants overwhelmingly support working together as a region. This Draft Strategy is therefore expressed not in terms of a local scorecard but as a region.

An important caveat to these recommendations is that, given the limited time frame and the complexity of this topic, local elected officials have not generally had the opportunity to consider the strategy. The general public also is not very aware of these issues.

B. AGRICULTURE

Importance of Agriculture

Among the regions in the Potomac Basin, the Southern Shenandoah Region is distinctive for its highly productive farms. Rockingham County and Augusta County, two of the largest counties in the state geographically, typically rank #1 and #2 in farm income, with Page County also in the top five. Farming is a mainstay of the local economy and is central to the cultural identity of the region. All of the local comprehensive plans call for maintaining a strong agricultural base, with agriculture as the desired predominant land use. Agriculture is intertwined with the overall economy, as agriculture drives substantial additional jobs in the processing industry and related businesses.

Recent Trends

Most Valley farmers are good stewards of the land and their use of practical and cost-effective measures on agricultural acres is projected to bring most of the localities close to their 40% reduction goal for non-point source pollution. In terms of reducing agricultural nutrient loadings even further, the region has the greatest practical knowledge of appropriate methods and associated challenges.

Significant progress has come about in the past 10 years in reducing nutrients from agricultural activities, in part because of increased public awareness and programs like the Chesapeake Bay Program's Agricultural BMP (Best Management Practices) Cost-Share Program. Through this program, farmers who volunteer to install BMPs on their farms have been offered cost-share funding to offset some of these costs.

Recent changes in state law (tax incentives and the Agricultural Stewardship Act), federal policy (the new Farm Bill), and private sector actions (such as the move by the poultry industry to require nutrient management plans for all growers by 2000) will encourage further progress.

Type of Farming in the Region

The dominant farming sectors in the Southern Shenandoah are livestock (cattle, dairy cows, and sheep) and poultry. In 1992, Rockingham County and Augusta County ranked first and second in the state for beef cattle, sheep (with Highland County third), and hay production, and first and third for dairy cows. Poultry has grown considerably in the last decade, but is not projected to grow much more in these counties. The region contains much pasture and crop land. Most crop production is for livestock feed, with the main crops being corn, wheat, and barley.

Current Farming Crisis

The two main agricultural sectors in the Valley, poultry and beef, currently are under great stress. As a result, neither is in a growth mode. The beef industry is suffering from the double blows of skyrocketing grain (feed) costs and plummeting prices received for cattle sold. The poultry industry also is squeezed by the price of feed -- earlier this year the price of a bushel of corn was the highest in history -- and by decreased sales projections. Any requirements that would increase the cost of doing business would add significant financial stress to farmers.

Potential for Nutrient Pollution

Waste from animals is a significant source of nutrient loadings. The main method to prevent pollution from agricultural operations is the use of BMPs. Pollution enters a waterway directly (from animals having access to a stream or from a stream running through areas where animals are concentrated) or is carried into the water in sediment from farmland containing improperly handled manures or commercial fertilizers. Nutrient management ensures that manures and fertilizers are contained, kept out of the rain, and applied to the land properly. A significant amount of sediment comes from raw streambanks (some estimates put the figure at 50%). Therefore, efforts to stabilize streambanks do a great deal to capture nutrients before they reach the stream.

Nutrient management plans specify appropriate steps for controlling nutrients. In many cases, additional BMPs, such as animal waste control facilities, are the most practical way to implement a plan.

Effective BMPs for the Valley

BMP cost-share funding in the region has never been high enough to serve all of those who express interest in the program. With additional funding, more practices could be achieved, still on a voluntary basis. A listing of the practices and levels of use in each county (current and projected) is presented in Appendix A.

1) Animal Waste Storage Facilities - A highly effective BMP, storage facilities allow animal waste to be stored safely until time of application, which is generally in the late spring and in the fall as crops are planted. Types of facilities include liquid waste pits for dairies, sheds and dry-stack storage for poultry litter, and loafing lot systems for beef cattle. To demonstrate the importance of the cost-share BMP program, an estimated 90% of the animal waste facilities now in place in Augusta County were installed over the last 12 years, since the program began.

   Liquid waste pits are the most expensive (costing between $65,000 and $110,000 each). Current state policies enforce a cap on cost-share of $20,000 for these facilities. Few additional pits are expected under the current program because most farmers who can afford to and are willing to pay the up to $90,000 remainder have already installed pits. A critical component of the regional strategy is lifting the cap on state cost-share funding.

2) Land BMPs - Practices such as crop rotation, conservation tillage, and cover crops work by slowing water down and helping to keep nutrients on the land. These practices have been familiar for a long time but the Bay program has increased their use.

3) Fencing Livestock from Streams - This practice includes adding alternative water sources. Fencing has been an increasingly popular and successful practice in some parts of the region. However, the terrain in the Valley makes it impractical in many cases to fence off pastures. Many farms do not have terrain appropriate to fence off their fields. Floods can wash away fences, necessitating repeated expenditure of time and money. In some areas, fencing would result in significant loss of usable acres.

4) Nutrient Management Plans - Nutrient management plans address the production of nutrients on a farm and the appropriate storage and use of the litter or manure. These nutrients are a valuable source of fertilizer and also a component in feed. As noted earlier, additional BMPs (actual structures) may be called for in order to fully achieve the benefits of a nutrient management plan. Some nutrients are exported off the farm to a nutrient-deficient area (often within the same county, but in the case of Page County typically to counties east of the Blue Ridge Mountains). Litter brokers in Rockingham County have moved approximately 210,000 tons of litter in the seven-year period from 1989 to 1995. Eighty percent of this litter has left the county.

5) Streambank Protection - Stabilizing the streambank (ideally with natural vegetation or trees) prevents erosion and the vegetation can take up excess nutrients from adjoining land. Trees are especially effective at taking up nutrients. The degree of work entailed can vary greatly, from regrading the bank and planting vegetation (bioengineering) to merely excluding livestock and allowing woody plants to reestablish on the bank naturally.

6) Forested buffers are an important complement to streambank protection. These buffers can work very effectively to absorb nutrients and capture sediment. They can be appropriate adjacent to all land uses, including those in urban settings. There is a federal standard in place in Virginia for forested buffers and the Virginia Department of Forestry and the Natural Resources Conservation Service are willing and knowledgeable cooperators in expanding and maintaining riparian forests.

Administrative Structure

The administrative structure for applying BMPs is already in place through the Soil and Water Conservation Districts and the Virginia Department of Conservation and Recreation. With additional funding, more benefits could be achieved through this structure.

One exception is the use of forested buffers. There would need to be a comprehensive effort to promote riparian forested buffers. Such an initiative should contain incentives, a strategic plan, and attention to standards for the buffers.

Growth in Agriculture

Ironically, agricultural intensification occurs alongside population growth, as farmers have less land available on which to farm. However, in a properly implemented nutrient management plan, these excess nutrients can be exported to a nutrient-deficient area as noted above.

Links to Other Issues

1) Groundwater Pollution - *The region has a high reliance on groundwater.* Groundwater pollution is a local concern, as the Southern Shenandoah Region is underlain by porous limestone formations that have a high potential for pollution. Therefore, while the region is trying to accommodate the goals of preventing nutrient loads from entering waterways and reaching the Bay, it also is very concerned with preventing nutrients from seeping into the groundwater.

2) Impact on Development Pattern - Land use is a major concern. It is hoped that the Tributary Strategy does not inadvertently encourage scattered development on septic systems because of

limits and costs placed on sewage treatment plants. Local governments in the region are trying to target development to those areas with public water and sewer systems. Costly sewage treatment plant upgrades to implement Biological Nutrient Removal (BNR) would likely result in rate increases that would make development on septic tanks seem more cost effective. The resulting sprawling development pattern would undermine efforts to retain the agricultural base and manage growth. Also, continued reliance on septic systems could lead to pollution not only of groundwater but of the surface waters flowing to the Chesapeake Bay.

Regulation

Regulation of farmers is not a realistic approach for this region. Much has been accomplished in a fairly short time with volunteer incentives. With increased incentives, additional gains can be made. In addition, there is now, through the Agricultural Stewardship Act, which is complaint driven, the means to target resources directly to problems.

Farming is a livelihood in this region, not an option. Especially given the current downturn in the farm economy, increased costs cannot be absorbed without potentially putting people out of business. This would be an unfair burden on this sector of the population.

Conversion of land out of agriculture would change forever the cultural fabric of the Southern Shenandoah Region. It is hoped that policies from the Tributary Strategies will not increase the myriad pressures on farming or inadvertently create incentives for sprawl.

C. POINT SOURCES

Ten treatment plants in the region are included in the Strategy as meeting the criteria of discharging in 1985 at least 0.5 million gallons daily of sewage or, for industries, the equivalent nutrient load. The list has changed since 1985. The Staunton sewage treatment plant is no longer in operation. Its flow has been diverted to the new Middle River Regional Wastewater Treatment Plant, which also will absorb the Verona Sewage Treatment Plant flow when that plant goes off line. Information is included on ten plants, seven municipal (Fishersville, Luray, Middle River Regional, North River Regional, Stuarts Draft, Verona, and Waynesboro; and three industrial (DuPont in Waynesboro, Merck in Elkton, and Rocco Farm Foods in Timberville).

The point source operators in the region met as a group and discussed at length the options for reducing nutrients. They agreed on policy statements and on a possible schedule of improvements, dependent on both the availability of outside funding and on the need for further reductions.

Measures of Nutrients

Accurate total nitrogen and phosphorus concentrations are not available for all of the point sources. There is no monitoring requirement for (and no regulation of) total nitrogen and phosphorus. There also was not a previously communicated need for such monitoring. Many plants have only a limited number of recent samples on which to base estimates. Other plants have a recent base of data because of participation in a current study sponsored by the Chesapeake Bay Program on the costs and practicality of implementing Biological Nutrient Removal (BNR) technology. The default used by the state may be fairly accurate for sewage flow, but not for the variety of processes used by industries. However, all three of the major industries (Rocco, Merck, and DuPont) have shown, for a variety of reasons, reduced nutrient discharges compared to the original projections in the state's August 1995 draft.

Flow Projections

Most localities in the region are projecting population growth. Therefore increased treatment plant flows are expected. Industries, however, cannot predict future flows or concentrations very well.

Potential to Improve Nutrient Reductions

A number of plants in the region are part of a multi-state study on Biological Nutrient Removal (BNR) being funded by the Chesapeake Bay Program. In Virginia, the study is being carried out by Virginia Tech civil engineering professor Clifford Randall under contract to the Virginia Department of Environmental Quality. Included are HRRSA, two of ACSA's plants, and DuPont in Waynesboro. Professor Randall also is working independently with the Town of Luray. In addition, through a Virginia Environmental Endowment grant to the Virginia Poultry Federation, two municipal and two industrial plants (Timberville, Broadway, Rocco, and WLR) are being studied for an alternative technology involving land application rather than point source discharge.

While these studies offer hope for effective and potentially less costly nutrient removal designs, there is no certainty that this will be the case. The funding to implement these plans is another hurdle.

Need for Further Information

1) Monitoring - Some of the plants have only limited sampling information.
2) Costs - The costs of upgrading to BNR are at this point very sketchy.
3) Unknowns:

<u>ACSA</u> - Two plants operated by ACSA are showing extremely good reduction levels for both nitrogen and phosphorus at current flows and operating methods (oxidation ditches). These plants are designed to accommodate BNR technology but it is not currently in place. It is expected that increased flows might change the chemistry of the process and make the current low concentration of nutrients unsustainable without moving to BNR. ACSA's Fishersville plant is also showing significant nitrogen reductions.

<u>Industries</u> - Industry changes are difficult to project.

D. URBAN NPS

Very little (2%) of the land in the Southern Shenandoah is classified as urban. What land is urban is not very densely developed compared to other regions in the watershed. Therefore, there is not as great an opportunity to achieve significant pollution reductions from this sector and there is not as great a sense of urgency for doing so, considering the cost.

However, there is support in the region for looking for measures that can reasonably be taken.

There also is sentiment, in fairness to the farm community's efforts in nutrient reduction, to provide public education and address commercial fertilizer applications. In determining the strategy, particularly for cap measures, it is important to recognize that not all non-urban NPS pollution is from agricultural operations and to continue exploration of the links between various land uses and the health of the Bay.

III. DRAFT REGIONAL STRATEGY

The participants developing the tributary strategy for the Southern Shenandoah Region discussed a variety of actions that could help to achieve the 40% reduction goals. The Draft Regional Strategy presented below relies primarily on increased agricultural BMPs. Figures to support these recommendations are presented in detail in the attachments.

The primary focus thus far has been on reaching the 40% goal in the most cost-effective manner possible. Maintaining the cap would be discussed more thoroughly later.

A. PROPOSED STRATEGY

The region's strategy calls for increased state funding of the voluntary incentives program, which provides cost-sharing for implementation of agricultural Best Management Practices (BMPs). In addition, there would have to be local ordinance changes and state policy changes. Under this scenario, soil and water conservation district and local staff believe they could encourage even more farmers to implement the kinds of practices that keep nutrients out of waterways. The final piece of the strategy is installation of Biological Nutrient Removal (BNR) at one basin of Harrisonburg Rockingham Regional Sewer Authority's (HRRSA) North River plant.

Additional minor reductions could be achieved at the region's treatment plants, but these do not appear necessary at this time in order to achieve the 40% reduction goal. It is important, however, for purposes of planning to realize that changes at a limited number of plants may be needed in order to maintain current reductions (Middle River and Stuarts Draft) or may be desirable based on cost efficiencies. For these reasons, information on installing BNR at specific plants is included. (See p. 11 "Supplemental Reductions for Point Sources" and Table 4 on BNR Results and Costs.)

<u>Summary of Strategy Actions</u>

1) Nutrient Management Plans (NMPs) would be required by local ordinance on all intensive agricultural operations.
2) Additional state staff would be provided to write these NMPs.
3) Increased BMP cost-share funding would be provided to the SWCDs.
4) Additional staff would be provided to the three SWCDs to oversee increased BMP activity. It is anticipated that the major additional activities would be in the areas of stream fencing, grazing land protection, stream protection, and animal waste control facilities (poultry litter sheds, dairy pits and loafing lot systems).
5) Seventy-five percent (75%) cost-share funding would be offered on all animal waste control facilities (removing the cost-share funding cap on these practices). The impact would be greatest on dairy pits, which cost an average of $100,000 each. Cost-share funding would have to be provided to cover this extra cost without drawing resources from other practices.
6) BNR would be installed at one basin of HRRSA's North River treatment plant.

<u>Additional Recommendations</u>

7) Voluntary monitoring for total nitrogen and phosphorus concentrations should be undertaken at all point source plants in the basin with flows of 0.**5 mgd or the equivalent.**
8) The state needs to continue to improve its efforts to verify the loadings from the Southern Shenandoah Region and to distribute that information.
9) Grant funding for BNR should be included for future point source facility upgrades and expansions.

B. EXPECTED RESULTS

The Draft Strategy is projected to achieve a 43.5% reduction in nitrogen and a 40.4% reduction in phosphorus. Of these reductions, all would be achieved through actions in the agricultural sector except for minor reductions, primarily in nitrogen, from installing BNR at one basin of the North River treatment plant.

For specific information, see Appendix C: Detailed Reduction Charts. These charts list projected results by activity for each county. One set of charts shows projections at current and planned programs and the other set shows projections under the strategy. Totals also are given for point sources as a whole and for the region.

C. FUNDING

Source of Funding - The strategy assumes the availability of outside (non-local) funding.

Timing of Funding - It is assumed that additional resources would be available by the end of 1997.

D. ESTIMATED COSTS

Estimated costs to implement the strategy are shown in the attachments. Costs are presented for activities beyond those planned under current program levels.

Table 1: Strategy Cost Summary
Table 2: Strategy Activities and Estimated Costs by County
Table 3: Cost Efficiencies of Proposed Activities
Table 4: Projected Results and Costs for Year-Round BNR

TABLE 1: Strategy Cost Summary - S. Shenandoah

Activity	Total	State Cost	Local Cost	Total Cost
Dairy Pits	48	$3,420,000	$975,000	$4,395,000
@ $75,000	39			
@ $55,000	9			
Poultry Litter Sheds	115	$708,750	$138,750	$847,500
@ $11,250	37			
@ $3,750	78			
Loafing Lot Systems	6	$30,000	$10,000	$40,000
@ $5,000				
Stream Fencing	112,200	$189,338	$63,113	$252,450
@ $1.6875/ft				
Stream Protection	8,400	$126,000	$42,000	$168,000
@ $15/ft				
Grazing Land Prot.	2,771	$190,437	$63,479	$253,916
@ $14.50/ac				
Combination Cost				
Additional Staff	6	$720,000	$0	$720,000
@ $40,000				
BNR Upgrade	1	$0	$50,000	$50,000
@ HRRSA 1 basin				
TOTAL	-	$5,384,525	$1,342,342	$6,726,866

NOTES:

Costs given for agricultural BMPs are for state portion only.

Cost difference for dairy pits and poultry litter sheds is due to portion of cost for some facilities being funded through existing cost-share program. Costs that are shown are in addition to current program funding.

See Table 2 for cost summaries by county.

Table 2: Strategy Activities and Estimated Costs by County

Rockingham County	State Cost	Local Cost	Total Cost
Dairy manure pits - 19 @ *$75,000* - 6 @ *$55,000*	$1,755,000	$475,000	$2,230,000
Poultry litter facilities - 15 @ *$11,250* - 60 @ *$ 3,750*	$393,750	$56,250	$450,000
Grazing land protection - 771 Ac Stream fencing - 27,000 ft Altern. Watering systems - 36	$207,000	$69,000	$276,000
Additional staff 2 for NMPs @ *$40,000* for 3 years 1 for technical support @ *$40,000* for 3 years	$360,000	$0	$360,000
BNR Upgrade of one basin at HRRSA	$0	$50,000	$50,000
Total	$2,715,750	$650,250	$3,366,000
Augusta County			
Dairy manure pits - 20 @ *$75,000* - 3 @ *$55,000*	$1,665,000	$500,000	$2,165,000
Poultry litter facilities - 12 @ *$11,250* - 18 @ *$ 3,750*	$202,500	$45,000	$247,500
Loafing lot systems - 6 @ *$ 5,000*	$30,000	$10,000	$40,000

Table 2: Continued

Stream fencing - 79,200 ft @ *$1.6875/ft*	$133,650	$44,550	$178,200
Stream protection - 6,900 ft @ *$15/ft*	$103,500	$34,500	$138,000
Additional staff 2 for NMPs @ *$40,000* for 3 years 1 for technical support @ *$40,000* for 3 years	$360,000	$0	$360,000
Total	$2,494,650	$634,050	$3,128,700
<u>Page County</u>			
Poultry litter facilities - 10 @ *$11,250*	$112,500	$37,500	$150,000
Stream fencing - 6,000 ft @ *$1.6875/ft*	$10,125	$3,375	$13,500
Stream protection - 1,500 ft @ *$15/ft*	$22,500	$7,500	$30,000
Total	$145,125	$48,375	$193,500
<u>Highland County</u>			
Grazing land protection 2000 ac @ *$14.50/ac*	$29,000	$9,667	$38,667
TOTAL	**$5,384,525**	**$1,342,342**	**$6,726,866**

Note: Costs shown in *italics* are itemized state portion of cost-share only.

Table 3: Cost Efficiencies of Proposed Activities

	N Reduction (lb)	P Reduction (lb)	State Cost $	N Efficiency ($/lb)	P Efficiency ($/lb)	Total Cost $	N Efficiency ($/lb)	P Efficiency ($/lb)
Animal Waste Control Facilities	51,576	11,228	$4,128,750	80.05	367.73	$5,242,500	101.65	466.92
Dairy Manure Pits	46,960	10,195	$3,420,000	72.83	335.45	$4,395,000	93.59	431.08
Poultry Litter Facilities	4,615	1,032	$708,750	153.56	686.52	$847,500	183.63	820.92
Nutrient Management	336,878	55,603	$160,000	0.47	2.88	$160,000	0.47	2.88
Grazing Land Protection	6,911	520	$102,415	14.82	196.95	$136,553	19.76	262.60
Stream Fencing	4,289	1,118	$189,338	44.15	169.31	$252,450	58.86	225.74
Stream Protection	3,405	1,361	$126,000	37.00	92.56	$168,000	49.34	123.41
Loafing Lot Systems	963	209	$30,000	31.15	143.61	$40,000	41.54	191.48
Biological Nutrient Removal								
Average 2000	442,497	N/A	$7,382,500	16.68	N/A	$14,765,000	33.37	N/A
Average Buildout	594,126	N/A	$7,382,500	12.43	N/A	$14,765,000	24.85	N/A

Note #1: Although the efficiency of animal waste facilities appears to be low, this is somewhat offset by the fact that the presence of these facilities allows the full implementation of a nutrient management plan. Without these facilities, the reduction achieved under nutrient management planning would be reduced because of the reduced efficiency in implementing a nutrient management plan without a storage facility.

Note #2: The N & P efficiencies of stream fencing, stream protection, and grazing land protection do not take into account the substantial sediment reduction benefit for local waters.

Note #3: A 50-50 split has been used in distributing the cost of BNR between state and total cost.

Note #4: See Table #4 for information on individual treatment plants.

TABLE 4: Projected Results and Costs for Year-Round BNR

			Current & Projected		BNR Year-Round				**	
Plant	Cost	2000 Flow mgd	2000 TN Conc	Reduction vs 1985 TN (lbs)	2000 TN Conc.	Reduction vs 1985 TN (lbs)*	Cost/ lb.	Capacity/ Permitted Flow	Red. @ Capac. vs. 1985	Cost/ lb.
Fishersville (ACSA)	$500,000	1.40	9.20	(3,583)	7.00	(34,405)	$14.53	2.00	(49,150)	$10.17
Luray Municipal	not relevant	1.60	5.00	(12,262)	7.00	NA	NA	2.40	NA	NA
Middle R. NET (ACS	$1,350,000	6.00	7.00	(24,117)	7.00	(147,449)	$9.16	6.00	(147,449)	$9.16
North River (HRRS	$3,600,000	10.00	14.20	44,918	7.00	(151,231)	$23.80	16.00	(264,822)	$13.59
Stuarts Draft (ACSA	$315,000	1.10	7.00	(3,466)	7.00	(27,033)	$11.65	1.40	(34,405)	$9.16
Waynesboro Munic.	$9,000,000	3.70	17.60	5,041	17.60	(82,379)	$109.25	4.00	(98,300)	$91.56
DuPont Co.	not relevant	3.69	9.55	(132,730)	9.55	NA	NA	NA	NA	NA
Merck & Co.	unknown	9.07	5.50	(56,594)	5.50	NA	NA	NA	NA	NA
Rocco Farm Foods	unknown	0.25	4.40	(7,663)	4.40	NA	NA	NA	NA	NA
TOTAL	$14,765,000	36.81	-	(190,456)	-	(442,497)	$33.37		(594,126)	$24.85

* Because Middle River & Stuarts Draft likely will have to convert to BNR eventually in order to sustain current low levels, all reductions in these plants are included under BNR.

** The sole purpose of this column is to calculate maximum reductions possible (ie, at permitted capacity) for BNR capital expenditure. It cannot be used to show net reductions, because increased loads due to the increased flows also would have to be taken into account.

Net results of the former Staunton and Verona plants combined into the new Middle River Regional plant.

NOTES:
Chart shows only nitrogen reductions because while BNR reduces nitrogen significantly it has only a minor effect on phosphorus.
All projected 2000 flows and concentrations are estimates only.
Decreases are shown in parentheses. Increases are shown without.

E. SUPPLEMENTAL REDUCTIONS FOR POINT SOURCES

The major point source operators in the Southern Shenandoah Region identified the following strategy to attempt to meet nutrient reduction targets. These measures could be used to maintain the cap, or to help meet the gap if growth exceeds expectations.

Willingness to add BNR technology depends on the availability of satisfactory funding. The availability of funding would have to be timed to the expansion or upgrade of facilities. For detailed information, see Table 4 and the information sheets in Appendix B on each treatment plant.

Willing to Add Year-Round BNR If Satisfactory Funding, At Any Time:

- HRRSA - North River - all basins (16 mgd)

Willing to Add Year-Round BNR If Satisfactory Funding, At Time of Expansion:

- ACSA - Fishersville
- ACSA - Middle River (if needed to maintain results currently being achieved)
- ACSA - Stuarts Draft (if needed to maintain results currently being achieved)

No Change in Operation Planned:

- ACSA - Middle River Regional (as long as current results can be maintained)
- ACSA - Stuarts Draft (as long as current results can be maintained)
- Luray
- Waynesboro POTW
- DuPont, Waynesboro
- Merck
- Rocco, Timberville

Explanation:

All of the industrial plants (and the Luray plant, which treats 50% industrial flow) have greatly reduced concentrations compared to the draft estimates and the 1985 baseline. Therefore, no changes are proposed at any of the industrial plants or at the Luray plant.

As for the public plants, the appropriateness of BNR implementation varies greatly. The Verona plant is planned to go off line by the year 2000 and so is not included. The Waynesboro plant, because of its design, would be prohibitively expensive to retrofit for BNR at the existing facility for the small reductions that would be gained. The two ACSA oxidation ditch plants (Middle River and Stuarts Draft) have extremely low concentrations currently, but likely would have to upgrade to BNR eventually in order to sustain these low figures.

Costs:

The ballpark estimate for implementing year-round BNR at the North River, Middle River, Fishersville, and Stuarts Draft treatment plants is $5,765,000. Implementation of BNR at the Waynesboro municipal plant would be estimated to add an additional $9,000,000, because of its design and site constraints.

APPENDIX A

AGRICULTURAL BMPS

Augusta County
Highland County
Page County
Rockingham County

Description:
Agricultural Best Management Practices (BMPs) are the primary means for reducing nutrient pollution from farming. The following charts show the level and type of BMPs already in place in each county (1994); the additional practices anticipated to be in place under current and planned programs; and further achievements that could be gained with additional resources.

The strategy's primary features are 75% cost-share for all practices, including animal waste control facilities, and the requirement of nutrient management plans on all intensive agricultural operations. More cost-share funding to cover these increases is assumed.

The numbers in the chart were used in Appendix C to show the reductions that would be gained and in Tables 1 and 2 to show the activities that would be undertaken and the estimated costs.

AGRICULTURAL BMPs - LOCALITY: Augusta County

Practice	Units	1995* Covered	Planned & Projected Annual Rate	Planned & Projected 2000 (x5yrs)**	Planned & Projected 2000 TOTAL**	Proposed Strategy Annual Rate	Proposed Strategy 2000 (2ss+3yrs)	Proposed Strategy 2000 TOTAL	Scenario 2 Annual Rate	Scenario 2 2000 (2ss+3yrs)	Scenario 2 2000 TOTAL
CROPS/PASTURE											
Conservation Tillage	acres	28,542	0	0	28,542	0	0	28,542	0	0	28,542
Farm Plans	acres	55,935	3,000	15,000	70,935	4,000	18,000	73,935	4,000	18,000	73,935
Nutrient Mgmt Plans	farms	23,350	4,773	23,865	47,215	21,000	72,546	95,896	21,000	72,546	95,896
HEL Retirement	acres	3,176	0	360	3,536	0	360	3,536	0	360	3,536
Cover Crops	acres	14,271	0	0	14,271	0	0	14,271	0	0	14,271
Woodland Buffer Filter	lf	0	-	-	26	-	0	0	-	-	26
Grass Filter	lf	0	0	0	0	0	0	0	0	0	0
Grazing Land Protection	acres	1,589	-	-	3,205	-	-	3,205	-	-	3,205
LIVESTOCK/STREAMS											
Altern. Water Sources	fac	40	10	50	90	16	68	108	16	68	108
Stream Fencing - 78'	lf	75,281	26,400	132,000	207,281	52,800	211,200	286,481	52,800	211,200	286,481
ANIMAL WASTE CONTR											
Poultry Litter	fac	107	6	30	137	10	42	149	15	57	164
Dairy - Wet Pits	fac	69	1	5	74	-	25	94	-	37	106
TOTAL	fac	176	7	35	211	10	67	243	15	94	270
Beef - Loafing Lot Syst	fac	14	2	10	24	4	16	30	4	16	30
Dead Bird Composters	fac	30	6	30	60	10	42	72	12	48	78
OTHER											
Stream Prot. + Bioengr.	lf str.	4,600	2,300	11,500	16,100	4,600	18,400	23,000	5,600	21,400	26,000
Forest Harvesting	acres	1,483	-	-	2,432	-	-	2,432	-	-	2,432

* Some include part of 1996. ** Total of '96-'00. *** Total of '95 plus '96-'00. (2ss + 3yrs) = 2 x ann. rate "planned" + 3 x ann. rate each scenario.
Scenarios assume additional resources would be available in 1998 ('96 and '97 at current rates and '98, '99 and '00 with additional resources).
Strategy: NMPs required on all int. ag; 2 add'l NMP writers; add'l cost-share; 1 add'l SWCD staff; 75% pd on dairy pits w/ separate funding.
Scen 1: NMPs required on all int. ag; 2 add'l NMP writers; add'l cost-share; 1 add'l SWCD staff; 100% pd on dairy pits w/ separate funding.
Sources: Bobby Whitescarver, Winston Phillips, Becky Earhart

AGRICULTURAL BMPs - LOCALITY: Highland County

Practice	Units	1995* Covered	Planned and Projected Annual Rate	Planned and Projected 2000 (x 5 yrs)**	Planned and Projected 2000 TOTAL**	Proposed Strategy Annual Rate	Proposed Strategy 2000 (2ss+3yrs)	Proposed Strategy 2000 TOTAL	Scenario 2 Annual Rate	Scenario 2 2000 (1ss+4yrs)	Scenario 2 2000 TOTAL
CROPS/PASTURE											
Conservation Tillage	acres	120			120			120			
Farm Plans	acres	5,500			8,800			8,800			
Nutrient Mgmt Plans	acres	667			1,322			1,322			
HEL Retirement	acres	373			424			424			
Cover Crops	acres	120			100			100			
Woodland Buffer Filter	lf	0			10			10			
Grass Filter	lf	0			8			8			
Grazing Land Protection	acres	500			500		2,000	2,500			
LIVESTOCK/STREAMS											
Altern. Water Sources	fac										
Stream Fencing - 78'	lf	0			0			0			
ANIMAL WASTE CONTR											
Poultry Litter	fac				1		3	4			
Dairy - Wet Pits	fac	not rel.			not rel.			not rel.			
Beef - Loafing Lot Syst	fac	not rel.			not rel.			not rel.			
TOTAL		0			0			0			
Dead Bird Composters					1			1			
OTHER											
Stream Prot. + Bioengr.	lf str.										
Forest Harvesting	acres	298			489			489			

* Current data (1996) - Potomac basin is so small (only 1/4 of county) and all farms accounted for. Used current amounts from M. Bennett's 6/26 fax.
** annual rates not applicable for such limited scale   *** "2000 Total" = sum of additional plus 1994/current.
NMPs: 1,322 acres estimated to cover all intensive operations.
Proposed Strategy - NMPs required on all int. ag. (& structures); double cost-share; add'l funding to ensure current staffing; eliminate cutoff date.
(to pick up 2 existing poultry without storage facilities, would need to relax cutoff date; no other intensive farms so dairy, etc. irrelevant)
Source of Information: Rodney Leech, Roger Canfield

AGRICULTURAL BMPs - LOCALITY: Page County

Practice	Units	1995* Covered	Add'l Planned '96-00 Annual Rate	2000 (x 5 yrs)	TOTAL	Proposed Strategy Annual Rate	2000 (2ss+3yrs)	TOTAL	Scenario 2 - Not Applic. Annual Rate	2000 (2ss+3yrs)
CROPS/PASTURE										
Conservation Tillage	acres	9,062			9,062			9,062		
Farm Plans	acres	11,945		581	12,526			12,526		
Nutrient Mgmt Plans	acres	6,151		12,150	18,301		29,600	35,751		
HEL Retirement	acres	788			788			788		
Cover Crops	acres	0			0			0		
Woodland Buffer Filter	lf	0			0			0		
Grass Filter	lf	0			0			0		
Grazing Land Protection	acres	432		351	783			783		
LIVESTOCK/STREAMS										
Altern. Water Sources	fac	no change			-			-		
Stream Fencing - 78'	lf	10,560	9,000	45,000	55,560	11,000	51,000	61,560		
					0			0		
ANIMAL WASTE CONTR					0			0		
Poultry Litter	fac	61			61			61		
Dairy - Wet Pits	fac	3			3			3		
Beef - Loafing Lot Syst	fac				0					
Brokered Litter**	tons	10,000	20,000	100,000	110,000	20,000	100,000	110,000		
TOTAL		64	-	40	104	-	50	114		
OTHER					0					
Stream Prot. + Bioengr.	lf str.	0	1,500	7,500	7,500	2,000	9,000	9,000		
Forest Harvesting	acres	794		507	1,301			1,301		

* to date; includes first part of 1996; Scenarios assume add'l resources available in '98 = '96 & '97 at steady state + '98, '99, & '00 at add'l resources
Strat: NMPs required on poultry; NMP writer on staff in '96; $200,000 cost-share; 1 SWCD staff (joint with R-ham); (dairy pits irrelevant). Scen. 2
NMPs: total intensive acres estimated at 35,751 (6,151 with NMPs plus 29,600 acres needing plans).
(estimated 160 farms without NMPs - 135 poultry + 25 beef & sheep: average farm size - 185 acres = 29,600)
NMPs - 6,151 a covered now (DCR and SWCD plans, which are compatible); additional 30 plans pending covering 5,500 acres (average 185 ac/fa
Brokered litter now mostly from farms without NMPs; however, since these farms will acquire NMPs by 2000, reductions will be credited through N
Per DCR, changed scenarios to 2 yrs current & 3 yrs add'l resources. This led to a slight reduction in fencing and stream prot. projections.
Cost-share: per B. Whittle, $200,000/year would enable staff to implement add'l BMPs; No dairy farms so payment on pits irrelevant.
Sources: Bill Whittle, David Knicely, Bill Patterson

AGRICULTURAL BMPs - LOCALITY: Rockingham County

Practice	Units	1994* Covered	Planned & Projected - '95-00 Annual Rate	2000 (x 6 yrs)	2000 TOTAL**	Proposed Strategy - 75% c-sh Annual Rate	2000 *** (3ss+3yrs)	2000 TOTAL	Scenario 2 - 100% c-sh Annual Rate	2000 (3ss+3yrs)	2000 TOTAL
CROPS/PASTURE											
Conservation Tillage	acres	30,000			30,000			30,000			30,000
Farm Plans	acres	46,116	3,000	18,000	64,116			64,116			64,116
Nutrient Mgmt Plans	acres	15,806	-	-	34,772	-	-	123,806	18,000	54,000	69,806
HEL Retirement	acres	1,878	23	138	2,016			2,016			2,016
Cover Crops	acres	23,000		0	23,000			23,000			23,000
Woodland Buffer Filter	lf	0		0	0			0			0
Grass Filter	lf	0	30	180	180			180			180
Grazing Land Protection	acres	2,568	171	1,026	3,594	428	1,797	4,365	685	2,567	5,135
LIVESTOCK/STREAMS											
Altern. Water Sources	fac	116	8	48	164	20	84	200	32	120	236
Stream Fencing - 78'	lf	9,000	600	3,600	12,600	1,500	6,300	15,300	2,400	9,000	18,000
ANIMAL WASTE CONTR											
Poultry Litter	fac	256	20	120	376	25	135	391	20	120	376
Dairy - Wet Pits	fac	195	2	12	207		31	226		50	245
TOTAL	fac	451	22	132	583	25	166	617	20	170	621
Beef - Loafing Lot Syst	fac	17	2	12	29	2	12	29	2	12	29
Dead Bird Composters		45	20	120	165	20	120	165	20	120	165
OTHER											
Stream Prot. + Bioengr.	lf str.	0		0	0			0			0
Forest Harvesting	acres	2,024	216	1,294	3,318			3,318			3,318

* Figures are through 1994, which leaves 6 additional years through 2000. ** 2000 total = 1994 + '95-00.

*** Annual rate applies to the 3 years with add'l resources = 3 yrs at annual rate "planned" + 3 years at this rate = amount by 2000.

Scenarios assume resources would be available in 1998 ('95, '96 & '97 at current rates and '98, '99, and '00 with additional resources).

NMPs - figure of 123,806 in 2000 includes 93,000 a. (575 plans) having NMPs not recognized by DCR and therefore not included in 1994 data. Howe as these are revalidated over the next 5 years, they will be recognized by DCR. An additional 15,000 ac. will be covered by NMPs if the county requires NMPs on all intensive ag operations.

Stat: NMPs on all int. ag.; 2 add'l NMP writers; add'l cost-share funding; 1 add'l SWCD staff (with Page?); 75% pd on dairy pits w/sep. funding

Scen. 2: NMPs on all int. ag.; 2 add'l NMP writers; add'l cost-share funding; 1 add'l SWCD staff (with Page?); 100% pd on dairy pits w/sep. funding

Sources: Rhonda Henderson, James Shiflet, Harold Roller

APPENDIX B

POINT SOURCE INFORMATION SHEETS

Publicly Owned Treatment Works:
Fishersville (ACSA)
Luray
Middle River Regional (ACSA)
North River Regional (HRRSA)
Stuarts Draft (ACSA)
Verona (ACSA)
Waynesboro

Industries:
DuPont
Merck & Co, Inc.
Rocco Farm Foods, Inc.

Description:
Ten point source treatment plants in the region were identified in the 1995 state draft as meeting the criteria of discharging in 1985 at least 0.5 million gallons per day of sewage or the equivalent. Since then, the Staunton city plant has been closed and its flow diverted to the new Middle River Treatment plant, which also will take Verona's flow when that plant is moved off line.

The information in these sheets was provided by each treatment plant operator. Much of the data included in the 1995 draft is updated. This new information is reflected in the reduction charts (Appendix C).

INFORMATION SHEET

Southern Shen. Region Wastewater Treatment Plants

1) Plant Description

Name: Fishersville STP
Location: Fishersville (Augusta County)

Contact: R.P. Moring, Augusta County Service Authority
Phone: (540) 245-5670
Fax: (540) 245-5684

Type of design: Activated Sludge

Permitted capacity: 2.0 mgd

Type of flows (industrial, etc): domestic/industrial

Expansion or upgrade plans (date, amount): projected c. 2007

Issues/factors:

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	0.78	18.7 (default)	6.4 (default)	2.0
1994 current	1.09	9.2*	2.49 **	2.0
2000 projected	1.40	9.2*	2.49 **	2.0

* BNR study data - March-May 1996
** average of 61 samples from 3/93 - 5/96

3) **Cost Estimates** (for year-round BNR):

$250,000/mgd (if done with expansion) - estimate; DEQ/Va Tech will provide better information
(2.0 mgd capacity x $250,000 = $500,000+)
O & M - ?

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: Luray Municipal
Location: Luray
Contact: Charles Hoke
Phone: (540) 743-4817
Fax: (540) 743-1486 (via Ronald Good, Town Manager)

Type of design: oxidation ditch

Permitted capacity: 2.4 mgd (by 1997)

Type of flows (industrial, etc): approximately 50/50% industrial & domestic

Expansion or upgrade plans (date, amount):
Any increase would be driven by industrial needs (unknown).

Issues/factors: Because of industry's process, flow is actually nutrient deficient; operator feeds ammonia 90% of the time and phosphorus 60% of the time to maintain levels of 1.0-2.0 and 0.5-2.0, respectively. Normally, ammonia is below technical limits, although it can spike up to 5 mg/l if industry is off line. Nitrates are typically 1.0-2.0. The N figures below leave out organic nitrogen. Dr. Clifford Randall will supply information that in this form it is tied up/unavailable. The industrial flow to the plant is much greater now than in 1985 but the concentrations are much lower; this is reflected below.

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	0.74	18.7	6.4	-
1994 current	1.6 mgd	c. 1.0-2.0	c. 0.5-2.0	2.4 mgd
2000 projected	1.6 mgd	5.0	2.0	

3) Cost Estimates
Not available (or relevant, since plant is nutrient deficient).

psinfo.tab 8/96 - cspdc

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: Middle River Regional Wastewater Treatment Plant
Location: Verona VA (Augusta County)
(replaced Staunton STP 11/95 and will replace Verona STP)

Contact: R.P. Moring, Augusta County Service Authority
Phone: (540) 245-5670
Fax: (540) 245-5684

Type of design: Oxidation Ditch (Staunton was trickling filter & Verona RBC)

Permitted capacity: 5.3 mgd

Type of flows (industrial, etc): domestic/industrial

Expansion or upgrade plans (date, amount): needs expansion near future - 1997-8

Issues/factors: combined Verona and Staunton permits

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	2.86 *	18.7 (def.)	6.4 (def.)	5.3 *
1994 current	3.4 **	6.29 ***	1.56 ***	5.3
2000 projected	6.0 ●	7.0 ●●	1.5 ●●	6.0●

* combined figures for former Staunton & Verona STPs
** does not include Verona STP flow (c. 1.2 mgd)
*** BNR study 2/96-5/96 (30 or so samples each of TKN, TN & P - edited out specific incidents from start up mode that would not be representative).
● Conservative estimate - DEQ/Virginia Tech study will give improved information
●● Current data suggests higher removals possible but data set is very small, results not planned & facility lightly loaded; concentrations may increase as load increases in future.

3) Cost Estimates (for year-round BNR)

$225,000/mgd (est.); may not be necessary as long as current concentrationshold.
(6.0 mgd cap. x $225,000 = $1,350,000+)
O & M - ?

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: North River Wastewater Treatment Facility
(Harrisonburg-Rockingham Regional Sewer Authority)
Location: Mt. Crawford, VA

Contact: Curtis L. Poe, HRRSA
Phone: (540) 434-1053
Fax: (540) 434-5160

Type of design: activated sludge with nitrification & filtration

Permitted capacity: 16 mgd

Type of flows (industrial, etc): industrial and domestic

Expansion or upgrade plans (date, amount):
Expansion/upgrade completed September 1995

Issues/factors:
Will convert aeration-basin #7 to BNR (2 mgd) by October 1996

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	6.45	18.7	6.4	8.0
1994 current	9.07	16.0	2.17	8.0
2000 BNR 1 basin	10.0	14.2	2.04	16.0
2000 BNR all basins	10.0	7.0	1.5	16.0

3) Cost Estimates

For BNR 1 basin: $50,000 plus ?
For BNR all 8 basins: $3.6 million
O&M increases: ?

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: Stuarts Draft STP
Location: Stuarts Draft (Augusta County)

Contact: R.P. Moring, Augusta County Service Authority
Phone: (540) 245-5670
Fax: (540) 245-5684

Type of design: Oxidation Ditch

Permitted capacity: 1.40 mgd

Type of flows (industrial, etc): domestic/industrial

Expansion or upgrade plans (date, amount): not planned

Issues/factors: rapid growth area

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	0.50	18.7 (default)	6.4 (default)	0.71
1994 current	0.71	6.87 *	1.42 **	1.40
2000 projected	1.10	7.0 ●	1.5 ●	1.40

* 5/96 TKN samples & MRRWWTP NO3 Conc.
** average of 29 samples taken from 9/93 through 5/96
● Current data suggests higher removals possible but data set is very small and results not planned; also facility lightly loaded; concentrations may increase as load increases in future.

3) **Cost Estimates** (for year-round BNR):

$225,000/mgd estimate - DEQ/Virginia Tech study will provide better information; upgrade not necessary until current concentrations can no longer be maintained.
(1.4 mgd capacity x $225,000 = $315,000+)
O & M - ?

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: Verona STP
Location: Verona VA (Augusta County)

Contact: R.P. Moring, Augusta County Service Authority
Phone: (540) 245-5670
Fax: (540) 245-5684

Type of design: RBC

Permitted capacity: 0.8 mgd

Type of flows (industrial, etc): domestic/industrial

Expansion or upgrade plans (date, amount): divert to MRRSTP

Issues/factors:

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	0.28	18.7 (def.)	6.4 (def.)	0.80
1994 current	0.80	18.7 (def.)	2.5 (def.)	0.80
2000 projected	0	DIVERTED TO Middle River WWTP		

3) Cost Estimates
N/A - plant will be removed from service

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: Waynesboro Municipal
Location: Waynesboro

Contact: Jax Bowman
Phone: (540) 942-6626
Fax: (540) 942-6671

Type of design: RBC

Permitted capacity: 4.0 mgd

Type of flows (industrial, etc): municipal

Expansion or upgrade plans (date, amount):
upgraded 1989

Issues/factors:
RBC addition, sand filters

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	3.2	19.6	4.96	-
1994 current	3.6	17.6 *	1.6 *	4.0 mgd
2000 projected	3.7	17.6 **	1.75 **	

* results of one sample in 6/96; second sample in same range.
** estimate based on limited 6/96 sampling.

3) Cost Estimates

$8-10 million

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: DuPont
Location: Waynesboro VA

Contact: Brenda Kennell
Phone: (540) 946-1320
Fax: (540) 946-1101

Type of design: Activated sludge with nitrification

Permitted capacity: available capacity in WTP - est. 1.4 mgd

Type of flows (industrial, etc): industrial, non-contact cooling

Expansion or upgrade plans (date, amount):

Issues/factors: Have more than met the 40% reduction from base year (estimated 64.2 % N and 90.1% P) due to reduction of load to WTP in 1990; very difficult to justify further expenditures.

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	4.34	22.68	4.33	
1994 current	3.54	9.55	0.5	
2000 projected	3.69 *	9.55 **	0.5	

* best estimate
** accepted state number, assuming they have done sample

3) Cost Estimates (upgrade to BNR)

capital: $870,000; O & M - $6,000 (based on Hazen and Sawyer Engineers study and 0.65 mgd flow, which is the treatment flow only, not total flow). Clifford Randall says $500,000 to reduce nitrogen by another 50-80%.

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: Merck & Co., Inc.
Location: Elkton, VA (Rockingham County)

Contact: Ted H. Jett, Manager, Environmental Engineering
Phone: (540) 298-4869
Fax: (540) 298-4882

Type of design: Activated Sludge

Permitted capacity: N/A

Type of flows (industrial, etc): industrial

Expansion or upgrade plans (date, amount):
none planned for biological portion of the system

Issues/factors:
Changes in production mix since 1994 have significantly reduced nitrogen loadings (the treatment system is in transition from a nutrient-rich feed to a nutrient-deficient feed). 2000 projections are based on '95 data.

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	6.44	11.93	6.44	NA
1994 current	9.07	9.7	2.4	NA
2000 projected	9.07	5.5	3.8	NA

3) Cost Estimates

Not available.

INFORMATION SHEET
Southern Shenandoah Region Wastewater Treatment Plants

1) Plant Description

Name: Rocco Farm Foods, Inc. (formerly Rocco Further Processing)
Location: Co-op Drive Timberville VA (Rockingham County)

Contact: Bob Wolfe
Phone: (540) 984-6805
Fax: (540) 984-8360

Type of design: anaerobic - aerobic digestion

Permitted capacity: no limit - typical flow is 0.18 - 0.23 mgd

Type of flows (industrial, etc): industrial - further processed poultry (cooking, not slaughter)

Expansion or upgrade plans (date, amount):
to meet new ammonia permit limits by March 1998

Issues/factors:
System and process haven't changed and aren't projected too, except maybe slight flow reduction. Numbers for 1994 are based on one grab sample only, in June '96.

2) Flow and Load Data (review Blue Book)

	Flow (mgd)	Concentration (mg/l)		Permitted Capacity
		Nitrogen	Phosphorus	
1985 base	0.08 *	51.3 *	60.0 *	
1994 current	0.20	4.4	30.7	
2000 projected	0.25	4.4	30.7	

* - from the Blue Book; industry doubts they were correct.

3) Cost Estimates

In an upgrade, could include nutrient reductions as a factor in the design.

APPENDIX C

REDUCTION CHARTS BY COUNTY AND REGION

1. Current/Projected Programs
Augusta County - NPS
Highland County - NPS
Page County - NPS
Rockingham County - NPS
Region - Point Source - NPS
Region - Total PS and NPS

2. Current/Projected Programs Plus Proposed Strategy
Augusta County - NPS
Highland County - NPS
Page County - NPS
Rockingham County - NPS
Region - Point Source - NPS
Region - Total PS and NPS

Description:
The Virginia Department of Conservation and Recreation used the numbers generated by local representatives (Appendices A & B) in its model to predict the reductions that would be gained.

The first set of charts shows the reductions projected under current and planned programs. The second set of charts adds the increased reductions estimated if the proposed activities under the Draft Regional Strategy are enacted.

Nonpoint Source Nutrient Reductions for Augusta County

Based on Implementation of Current & Projected Programs

BMP Treatment	units	Year 1994 Progress Coverage	Year 1994 Progress Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus	Year 2000 Projection Coverage	Year 2000 Projection Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus
Conservation Tillage	acres	28,542	72.9%	0	0	28,542	72.9%	0	0
Farm Plans	acres	55,935	54.3%	33,723	11,970	70,935	57.0%	42,766	15,180
Nutrient Management	acres	23,350	22.7%	97,581	15,976	47,215	45.9%	197,311	32,304
Highly Erodible Land Retirement	acres	3,176	1.6%	23,103	5,658	3,536	1.8%	26,713	6,268
Grazing Land Protection	acres	1,589	1.6%	3,789	299	3,205	3.3%	7,641	603
Stream Fencing	linear feet	75,281	-----	2,878	752	207,281	-----	7,925	2,071
Stream Protection	linear feet	4,600	-----	1,865	746	16,100	-----	6,527	2,610
Cover Crops	acres	14,271	-----	50,063	4,924	14,271	-----	50,063	4,924
Grass Filter Strips	acres	0	-----	0	0	0	-----	0	0
Woodland Buffer Filter Area	acres	0	-----	0	0	26	-----	410	69
Forest Harvesting	acres	1,483	61.0%	19,501	770	2,432	100.0%	31,969	1,262
Animal Waste Control Facilities	systems	176	-----	89,289	19,498	211	-----	97,049	21,214
Loafing Lot Sysyems	systems	14	-----	2,247	488	24	-----	3,852	836
Erosion & Sediment Control	acres	203	52.0%	1,311	771	391	100.0%	3,642	2,140
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	347	10.0%	370	39
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				325,349	61,850			476,238	89,520
Adjustment for Urban Growth:				4,429	(894)			4,443	(897)
Adustment for Poultry Growth:				4,946	1,164			4,946	1,164
Adjusted Reduction:				315,973	61,581			466,849	89,253
Nonpoint Controllable Amount:				1,263,895	264,709			1,263,895	264,709
Percent Reduction:				25.00%	23.26%			36.94%	33.72%

Nonpoint Source Nutrient Reductions for Highland County

Based on Implementation of Current & Projected Programs

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	120	44.9%	0	0	120	47.5%	0	0
Farm Plans	acres	5,500	33.3%	2,731	1,249	8,800	35.0%	4,370	1,998
Nutrient Management	acres	667	18.9%	1,168	121	1,322	37.4%	2,304	240
Highly Erodible Land Retirement	acres	373	2.8%	1,841	805	424	3.2%	2,375	909
Grazing Land Protection	acres	500	0.0%	1,192	94	500	0.0%	1,192	94
Stream Protection	acres	0	-----	0	0	0	-----	0	0
Cover Crops	acres	120	-----	382	36	100	-----	318	30
Grass Filter Strips	acres	0	-----	0	0	8	-----	42	9
Woodland Buffer Filter Area	acres	0	-----	0	0	10	-----	158	27
Forest Harvesting	acres	298	61.0%	4,227	65	489	100.0%	6,930	107
Animal Waste Control Facilities	systems	0	-----	0	0	1	-----	121	28
Erosion & Sediment Control	acres	1	52.0%	4	3	1	100.0%	12	8
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	2	10.0%	2	0
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				11,547	2,372			17,826	3,450
Adjustment for Urban Growth:				5	1			15	4
Adustment for Poultry Growth:				121	33			121	33
Adjusted Reduction:				11,420	2,338			17,690	3,413
Nonpoint Controllable Amount:				56,028	9,066			56,028	9,066
Percent Reduction:				20.38%	25.79%			31.57%	37.65%

Nonpoint Source Nutrient Reductions for Page County

Based on Implementation of Current & Projected Programs

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	9,062	76.6%	0	0	9,062	76.6%	0	0
Farm Plans	acres	11,945	38.5%	6,944	2,437	12,526	40.4%	7,282	2,556
Nutrient Management	acres	5,018	16.2%	21,162	1,820	18,301	29.7%	44,233	3,803
Highly Erodible Land Retirement	acres	788	1.3%	5,482	1,395	788	1.3%	5,482	1,395
Grazing Land Protection	acres	432	1.5%	1,030	81	783	2.8%	1,866	147
Stream Fencing	linear feet	10,560	-----	404	106	55,560	-----	2,126	558
Stream Protection	linear feet	0	-----	0	0	7,500	-----	3,041	1,216
Cover Crops	acres	0	-----	0	0	0	-----	0	0
Grass Filter Strips	acres	0	-----	0	0	0	-----	0	0
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	794	61.0%	10,158	393	1,301	100.0%	16,653	644
Animal Waste Control Facilities	systems	64	-----	11,020	2,507	104	-----	15,956	3,655
Erosion & Sediment Control	acres	21	52.0%	136	80	41	100.0%	378	222
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	104	10.0%	112	12
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				56,335	8,819			97,128	14,209
Adjustment for Urban Growth:				1,748	182			2,155	225
Adustment for Poultry Growth:				13,766	3,203			13,766	3,203
Adjusted Reduction:				40,821	5,433			81,206	10,780
Nonpoint Controllable Amount:				364,289	74,936			364,289	74,936
Percent Reduction:				11.21%	7.25%			22.29%	14.39%

Nonpoint Source Nutrient Reductions for Rockingham County

Based on Implementation of Current & Projected Programs

BMP Treatment	units	Year 1994 Progress Coverage	Year 1994 Progress Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus	Year 2000 Projection Coverage	Year 2000 Projection Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus
Conservation Tillage	acres	30,000	59.1%	0	0	30,000	59.1%	0	0
Farm Plans	acres	46,116	54.0%	31,501	10,021	64,115	56.7%	43,797	12,611
Nutrient Management	acres	15,806	18.4%	71,976	10,620	34,772	72.8%	124,089	18,307
Highly Erodible Land Retireme	acres	1,878	0.9%	13,519	3,261	2,016	0.9%	15,034	3,495
Grazing Land Protection	acres	2,568	0.3%	7,139	480	3,594	0.7%	9,992	671
Stream Fencing	linear feet	9,000	-----	344	90	12,600	-----	482	126
Cover Crops	acres	23,000	-----	65,780	5,693	23,000	-----	65,780	5,693
Grass Filter Strips	acres	0	-----	0	0	180	-----	2,037	237
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	2,024	61.0%	24,813	791	3,318	100.0%	40,677	1,297
Animal Waste Control Facilitie	systems	451	-----	275,518	59,819	583	-----	309,054	67,101
Loafing Lot Systems	systems	17	-----	2,729	592	29	-----	4,655	1,010
Erosion & Sediment Control	acres	120	52.0%	805	454	231	100.0%	2,235	1,260
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	121	10.0%	141	14
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				494,124	91,820			617,971	111,821
Adjustment for Urban Growth:				74	(2)			78	(2)
Adustment for Poultry Growth:				28,311	6,148			28,311	6,148
Adjusted Reduction:				465,739	85,674			589,582	105,675
Nonpoint Controllable Amount:				1,443,127	267,945			1,443,127	267,945
Percent Reduction:				32.27%	31.97%			40.85%	39.44%

Southern Shenandoah Region - Point Sources: Current and Projected Programs

Year 1994 Progress to Date

	1985 Point Load (lbs)		Year 1994 Reported Values (lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Augusta	501,098	150,990	328,702	-34.4%	52,351	-65.3%
Highland	0	0	0	0.0%	0	0.0%
Page	29,066	11,692	59,310	104.1%	9,319	-20.3%
Rockingham	425,186	162,800	491,852	15.7%	148,664	-8.7%
S. Shenandoah	955,350	325,482	879,864	-7.9%	210,335	-35.4%

Year 2000 Projections

	1985 Point Load (lbs)		Year 2000 Estimates (lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Augusta	501,098	150,990	350,792	-30.0%	62,387	-58.7%
Highland	0	0	0	0.0%	0	0.0%
Page	29,066	11,692	16,803	-42.2%	7,980	-31.7%
Rockingham	425,186	162,800	443,094	4.2%	157,401	-3.3%
S. Shenandoah	955,350	325,482	810,689	-15.1%	227,768	-30.0%

Southern Shenandoah Region - Total Reductions: Current and Projected Programs

	Nitrogen Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Augusta	3,283,199	1,764,993	705,997	488,369	-27.7%	617,155	-35.0%
Highland	252,836	56,028	22,411	11,420	-20.4%	17,690	-31.6%
Page	984,113	386,656	154,662	10,577	-2.7%	93,469	-24.2%
Rockingham	3,548,588	1,868,313	747,325	399,073	-21.4%	571,674	-30.6%
S. Shenandoah	8,068,736	4,075,990	1,630,396	909,440	-22.3%	1,299,988	-31.9%

	Phosphorus Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Augusta	512,942	415,699	166,280	160,219	-38.5%	177,856	-42.8%
Highland	15,118	9,066	3,626	2,338	-25.8%	3,413	-37.7%
Page	120,361	86,314	34,526	7,806	-9.0%	14,492	-16.8%
Rockingham	526,450	430,745	172,298	99,809	-23.2%	111,074	-25.8%
S. Shenandoah	1,174,870	941,825	376,730	270,173	-28.7%	306,835	-32.6%

Nonpoint Source Nutrient Reductions for Augusta County

Based on Implementation of Current , Planned, & Proposed Activities under Draft Strategy

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	28,542	72.9%	0	0	28,542	72.9%	0	0
Farm Plans	acres	55,935	54.3%	33,723	11,970	73,935	57.0%	44,575	15,822
Nutrient Management	acres	23,350	22.7%	97,581	15,976	95,896	45.9%	400,753	65,613
Highly Erodible Land Retirement	acres	3,176	1.6%	23,103	5,658	3,536	1.8%	26,713	6,268
Grazing Land Protection	acres	1,589	1.6%	3,789	299	3,205	3.3%	7,641	603
Stream Fencing	linear feet	75,281	-----	2,878	752	286,481	-----	10,954	2,862
Stream Protection	linear feet	4,600	-----	1,865	746	23,000	-----	9,324	3,728
Cover Crops	acres	14,271	-----	50,063	4,924	14,271	-----	50,063	4,924
Grass Filter Strips	acres	0	-----	0	0	0	-----	0	0
Woodland Buffer Filter Area	acres	0	-----	0	0	26	-----	410	69
Forest Harvesting	acres	1,483	61.0%	19,501	770	2,432	100.0%	31,969	1,262
Animal Waste Control Facilities	systems	176	-----	89,289	19,498	243	-----	121,827	26,606
Loafing Lot Sysyems	systems	14	-----	2,247	488	30	-----	4,815	1,045
Erosion & Sediment Control	acres	203	52.0%	1,311	771	391	100.0%	3,642	2,140
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	347	10.0%	370	39
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	*linear feet*	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				325,349	61,850			713,055	130,981
Adjustment for Urban Growth:				4,429	(894)			4,443	(897)
Adustment for Poultry Growth:				4,946	1,164			4,946	1,164
Adjusted Reduction:				315,973	61,581			703,666	130,713
Nonpoint Controllable Amount:				1,263,895	264,709			1,263,895	264,709
Percent Reduction:				25.00%	23.26%			55.67%	49.38%

Nonpoint Source Nutrient Reductions for Highland County

Based on Implementation of Current , Planned, & Proposed Activities under Draft Strategy

BMP Treatment	units	Year 1994 Progress Coverage	Year 1994 Progress Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus	Year 2000 Projection Coverage	Year 2000 Projection Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus
Conservation Tillage	acres	120	44.9%	0	0	120	47.5%	0	0
Farm Plans	acres	5,500	33.3%	2,731	1,249	8,800	35.0%	4,370	1,998
Nutrient Management	acres	667	18.9%	1,168	121	1,322	37.4%	2,304	240
Highly Erodible Land Retirement	acres	373	2.8%	1,841	805	424	3.2%	2,375	909
Grazing Land Protection	acres	500	0.0%	1,192	94	2,500	0.0%	5,960	470
Stream Protection	acres	0	-----	0	0	0	-----	0	0
Cover Crops	acres	120	-----	382	36	100	-----	318	30
Grass Filter Strips	acres	0	-----	0	0	8	-----	42	9
Woodland Buffer Filter Area	acres	0	-----	0	0	10	-----	158	27
Forest Harvesting	acres	298	61.0%	4,227	65	489	100.0%	6,930	107
Animal Waste Control Facilities	systems	0	-----	0	0	1	-----	121	28
Erosion & Sediment Control	acres	1	52.0%	4	3	1	100.0%	12	8
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	2	10.0%	2	0
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				11,547	2,372			22,594	3,826
Adjustment for Urban Growth:				5	1			15	4
Adustment for Poultry Growth:				121	33			121	33
Adjusted Reduction:				11,420	2,338			22,458	3,789
Nonpoint Controllable Amount:				56,028	9,066			56,028	9,066
Percent Reduction:				20.38%	25.79%			40.08%	41.80%

Nonpoint Source Nutrient Reductions for Page County

Based on Implementation of Current , Planned, & Proposed Activities under Draft Strategy

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	9,062	76.6%	0	0	9,062	76.6%	0	0
Farm Plans	acres	11,945	38.5%	6,944	2,437	12,526	40.4%	7,282	2,556
Nutrient Management	acres	5,018	16.2%	21,162	1,820	35,751	29.7%	74,543	6,410
Highly Erodible Land Retirement	acres	788	1.3%	5,482	1,395	788	1.3%	5,482	1,395
Grazing Land Protection	acres	432	1.5%	1,030	81	783	2.8%	1,866	147
Stream Fencing	linear feet	10,560	-----	404	106	61,560	-----	2,354	615
Stream Protection	linear feet	0	-----	0	0	9,000	-----	3,649	1,459
Cover Crops	acres	0	-----	0	0	0	-----	0	0
Grass Filter Strips	acres	0	-----	0	0	0	-----	0	0
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	794	61.0%	10,158	393	1,301	100.0%	16,653	644
Animal Waste Control Facilities	systems	64	-----	11,020	2,507	114	-----	17,490	4,006
Erosion & Sediment Control	acres	21	52.0%	136	80	41	100.0%	378	222
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	104	10.0%	112	12
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				56,335	8,819			129,808	17,466
Adjustment for Urban Growth:				1,748	182			2,155	225
Adustment for Poultry Growth:				13,766	3,203			13,766	3,203
Adjusted Reduction:				40,821	5,433			113,887	14,037
Nonpoint Controllable Amount:				364,289	74,936			364,289	74,936
Percent Reduction:				11.21%	7.25%			31.26%	18.73%

Nonpoint Source Nutrient Reductions for Rockingham County

Based on Implementation of Current , Planned, & Proposed Activities under Draft Strategy

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	30,000	59.1%	0	0	30,000	59.1%	0	0
Farm Plans	acres	46,116	54.0%	31,501	10,021	64,115	56.7%	43,797	12,611
Nutrient Management	acres	15,806	18.4%	71,976	10,620	123,806	72.8%	257,525	37,996
Highly Erodible Land Retirement	acres	1,878	0.8%	13,519	3,261	2,016	0.9%	15,034	3,495
Grazing Land Protection	acres	2,568	0.3%	7,139	480	4,365	0.7%	12,135	815
Stream Fencing	linear feet	9,000	-----	344	90	39,600	-----	1,514	396
Cover Crops	acres	23,000	-----	65,780	5,693	23,000	-----	65,780	5,693
Grass Filter Strips	acres	0	-----	0	0	180	-----	2,037	237
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	2,024	61.0%	24,813	791	3,318	100.0%	40,677	1,297
Animal Waste Control Facilities	systems	451	-----	275,518	59,819	617	-----	334,317	72,586
Loafing Lot Systems	systems	17	-----	2,729	592	29	-----	4,655	1,010
Erosion & Sediment Control	acres	120	52.0%	805	454	231	100.0%	2,235	1,260
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0.0%	0	0
Urban Nutrient Management	acres	0	0.0%	0	0	121	10.0%	141	14
Septic Pumping	systems	0	-----	0	0	0	-----	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	-----	0	0
Total Pounds Reduced:				494,124	91,820			779,847	137,409
Adjustment for Urban Growth:				74	(2)			78	(2)
Adustment for Poultry Growth:				28,311	6,148			28,311	6,148
Adjusted Reduction:				465,739	85,674			751,457	131,263
Nonpoint Controllable Amount:				1,443,127	267,945			1,443,127	267,945
Percent Reduction:				32.27%	31.97%			52.07%	48.99%

Southern Shenandoah Region - Point Sources: Current , Planned, & Proposed Activities

Year 1994 Progress to Date

	1985 Point Load (lbs)		Year 1994 Reported Values (lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Augusta	501,098	150,990	328,702	-34.4%	52,351	-65.3%
Highland	0	0	0	0.0%	0	0.0%
Page	29,066	11,692	59,310	104.1%	9,319	-20.3%
Rockingham	425,186	162,800	491,852	15.7%	148,664	-8.7%
S. Shenandoah	955,350	325,482	879,864	-7.9%	210,335	-35.4%

Year 2000 Projections

	1985 Point Load (lbs)		Year 2000 Estimates (lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Augusta	501,098	150,990	350,792	-30.0%	62,387	-58.7%
Highland	0	0	0	0.0%	0	0.0%
Page	29,066	11,692	16,803	-42.2%	7,890	-32.5%
Rockingham	425,186	162,800	405,286	-4.7%	154,196	-5.3%
S. Shenandoah	955,350	325,482	772,881	-19.1%	224,473	-31.0%

Southern Shenandoah Region - Total Reductions: Current , Planned, & Proposed Activities

	Nitrogen Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Augusta	3,283,199	1,764,993	705,997	488,369	-27.7%	853,972	-48.4%
Highland	252,836	56,028	22,411	11,420	-20.4%	22,458	-40.1%
Page	984,113	386,656	154,662	10,577	-2.7%	126,150	-32.6%
Rockingham	3,548,588	1,868,313	747,325	399,073	-21.4%	771,357	-41.3%
S. Shenandoah	8,068,736	4,075,990	1,630,396	909,440	-22.3%	1,773,936	-43.5%

	Phosphorus Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Augusta	512,942	415,699	166,280	160,219	-38.5%	219,316	-52.8%
Highland	15,118	9,066	3,626	2,338	-25.8%	3,789	-41.8%
Page	120,361	86,314	34,526	7,806	-9.0%	17,839	-20.7%
Rockingham	526,450	430,745	172,298	99,809	-23.2%	139,867	-32.5%
S. Shenandoah	1,174,870	941,825	376,730	270,173	-28.7%	380,812	-40.4%

APPENDIX D

LIST OF PARTICIPANTS

Description:
The Draft Regional Strategy is based on local input. Many meetings were held throughout the spring and summer of 1996, with coordination provided by the Central Shenandoah Planning District Commmission. Mark Bennett of the Virginia Department of Conservation and Recreation, served as the state team leader for the effort and will be responsible for fitting this region's strategy into the overall state Potomac Basin strategy.
The "committee" consisted of local staff (each locality assigned a representative); staff from the three soil and water conservation districts and the four extension offices; and operators of the participating treatment plants. Other resource people were contacted as necessary.

The governing bodies and the general public have not yet had the opportunity to review the recommendations.

APPENDIX D

LIST OF PARTICIPANTS
Southern Shenandoah Draft Tributary Strategy

Team Leader:
Mark Bennett
Virginia Department of Conservation and Recreation

PDC Coordinator:
Sara Hollberg
Senior Planner
Central Shenandoah Planning District Commission

Locality Representatives:*

Augusta County
Becky L. Earhart
Senior Planner

Highland County
Rodney Leech
Extension Agent

Page County
Ron Wilson
Page County Administrator

Rockingham County
William L. Vaughn
GIS Coord./Planning Director

Rhonda Henderson
Planner

City of Harrisonburg
Mike Collins
Director of Water and Sewer

Rajat Sarkar
City Planner

City of Staunton
Sharon E. Angle
Planning Director

City of Waynesboro
Jax Bowman
Director of Public Works

Point Sources:
Richard Moring, Executive Director
Augusta County Service Authority

Curtis Poe, Executive Director
Harrisonburg-Rockingham Regional Sewer Authority

Charles Hoke
Luray Municipal Treatment Plant

Brenda Kennell
Environmental Engineer
DuPont

Ted Jett
Manager, Environmental Engineering
Merck & Co., Inc.

Robert Wolfe
Rocco Farm Foods

Soil and Water Conservation Districts
Bobby Whitescarver
District Conservationist
Headwaters SWCD

Roger Canfield

District Conservationist
Mountain SWCD

James Shiflet
Conservation Technician
Shenandoah Valley SWCD

David Knicely
Conservation Specialist
Shenandoah Valley SWCD

<u>Extension</u>
Rick D. Heidel
Augusta County Extension Agent

Rodney Leech
Highland County Extension Agent
(also locality representative)

Bill Whittle
Page County Extension Agent

Harold Roller
Rockingham County Extension Agent

<u>also consulted:</u>
John Johnson
Virginia Poultry Federation

Winston Phillips
Nutrient Management Specialist
VDCR Valley Office

Mark Hollberg
Augusta Area Forester
Virginia Dept. of Forestry

Ron Harrison
WLR Foods

* Town representatives also were involved in initial meetings; however only Luray has a treatment plant large enough to be included in the Strategy.

Potomac Basins Tributary Strategies Tracking

Southern Shenandoah Meetings

Inv	Affiliation	Name	Title	20-Mar	15-May	27-Jun	29-Aug
Local Governments							
x	Augusta County	Charles W. Curry	Chairman, Board of Supervisors	x			x
	Augusta County	J. Donald Hanger	Board of Supervisors	x	x		x
	Augusta County	Richard P. Moring	Public Works/Utilities Director	x	x	x	x
	Augusta County	Becky Earhart		x	x	x	x
x	Bridgewater, Town of	Roland Z. Arey	Mayor				x
	Bridgewater, Town of	Jerry Oakes	Public Works/Utilities Director	x	x		
x	Broadway, Town of	Wanda Wilt	Mayor				
x	City of Harrisonburg	John Neff	Mayor				
	City of Harrisonburg	Rajat Sarkar	City Engineer's Office		x	x	x
	City of Harrisonburg	A. Mike Collins	Public Utilities Director		x	x	x
x	City of Staunton	G. John Avoli	Mayor				
	City of Staunton	Douglas C. Wine	Vice Mayor	x			x
	City of Staunton	Sharon E. Angle	Planning Director	x	x	x	x
	City of Staunton	R. Douglas Manning	City Council Member	x			
x	City of Waynesboro	Louis A. Brooks	Mayor				
	City of Waynesboro	S. B. Kiger	City Council Member	x			
	City of Waynesboro	Michael Hamp	Assistant Manager	x			
	City of Waynesboro	Steve Yancey	Public Works Office		x		
	City of Waynesboro	H. Jax Bowman	Public Works/Utilities Director	x		x	x
x	Dayton, Town of	Edgar H. Bartley	Mayor				
x	Elkton, Town of	Charles Dean	Mayor				
	Grottoes, Town of	Doug Shifflett	Mayor				
x	Grottoes, Town of	Carter Miller	Manager	x		x	
	Harrisonburg-Rockingham Regional Sewer Authority	Curtis Poe		x	x	x	x
x	Highland County	Ronald T. Malcolm	Chairman, Board of Supervisors				
	Highland County	D. "Robin" Sullenberger	Vice Chairman, Board of Supervisors	x			
x	Luray, Town of	Ralph H. Dean	Mayor	x			
	Luray, Town of	Ronald W. Good	Manager	x			
x	Mount Crawford, Town of	Roscoe A. Bishop	Mayor				
x	Page County	Nora Belle Comer	Chairman, Board of Supervisors				
	Page County	Ron Wilson	Administrator	x	x		x
x	Rockingham County	J. R. Correa	Chairman, Board of Supervisors				
	Rockingham County	William Vaughn	Planning Director	x	x	x	
	Rockingham County	Rhonda Henderson	Planning Office	x	x	x	x
x	Shenandoah, Town of	Clinton O. Lucas	Mayor				
x	Stanley, Town of	Douglas L. Purdham	Mayor				
	Stanley, Town of	Terry Pettit	Public Works/Utilities Director	x			
County Soil and Water Conservation Districts							

Potomac Basins Tributary Strategies Tracking

Southern Shenandoah Meetings

Inv	Affiliation	Name	Title	20-Mar	15-May	27-Jun	29-Aug
x	Headwaters SWCD	Charles E. Horn	Chairman				
	Headwaters SWCD	Richard Coon		x			
	Headwaters SWCD	John Kaylor		x		x	
	Headwaters SWCD	C. S. Patterson		x			
	Lord Fairfax SWCD	Jeffrey Slack		x			
x	Mountain Castles SWCD	Fred B. Givens	Chairman				
	Mountain SWCD	J. Frank Shepherd	Chairman	x			x
x	Shenandoah Valley SWCD	E. S. Long	Chairman	x			
	Shenandoah Valley SWCD	David R. Knicely	Conservation Specialist		x	x	
	Shenandoah Valley SWCD	C. G. Luebben	Assoc. Director		x	x	x
	Shenandoah Valley SWCD	Randy Maupin			x		
	Shenandoah Valley SWCD	James Shifflett	Conservation Technician		x		x
PDCs and Other Regional Groups							
	Central Shenandoah PDC	Sara Hollberg	Regional Planner	x	x	x	x
	Cendtal Shenandoah PDC	James Shaw					x
	Central Shenandoah PDC	William Strider	Executive Director				x
Legislators							
X	Virginia House of Delegates	Steve Landes					x
	Delegate Steve Landes' Office	Angela Taylor	Aide		x	x	
x	Virginia House of Delegates	R. Creigh Deeds			x		
x	Virginia State Senate	Emmett Hanger					
	Senator Emmett Hanger's Office	Holly Wyatt	Aide			x	
State and Federal Agencies							
	VA Chesapeake Bay Local Assistance Dept.	Shawn Smith		x	x	x	x
	VA Cooperative Extension	Harold W. Roller		x			x
	VA Cooperative Extension	Randy Shank		x	x		x
	VA Dept. Conservation & Recreation	Tony Pane			x		
	VA Dept. Conservation & Recreation	Charles Wade		x	x	x	x
	VA Dept. Conservation & Recreation	Robert Connelly		x	x		
	VA Dept. Conservation & Recreation	John Milnarcik		x		x	x
	VA Dept. Conservation & Recreation	Winston Phillips		x	x	x	
	VA Dept. Conservation & Recreation	Kathleen W. Lawrence	Director••	x			
	VA Dept. Conservation & Recreation	Jack Frye		x			
	VA Dept. Conservation & Recreation	Moria Croghan		x			
	VA Dept. Conservation & Recreation	Mark Bennett	S. Shenandoah Team Leader	x	x	x	x
	VA Dept. Environmental Quality	Rod Bodkin		x	x	x	x

Potomac Basins Tributary Strategies Tracking

Southern Shenandoah Meetings

Inv	Affiliation	Name	Title	20-Mar	15-May	27-Jun	29-Aug
	VA Dept. Environmental Quality	Alan E. Pollock		x	x		
	US Natural Resource Conservation Service	Wade Biddix		x	x	x	x
	US Natural Resource Conservation Service	Bobby Whitescarver		x	x		
	US Natural Resource Conservation Service	Chuck Cummings				x	x
Citizen and Business Groups							
	Virginia Farm Bureau	Witmer Stoneman		x			x
	Virginia Poultry Federation	John Johnson		x	x	x	
	Chesapeake Bay Foundation	Jean Watts	Staff Scientist	x	x		
	Earth Technology	James Heyen					x
	FORVA	Corbin Dixon		x	x		x
	Friends of the Shenandoah River	John Gibson		x	x		
	Valley Conservation Council	Faye Cooper		x			
	Valley Conservation Council	Van Anderson			x	x	x
	WLR Foods	David Frackelton					x
Media							
	Daily News Record	Eric Gorton	Reporter		x		
	News-Virginian Waynesboro	Don McCauly	Reporter	x			
	News Leader	Paul Bergen	Reporter				x

APPENDIX I

Northern Shenandoah Region:
Tributary Assessment

POTOMAC/SHENANDOAH RIVER BASIN TRIBUTARY STRATEGY

REGIONAL ASSESSMENT

Assessment of

Practices and Costs for Achieving 40% Nutrient Reduction

In Virginia's Northern Shenandoah Region

Northern Shenandoah Regional Assessment

Summary of the Northern Shenandoah Regional Assessment

This document is part of Virginia's Potomac River Basin Tributary Nutrient Reduction Strategy. It presents a listing (or "assessment") of the kinds of practices that could be effective, practical and publicly supported in the Northern Shenandoah region for reducing nutrient loadings into the Shenandoah and Potomac Rivers, and thus the Chesapeake Bay.

To meet Virginia's goal of reducing nutrient loadings into the Chesapeake Bay by 40% and restore the health of its fisheries, the Commonwealth has been working on an assessment process with local governments, interest groups, farmers and others in the Potomac basin to identify practical and cost-effective methods for reducing nutrient loadings into the Potomac River. For this process, the localities in the basin were grouped into four regions, based on similarities of land uses, industries, population densities and nutrient sources. This document is the result of an assessment process conducted in the Northern Shenandoah region, consisting of the Counties of Clarke, Frederick, Shenandoah and Warren and the City of Winchester.

The Northern Shenandoah assessment was cooperatively supervised by the chairperson of the Lord Fairfax Soil and Water Conservation District (LFSWCD), and the state technical assistance team leader from the Department of Environmental Quality (DEQ). The assessment included five regional meetings and additional meetings with various groups, including the board of supervisors of each county, Farm Bureau representatives, and the Frederick Winchester Sewer Authority Board.

The meetings included representatives of each of the four counties, the City of Winchester, the towns of Berryville, Strasburg and Woodstock, LFSWCD, the Friends of the Shenandoah River and the Friends of the North Fork of the Shenandoah River.

In the assessment process, local governments were asked to involve and represent the interests of citizens and stakeholders in their jurisdiction. Technical information was provided to these participants on nutrient loads and reductions targets, the Bay Program's computer models, and options for Biological Nutrient Removal at wastewater treatment plants in the region. Discussions were held regarding the approach of the regional assessment process; and the participants decided to construct a "regional framework' that would be used to guide the development of local nutrient reduction plans.

The regional, participants constructed a Regional Framework to guide local nutrient reduction plans. The Framework was adopted by the Lord Fairfax Planning District Commission and was then sent to local governments for final review. The only dissent of the Regional Framework was from the Frederick County Board of Supervisors.

The full Regional Framework includes a list of the benefits that would accrue to citizens in the region as a result of nutrient reduction. Several common goals are then set forth. First, the region will focus on agricultural BMPs as the most cost-effective way to reduce nutrients. Second, each local strategy will combine cost effectiveness with shared responsibility. Finally, the region will look for economic incentives to encourage citizens to voluntarily implement nutrient reduction.

The Framework also presents recommended approaches and actions for addressing the different types of nutrient sources: agriculture, municipal, industrial, residential and growth and development. The participants cited agricultural BMPs as the most cost-effective method for reducing nutrients and recommended that localities request additional state cost-share funds for BMP implementation. The full Regional Framework, adopted June 19, 1996 by the Lord Fairfax Planning District Commission.

The participants in the Northern Shenandoah assessment determined that the localities would individually consider developing local nutrient reduction plans. For this effort, Clarke and Shenandoah developed and adopted comprehensive local nutrient reduction plans. Officials from Clarke and Shenandoah Counties cited the close relationship that exists among the health of their economies, their natural resources, their farming communities and the productivity of agricultural land as a major reason for their development of nutrient reduction assessments. The principal element of these two local assessments is a request for additional cost-share funding from the state for their farmers to expand implementation of best management practices. In addition, both of the assessments address other types of nutrient sources to ensure a balanced approach to nutrient reduction. Both localities included specific local commitments in their assessments in order to do their part to achieve the 40% nutrient reduction goal.

Warren County has mostly already achieved its local nutrient reduction goal as a result of the closure of the Avtex industrial facility and also as a result of conversions in cropland that have taken place since the baseline year 1985. County staff participated in the assessment and developed a draft local nutrient reduction plan which was reviewed by the County Board of Supervisors at two meetings. The plan described the types of management measures which could be available for further nutrient reductions in the County including enhanced cost-share funding for a number of agricultural best management practices (BMPs) and addressing failing septic systems.

In response, the Warren County Board adopted a resolution is support of nutrient reductions and for continued efforts, particularly in the areas of citizen education and financial assistance. The Board determined that further study of the issue of septic system management was warranted and established a Potomac Strategy Committee to consider this, and other, options which would continue to reduce nutrient loadings from Warren County.

The Frederick County Board of Supervisors went on record as not supporting the language of the Regional Framework. The Board expressed their concern that there had been insufficient coordination between the assessment process and the County's farming community. The Board also expressed concern over the effect that the nutrient cap would have on future growth and development in the County. However, the Frederick County Board agreed that the state technical assistance team could put together a "strawman" list of agricultural practices that could potentially be available for implementation in the County. After that list was created, the state assistance team leader coordinated efforts with the County's agricultural community through the Virginia Farm Bureau (state and local) to ensure that their interests were represented in the regional assessment.

The City of Winchester and the Frederick-Winchester Sewer Authority (FWSA) participated in the Potomac Strategy assessment process.The FWSA is currently considering whether they it will propose the Opequon for cost-share funding and BNR upgrade through the final Potomac Strategy.

This document is not a full "Nutrient Reduction Strategy" for the Northern Shenandoah region. A Strategy would present a complete regional plan for reaching the 40% nutrient reduction goal and would include funding sources, parties responsible for implementing the identified practices, and specific plans for achieving implementation. Rather, this assessment document sets forth the types (and costs) of nutrient reduction practices that would make sense in the region under certain conditions, such as availability of cost-share funding and expanded technical assistance.

In the effort to achieve nutrient reductions across the Potomac basin, a final Potomac Nutrient Reduction Strategy will be developed which will address point sources of pollution (primarily wastewater treatment plants) and nonpoint sources of pollution (primarily runoff from farms and residential areas). The final Potomac Nutrient Reduction Strategy will be submitted to the 1997 Virginia General Assembly. The Strategy will provide the General Assembly with the information necessary to make decisions on allocations of cost-share funds for nutrient reductions in the Potomac basin and to weigh the costs of these practices against their benefits.

In the Northern Shenandoah region, nonpoint sources are the major source of nutrient pollution; and reducing these nutrient loads makes practical sense for the quality of local waters, the fisheries of the Chesapeake Bay and also for the farmer. Keeping topsoil and nutrients on farm fields and out of waterways is a benefit to both. The agricultural cost-share proposals that will make up a major component of the Potomac Nutrient Reduction Strategy can be viewed as a choice of whether or not the state should invest additional cost-share funding into the two most important renewable-resource sectors of Virginia's economy - agriculture and fisheries - in order to conserve them both over the long run.

I. Background and Introduction

Regional Goal for Nutrient Reduction

As a signatory of the 1987 Chesapeake Bay Agreement, Virginia is working toward a 40% reduction of the controllable nutrient load to the Chesapeake Bay by the year 2000. Individual Tributary Strategies are being developed as the means to reach this goal, and in Virginia's portion of the Potomac basin this has been facilitated by subdividing the drainage area into four regions (Northern and Southern Shenandoah, Northern Virginia, and Lower Potomac). A 40% reduction target was determined for each region, with the ultimate intent of improving the quality of local waters and of fulfilling the Bay Program commitment when the four regional plans are combined.

Assessment of Locally-Based Solutions for Nutrient Reduction

An "assessment process" was conducted in the Northern Shenandoah region from March through September of 1996 to identify practical solutions for reducing nutrient loadings in the region through local decision-making. The process included representatives of local governments, soil and water conservation districts, planning district commissions, conservation groups and farmers and citizens in order to link the development of Virginia's Potomac Nutrient Reduction Strategy as closely as possible to the interests and concerns of stakeholders in the region.

This assessment process is the heart of Virginia's Potomac Nutrient Reduction Strategy. It identifies selected practices for reducing nutrient loadings into the Shenandoah and Potomac Rivers and sets forth how the Northern Shenandoah region's 40% nutrient reduction goal could be met. It also provides an estimate of the costs that would be associated with these practices.

A New Approach to Water Quality Protection

This assessment, and Virginia's Potomac Tributary Strategy, is an attempt to return important decisions on water quality protection to citizens and state and local elected officials. The decisions and recommendations that comprise this assessment arose from the professional judgement and creative thinking of citizens, stakeholders, interest groups and local representatives in the Northern Shenandoah region. The role of agency staff in this assessment has been to provide information, technical assistance and a format for this effort. Final decisions on the recommendations contained in this document will be made by state elected officials in the Virginia General Assembly.

Not a Commitment to Final Implementation

This document does not impose any commitments to implement nutrient reduction practices on individuals who were involved in the assessment process, nor on any third party, except where such commitments have been voluntarily assumed. The assessment is not an effort by the Commonwealth of Virginia to require the development and operation of these practices by citizens, farmers, businesses or local governments. Rather, the assessment is an effort to identify the types of practices that would be cost-effective, practical and equitable in reducing nutrient loadings from the Northern Shenandoah region. The document then provides a summary of the costs that would be associated with the implementation of these practices at a level that would reach the 40% nutrient reduction goal.

II. Process and Development of Virginia's Potomac Tributary Strategy

Progress to Date Toward Meeting 40% Nutrient Reduction Goal

Since Virginia began working toward the 40% goal in the Potomac River basin, nutrient loadings have been reduced through increased use of agricultural best management practices (BMP)s, enhanced nutrient removal at wastewater treatment plants, improved local erosion and sediment control, and other initiatives. Between 1985 and 1994, the annual nitrogen load was reduced by an estimated 1.346 million pounds, and the annual phosphorus load was reduced by an estimated 0.526 million pounds. This represents a 6.5% annual load reduction for nitrogen, and a 25.6% annual load reduction for phosphorus, relative to the 1985 baseline nutrient load. The gross nutrient reductions achieved between 1985 and 1994 were actually greater, but were partially offset by the nutrient-related impacts of growth and development during that period.

Projected Gap in Meeting 40% Goal

That progress leaves us with an annual loading "nutrient gap" that will need to be closed of 6.79 million pounds for nitrogen (32.8% yet to be achieved, compared to the full 40% goal) and 0.16 million pounds of phosphorus (7.7% yet to be achieved). Closing this gap is the task of Virginia's Potomac River Basin Tributary Strategy.

Previous Publications and Guidance from Virginia Citizens

In August of 1993, Virginia produced a discussion paper, *Reducing Nutrients in Virginia's Tidal Tributaries: the Potomac Basin*, that explained the need for nutrient reductions and characterized the land use, water quality and living resources in the Potomac basin. The paper discussed opportunities for nutrient reduction, focusing primarily on those that are most cost-effective (i.e., lowest cost per pound of nutrient reduced), particularly agricultural BMPs.

Many farmers who provided comments on that discussion paper stated their viewpoint that the Strategy should portray a more equitable distribution of responsibility for nutrient reductions in the basin, even if that will lead to a higher total cost. A more equitabe approach was included in Virginia's second Potomac Strategy paper, published in October, 1994, entitled *Actions and Options for Virginia's Potomac Basin Tributary Nutrient Reduction Strategy.*

In October, 1994, staff of Virginia's Natural Resources agencies held six public meetings in the Potomac basin to further inform citizens of the Potomac Nutrient Reduction Strategy and to hear their viewpoints and responses. During March and April of 1995, agency staff met with local government officials and local interest groups across the Potomac basin. During those meetings, many citizens stated that the best way to achieve cost-effectiveness, practicality and equity would be to include citizens, interest groups and stakeholders at the local level into the fundamental decision-making and development of the Potomac Tributary Strategy.

This very important guidance from citizens in the basin was incorporated into the publication of the *Draft Virginia Potomac Basin Tributary Nutrient Reduction Strategy*, in August of 1995, and led to the locally-based assessment process that is documented herein. As noted above, this process began with the division of the basin into four regions and the determination of nutrient loading figures and 40% nutrient reduction targets for each region.

III. The Northern Shenandoah Regional Assessment Process

Regional Description

The Northern Shenandoah region is one quarter of the area of Virginia's Potomac basin and includes all of Clarke, Frederick, Shenandoah and Warren Counties and the city of Winchester. The majority of the North Fork Shenandoah River and all of the main stem of the Shenandoah River are in this region. Agriculture and forestry are the predominate land uses, with 53% forested and 39% in farmland and pasture. Only 7% is urban or suburban.

In 1985, this region contributed 13% of the total controllable nitrogen load and 20% of the total controllable phosphorus load of Virginia's Potomac basin. In 1985, point sources contributed 33% of both nutrients and nonpoint sources contributed the other 67%. Six municipal and industrial wastewater treatment plants in the region are considered "major" point sources.

The Purpose of the Assessment Process

The assessment process separated the question of: "Which practices are most appropriate to reduce nutrient loadings in the region?" from the question of: "Who will implement and pay for those practices?". The purpose of this approach was to focus the deliberations on the single task of identifying the most cost-effective, practical and equitable options for nutrient reduction.

Initial Meetings and Consensus

The assessment was initiated with a letter from the Secretary of Natural Resources to the chief elected official of each county, city, town, in the region, and to the Chairperson of the Lord Fairfax Soil and Water Conservation District. Secretary Dunlop asked these officials to become directly involved in the assessment to ensure that it would be guided by local perspectives and benefits. She invited these officials to attend the first assessment meeting on March 11, 1996.

That meeting was run by Natural Resources agency staff assigned to serve on a Northern Shenandoah technical assistance team. Presentations were given on the history of the Potomac Tributary Strategy and on the goal of the assessment. In attendance at that meeting were representatives of the four counties - Clarke, Frederick, Shenandoah and Warren - and the towns of Berryville, Strasburg and Woodstock. The City of Winchester was not represented.

At that meeting, it was decided that the regional nutrient-loading data provided by the state should be subdivided to the county level to allow local officials to determine their individual nutrient reduction targets. The participants agreed that a regional working group, steered by the Lord Fairfax Soil and Water Conservation District and the Lord Fairfax Planning District Commission, should be formed to review the nutrient loading data and to consider available nutrient reduction options. The participants also agreed that a successful nutrient reduction effort in the region would have to include improved education and information to the public.

Representation at the second regional meeting, held April 18, 1996, included the City of Winchester. Natural Resources agency staff presented a paper that set forth baseline nutrient loading figures, 40% reduction targets and year 2000 projected loading figures for each of the four counties. Agency staff also provided a paper describing the Bay Program's watershed model, and water quality model, used to arrive at those figures. A paper was presented that discussed Biological Nutrient Removal options and costs for wastewater treatment plants in the region. At this meeting local representatives decided that a "regional framework" would be developed but that localities would put together their own nutrient reduction assessments.

Building a Regional Framework

At the third and fourth regional meetings, held June 5 and 18, 1996, participants worked toward constructing a regional framework that would outline areas of consensus achieved during the assessment and could serve as a reference guide for the development of local nutrient reduction strategies. The final Regional Framework was adopted by the Lord Fairfax Planning District Commission on June 19, 1996 and was then sent to the individual local governments for their final review. At a meeting on July 10, 1996, the Frederick County Board of Supervisors went on record as not supporting the language in the Regional Framework.

The adopted Regional Framework is provided in its entirety in the following pages.

IV. Regional Framework For The Northern Shenandoah Region Potomac River Strategies

Adopted June 19, 1996 - Lord Fairfax Planning District Commission

The Northern Shenandoah Region of the Potomac River Strategy area consists of Frederick County, Clarke County, Warren County, Shenandoah County, and the City of Winchester. The same boundary lines encompass the Lord Fairfax Soil and Water Conservation District. These local jurisdictions have met and prepared a regional strategy to serve as the framework to guide each locality in accomplishing its own nutrient reduction strategy. Although the impetus for nutrient reduction comes from the Chesapeake Bay Agreement, all jurisdictions recognize that the immediate beneficiaries of their efforts will be the citizens they represent.

A few of the benefits to localities are:

- Elimination of algae blooms in public waters
- Promotion of the Tourist Industry by preserving our natural and cultural heritage
- Enhancement of Recreational opportunities such as fishing and boating
- Clean water for citizens, businesses (including agri-business) and industry
- Protection of wildlife
- General health and safety of the populace

The following goals were developed with several common elements in mind. First, the region will focus on agricultural BMP's as the most effective way to reduce nutrient pollution. Secondly, each strategy will be developed to combine cost effectiveness with shared responsibility. Finally, the region will look for ways to develop economic incentives to encourage citizens to voluntarily implement nutrient reduction.

<u>AGRICULTURE</u>

- Nutrient Management Emphasized

  Each locality will fund 1/5 of an employee to be hired by the Conservation District to work with BMP cost share projects, erosion and sedimentation control, and education.

- Best Management Practices

  Funds will be requested from the state to fund additional District personnel to administer increased numbers of BMP projects. The localities will also request additional state funding in the amount necessary to accomplish nutrient reduction goals.

- Economic incentives should be explored to provide new sources of income for farmers.
  Example: Fee fishing for native trout

- Explore possibilities for stream protection from high density livestock populations.

- Manure sharing program - move manure waste from localities that have surplus to areas that need it.
  Explore composting manure to package and sell to the public.

MUNICIPAL

- Monitor all sewage treatment plants to determine actual rates of Nitrogen and Phosphorus in effluent.

- Explore zero discharge treatment at smaller plants.

- Determine if Biological Nutrient Removal (BNR) is practical and cost effective in our area. Dr. Randall from VPI&SU is currently conducting a study to determine the economic feasibility of BNR technology.

- The state should provide technical and financial assistance to treatment plants to implement improved nutrient removal while maintaining capacity.

- Look at additional nutrient removal options when upgrades are planned.

- Enforce compliance of existing water quality regulations.

- Explore nutrient trading, but only when it can be accomplished without detriment to individual water bodies.

- DEQ should cooperate with local volunteer water monitoring groups to develop standard criteria that can be used statewide and incorporate volunteer monitoring data into the decision-making process.

INDUSTRIAL

- Monitor effluent at treatment sites.

- Explore use of new technology to better treat and/or dispose of effluent.
  Example: Composting organic waste

- Explore ways to assist all treatment plants in the region to improve nutrient removal efficiencies.

RESIDENTIAL

- Public education to reduce home use of fertilizers and other chemicals. Existing programs which are available:
  - Home Assist - NRCS
  - Farm Assist - NRCS
  - Bayscaping - Alliance for the Chesapeake Bay
  - Virginia Cooperative Extension programs

- Target audiences with public seminars.

- Educate homeowners on installation, use and maintenance of septic tanks.

- Recycling waste community-wide.

GROWTH AND DEVELOPMENT

- Stormwater management.
  Explore ways to eliminate stormwater infiltration into sewer lines to prevent combined sewage overflows.

- Increase treatment capacity and encourage new development in treatment plant service areas.

- Explore regional opportunities to prevent pollution at its source.

- Form public/private partnerships to handle waste.
  Example: Joint municipal/ industry waste treatment and land application of effluent.

- Land use planning to minimize sprawl and encourage healthy agribusiness.

- Minimize impervious surfaces and maintain open space.

V. Local Nutrient Reduction Assessments for the Northern Shenandoah Region

Local Prerogative

The assessment process was initiated on a regional scale. However, during that process local governments in the Northern Shenandoah region agreed that each participating jurisdiction would develop its own local nutrient reduction assessment. To assist this effort, Natural Resource agency staff then subdivided the regional data on baseline nutrient loadings, projected nutrient loadings and 40% nutrient reductions and applied them to the county level.

Local Nutrient Reduction Targets

The following table presents a series of numbers which lead to the calculation of the nitrogen reduction goals and phosphorus reduction goals for each county in the Northern Shenandoah region. These figures begin with the 1985 baseline nutrient loadings, from which are derived the "controllable load" and the 40% reduction goal (40% of the controllable load). Based on current understanding of nutrient reductions fom current programs and increased nutrient loadings from existing sources, or growth, estimated and projected loadings are provided for 1994 and 2000, leading to the gap that must be closed to reach the 40% reduction goal.

Estimated Nutrient Loads & Reductions by County

Based on Projected Growth and Current and Projected Implementation of Nutrient Reduction Programs

	Nitrogen Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	Lbs Reduc	% Change	Lbs Reduc	% Change
Clarke	764,000	388,000	155,200	61,200	-15.8%	71,000	-18.3%
Frederick	1,743,500	833,600	333,400	24,600	-3.0%	(24,900)	3.0%
henandoah	1,720,200	796,300	318,500	76,000	-9.6%	195,400	-24.5%
Warren	1,098,800	724,000	289,600	474,600	-65.6%	400,200	-55.3%
N. Shen.	5,326,500	2,741,800	1,096,700	636,400	-23.2%	641,600	-23.4%

	Phosphorus Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	Lbs Reduc	% Change	Lbs Reduc	% Change
Clarke	79,700	59,700	23,900	6,300	-10.5%	6,800	-11.3%
Frederick	200,500	163,600	65,400	35,200	-21.5%	28,700	-17.5%
henandoah	174,700	136,200	54,500	26,700	-19.6%	48,700	-35.8%
Warren	77,100	59,500	23,800	28,700	-48.2%	19,400	-32.5%
N. Shen.	532,000	419,000	167,600	96,900	-23.1%	103,600	-24.7%

Local Nutrient Reduction Assessments

In the following pages are provided fully adopted local nutrient reduction assessments from two counties (Clarke and Shenandoah), of the four counties in the Northern Shenandoah region, and status reports from the counties of Frederick and Warren and the City of Winchester.

The Warren and Frederick County status reports include a "strawman" table of potential practices and acreages that may be available for increased cost-share funding and implementation.

The City of Winchester Report includes references to possible participation in the Strategy by the Frederick-Winchester Sewer Authority.

Clarke and Shenandoah Counties

The efforts of the locally elected officials in Clarke and Shenandoah Counties to actively represent the interests of their farmers, businesses and other citizens in the Northern Shenandoah assessment process deserves special mention. During the regional assessment meetings held between April and June of 1996, these officials stated that their local economies and future growth potentials were integrally linked to clean water, productive agricultural land and a healthy environment. These officials stated that maintaining the quality of their waters both protected their citizens and also created attractive conditions for businesses and continued economic development. In particular, the availability of clean water removed one more variable from the uncertainties that businesses and industries face in their decisions to locate or expand.

In adopting their local assessments, representatives from both of these counties stated that there will need to be increased information and education provided to farmers to ensure that they know the availability of increased cost-share monies for best management practices, and the value that these practices offer to their own farming operations.

1. Non-Point Source Reduction Strategy for Clarke County

Introduction

The Virginia Potomac Tributary Strategy is a program designed to meet the 1987 Chesapeake Bay Agreement's 40% nutrient reduction goal by the year 2000. The primary purpose for initiating a reduction strategy is to improve water quality in the Potomac River and Chesapeake Bay so as to reverse the decline of living resources caused by water quality degradation.

In order to meet the overall goal, each locality must reduce the controllable load of nutrients entering the Potomac River from point source s (e.g., waste water treatment plants) and non-point (runoff from agricultural lands and urban areas) by 40% relative to the established 1985 baseline nutrient load. The Virginia Natural Resource Agencies including the Department of Environmental Quality (DEQ), Department of Conservation and Recreation (DCR), the Chesapeake Bay Local Assistance Department (CBLAD), and the Division of Soil and Water Conservation (DSWC) working cooperatively under direction from the Secretary of Natural Resources, have requested each locality to develop a preliminary plan which outlines specific reduction strategies. These plans will serve to provide the State with a cost estimate for implementing the tributary strategy.

Resource Description

Clarke County is located in the northern Shenandoah Valley and consists of approximately 114,000 acres. The eastern third of the County consists of the western slope of the Blue Ridge Mountains. This region is primarily forested and contains roughly 9 perennial tributaries of the Shenandoah River. The river divides the mountain from the valley portion of the County. Approximately 22 miles of the main stem of the Shenandoah River runs through the County. The western two thirds of the County is the northern Shenandoah Valley and is primarily open land in agricultural use. Nine perennial streams flow eastward through the valley to the Shenandoah River. Three tributaries flow into the Opequon Creek drainage which forms the western boundary between Clarke and Frederick County, Virginia. In all, six hydrologic units, as designated by the State Division of Soil and Water Conservation (DSWC), are either wholly or partially within Clarke County.

Primary nutrient loading to Clarke County is from non-point agricultural sources. Approximately 28% of agricultural land is currently in crop production, 39% pasture, 27% forest, and 6% in urban land use according to DSWC. The point sources within the County include the Berryville and Boyce Sewage Treatment Plants.

Reduction Strategy

Two basic strategies for Clarke County need to be implemented. The first addresses closing the 'gap' or reaching the goal of reducing our 1985 nutrient loads by 40% by the year 2000. DEQ has estimated that Clarke County needs to reduce its controllable nutrient load by 100,000 lbs. of nitrogen and 57,000 lbs. of phosphorous annually. Secondly, the County must maintain this reduced level or 'cap' through long term practices such as flood plain management and strict requirements for septic installation.

Gap Requirements

DEQ has provided tables, detailing potential Best Management Practices (BMP's), pounds of nutrients reduced by these practices and cost estimates for implementation. Table 1 outlines BMP's which will serve as the framework for meeting our reduction goal.

Table 1: Non-point source nutrient reduction for Clarke County - Scenario one. Based on increased coverage beyond current and planned State programs.

BMP Treatment	Coverage	%	Nitrogen	Phosphorus	Acre Treated	Incr. Coverage
Conservation Tillage	9,662	80	740	60	$17.30	$14,068
Farm Plans	26,622	90	9,924	2,606	17.90	291,899
Nutrient Management	15,996	90	55,186	7,278	2.40	38,630
Highly Erodible Land Retrmt.	2,979	5	21,835	3,720	103.00	240,183
Grazing Land Protection	22,132	60	77,460	6,577	38.00	852,067
Stream Protection	1,000	--	1,186	88	16.20	13,348
Cover Crops	500	--	4,090	316	20.20	10,112
Grass Filter Strips	500	--	5,655	697	232.00	116,399
Woodland Buffer Filter Area	500	--	8,825	1,450	141.00	70,600
Forest Harvesting	376	100	4,600	87	--	0
Animal Waste Control Facility	8	--	11,006	2,076	--	0
Erosion & Sediment Control	37	100	413	198	--	0
Urban SWM BMP Retrofits	0	--	0	0	--	0
Urban Nutrient Management	0	--	0			0
Septic Pumping	2,250	75	1,687	N/A	28.50	64,125
Shoreline Protection	--	--	--	--	--	--
Total Pounds Reduced			202,607	25,153		$1,711,431
Adjustment for Urban Growth			(24)	(140)		
Nonpoint controllable Amount			387,984	59,672		
Percent Reduction			52%	42%		

Most practices outlined, with the exception of forest harvesting, urban runoff management and septic pumping impact the agricultural community. Primary means for reducing the current nutrient loading include requiring protection, encouraging conservation tillage, and instigating septic pump-out requirements. Secondary methods will be erosion and sediment control and forest harvest management. Requiring farm plans and nutrient management plans appear to be the most cost effective BMP's available.

The overall goal is to produce a strategy which is most cost effective, equitable and practical. Strategies to reduce nutrient loading from point sources such as upgrading waste water treatment plants, may be effective, however are perhaps the most expensive means of reducing nutrient loading. Costs associated with agricultural BMP implementation have been shown to produce the highest benefit for the lowest cost to communities overall.

A regional approach to reducing nutrient loads includes requiring farm plans for all agricultural operations and funding additional extension agents or Soil and Water Conservation personnel to assist farmers in preparing and implementing these plans. In addition, using poultry manure, abundant in the southern portions of the basin for fertilizer in the northern portions serves needs of both areas and is a cost effective approach to nutrient management.

Cap Requirements

The County is currently implementing many strategies which will serve to maintain the nutrient cap. These include previously adopted County Septic, Well, Sinkhole, Erosion and Sediment (E&S) Control ordinances. The County septic ordinance requires increased siting requirements which exceed current state requirements, installation of a 100% reserve area, and sets forth provisions for mandatory septic pump-out. The well ordinance increases standards for grouting and casing, and establishes setbacks from known sources of pollution. The sinkhole ordinance serves to increase awareness of the potential to contaminate groundwater through sinkholes and imposes penalties for illegal dumping. The E&S ordinance establishes a minimum disturbance area of 2500 square feet which may require an E&S plan approved by the division of Soil & Water Conservation.

The County has added sections to the zoning Ordinance which require a minimum 100 foot building setback to perennial streams, 50 feet to intermittent streams and minimal clearing within these setback areas. Beginning September 1, 1994, anyone harvesting timber for commercial purposes must have a pre-harvest plan approved by the Department of Forestry, which ensures installation of BMP's for timer harvest practices.

In 1995, the County applied for and recently received an EPA 319 grant of $100,000 to conduct a watershed study which specifically looks at practical approaches of BMP installation to improve water quality. The main objective of this project is to determine the most cost effective means to improve surface and ground water quality in karst areas. In addition, the project will serve as a demonstration project to encourage other riparian land owners throughout the County to implement appropriate management practices.

In addition, the County has been aggressively seeking approval from the State Health Department to install two zero discharge waste water treatment facilities in the County to dispose of County septage and town sewage. A considerable volume (approximately 38,700 gallons/day in Millwood and 25,000 gallons/day in Waterloo) will be processed by these facilities and the effluent will be used as irrigation water rather than being discharged into area tributaries. Over time this will have a considerable impact in the reduction of nutrients entering the Shenandoah River Basin.

Conclusion

Clarke County is well aware of the need for and has initiated many programs which serve to improve both ground and surface water quality. Solutions to water quality issues which involve localities throughout the Shenandoah River Basin region are the most practical and provide a framework for discussion for many regional water issues.

2. Shenandoah County Nutrient Reduction Plan

Shenandoah County is pleased to respond to the request from the Virginia Secretary of Natural Resources to develop a Nutrient Reduction Plan in support of the Potomac Tributary Strategy. This plan was prepared by the County's Water Resources Steering Committee and was approved by the Board of Supervisors on September 10, 1996. A primary goal of the plan is to reduce nitrogen and phosphorus loads to the Shenandoah River, and therefore to the Potomac River and Chesapeake Bay, by 40% from 1985 to 2000. A second, but no less important goal, is to prevent any future increases in pollutant loads beyond the year 2000.

Progress in Nutrient Reduction

According to page 33 for the *Summary of Nonpoint & Point Source Calculations, Northern Shenandoah Region,* April 18, 1996, prepared by the Department of Conservation and Recreation (DCR), Shenandoah County, if it continues its current nutrient reduction activities, is projected to achieve a 29.3% reduction in nitrogen load from 1985 to the Year 2000. The reduction in phosphorus load is projected to be 40.4%. Table A shows these projected reductions. Therefore, the County is expected to meet the 40% reduction goal for phosphorus, though it must find ways to reduce nitrogen loads by an additional 10.7% or 82,512 pounds. The country must also find ways to cap nutrient growth beyond the year 2000 by maintaining these nutrient levels.

The DCR report shows that the excellent progress made so far by Shenandoah County is due in great part to the implementation of many agricultural best management practices and nutrient management plans by the County's farmers. This is demonstrated by Table B. Less success has been achieved in reducing nutrient loads by the point sources of pollution in the County, the municipal and industrial wastewater treatment plants as shown in Table C. Current discharge standards for treatment plants in the County do not set nitrogen or phosphorus limits.

Process for Developing a Plan

The Water Resources Steering Committee met on May 23, 1996, to discuss the information provided above and to begin developing a nutrient reduction plan focusing on nitrogen. Mr. Collin Powers of DEQ provided technical support in the meeting. While the Committee acknowledged that the wastewater treatment plants in the County provide a significant source of nitrogen, it was determined in the meeting that the implementation of nutrient reduction techniques at such plants is a very expensive proposition. Small treatment plants, such as those we have in the County, are especially expensive to retrofit with biological nutrient removal (BNR) technology. A preliminary calculation for the Woodstock treatment plant showed that BNR would raise water rates in the town by more than 33%.

The committee decided that it would be unfair to make the town citizens bear all the costs of nutrient reduction since there are many sources of nutrient pollution in the County: industry, agriculture, mal-functioning septic systems, over-fertilization of lawns and gardens by homeowners, for example. Since we all contribute to the problem, the committee decided to develop a plan that chose the most cost-effective methods of nutrient reduction but spread the costs over the entire population. In general, agricultural best management practices (BMPs) were found to be the most cost-effective methods.

The Year 2000 Plan: Closing the Gap

Working with DEQ staff and the Lord Fairfax Soil and Water Conservation District(LFSWCD), County staff tested the effectiveness of implementation of various agricultural BMPs. It was determined that with a modest increase in the implementation of farm and forest plans, conservation tillage, and nutrient management, Shenandoah County could meet the nitrogen reduction goal.

This reduction can be achieved by requiring all farmers and forest owners to have farm and/or forest plans prepared that would include soil and water conservation and nutrient management recommendations. (Such plans are now prepared at no cost by the Natural Resources Conservation Service and the Virginia Division of Forestry.) Preparation of farm and forest plans alone will not solve the problem; they must be implemented. The educational process involved in working with the farmer on the plan will increase the implementation of BMPs, because often BMPs save farmers money in the long run. However, an impediment to implementation is a lack of funds for improvements. Only $100, 000 per year is now available to farmers throughout the Soil and Water Conservation District (four counties) and this amount does not meet the demand. Therefore, a key element of Shenandoah County's nutrient reduction plan is a request to State government to provide $100,000 per year for the next five years to Shenandoah County alone for agricultural BMP cost-share funds through the Lord Fairfax Soil and Water Conservation District. Shenandoah County would contribute the cost of one part-time position at the LFSWCD to administer the cost share program and assist in the preparation of farm and forest plans.

Other elements of the plan include the continued implementation of erosion and sediment control plans and implementation of educational programs for homeowners to reduce over-use of fertilizers and promote home conservation techniques.

Beyond Year 2000: Maintaining the Cap

The County must not only close the gap on nutrient reduction, it must maintain nutrient production levels at the Year 2000 level despite growth and development. This will be achieved through adoption of a stream buffer ordinance for new development, requiring applicants for County permits for new sewage treatment plants and plant expansions to consider nutrient reduction technologies, and possibly requiring the pump-out of septic systems. The latter plan is more tentative due to concerns over the funding of a septage handling facility. The County will be looking to the State for assistance in funding such a facility.

The following outlines the elements of the County's Nutrient Reduction Plan:

I. Current Nutrient Reduction Activities

Activities that Close the Gap

A. Nutrient management plans are required of all intensive facilities by Section 516.4 of the *Zoning Ordinance*. According to our ordinance, this will be completely implemented by July 9, 1996.

B. The Lord Fairfax Soil and Water Conservation District offers cost-sharing funds and technical assistance to farmers in the County to implement agricultural Best Management Practices.

C. Shenandoah County has an Erosion and Sediment Control Ordinance, which it will continue to implement as effectively as possible.

Activities that Maintain the Cap

D. Regulations in the County's *Floodplain Ordinance* include water quality protection performance standards for new septic drainfields in the 100-year floodplain.

E. The County has published a brochure on sinkhole protection that is distributed in all Town and County offices and has been used in school science classes as a resource material.

F. The Shenandoah County Zoning Ordinance allows cluster development in its High Density Residential (R-3) Zone. The County is considering expanding the cluster option to other zoning districts.

G. The Virginia Department of Conservation and Recreation and the Valley Conservation Council, a regional conservation group, are active in securing conservation easements on riparian and steep mountain land in the County. In the last two years, approximately 133 acres have been placed in conservation easements.

H. The Friends of the North Fork of the Shenandoah River, a local conservation group, has implemented on-going water quality monitoring programs for the Shenandoah River, several County streams, and a selection of private wells.

II. Planned New Nutrient Activities

Activities that Close the Gap

A. The County asks that the State Legislature enable all counties to adopt ordinances to require farm and forest owners have prepared and to file with the County a farm and/or forest plan, including soil and water conservation and nutrient management measures. If such enabling legislation is adopted, Shenandoah County will adopt the farm/forest plan requirement by local ordinance. The County intends for this ordinance to require only that the plans be prepared. Implementation of the plans by farmers shall remain voluntary.

B. The County also asks the State Legislature to provide Shenandoah County $100,000 per year for five years for agricultural DMP cost-sharing through the Lord Fairfax Soil and Water Conservation District. This extra five-year funding will ensure that the County meets the nutrient reduction goal.

After five years, the County asks that the State Legislature continue the agricultural cost-share program at current (1996) levels to help maintain the goal nutrient levels.

C. The County plans to fund a part-time position at the Lord Fairfax Soil and Water Conservation District to administer the extra cost-sharing funds and help prepare farm and forest plans.

D. The County asks the State to develop appropriate educational materials to show farmers and homeowners how to reduce nutrient pollution. These materials should emphasize local water quality and health benefits to be achieved.

E. The County plans to develop a Farm*A*Syst/Home*A*Syst Program as outlined in the attached brochures. This voluntary program enables farmers and homeowners to analyze pollution threats to their wells and to develop plans to reduce those threats. The program was developed in Wisconsin; however, Virginia Tech is now in the process of developing a program for Virginia. Once Virginia Tech has completed its materials, the County will initiate a program through the County Extension Office.

F. The County has endorsed and agreed to act as fiscal agent for a Section 319 grant for the Holmans Creek/North Fork Shenandoah River Watershed Study. The grant has been awarded and a person hired to carry out stream and well monitoring to assess the extent and sources of non-point source pollution in the watershed. In 1993, an assessment conducted by the Virginia Division of Soil and Water Conservation indicated that this watershed has a high potential for non-point source pollution. Results of the study will be used to develop nutrient reduction strategies and carry out community education projects.

G. Shenandoah County has joined with three Soil and Water Conservation Districts to request the U.S. Natural Resources Conservation Service to prepare a Shenandoah River Basin Study.

Activities that Maintain the Cap

H. The County is considering adopting a stream buffer protection ordinance so as to reduce non-point source pollution of county streams caused by development.

I. The County is considering adopting an amendment to the Zoning Ordinance that would require applications by the private sector for special use permits for sewage treatment facilities to include a feasibility study addressing nutrient reduction technologies. Such a feasibility study would be prepared by the County when it decides to construct a new plant or expand an existing one. Towns will be asked to do the same thing for their sewage treatment plants. State assistance in this effort is requested as follows:

- Provision of technical assistance in the development and evaluation of innovative nutrient reduction technologies, such as deep cell aeration.

- Provision of funding to cover the incremental cost, if any, of incorporating nutrient nutrient reduction technologies into sewage treatment plant design.

J. The County will explore whether to implement a program to either encourage or require regular pump-out of septic systems in the County. To that end the County has initiated two studies at its current septage treatment facility: (1) a study of plant operations to determine the level of septage that can be handled and improvements needed to handle additional septage, and (2) a sludge management plan. These will be completed within one year. Current obstacles that must be overcome:

- Securing funding for septage handling facilities. State grants will be sought.

- Restrictions on the County regarding requiring septic system pump-out in light of a recent Attorney General Opinion stating that local governments do not have authority to adopt ordinances that would be inconsistent with or more stringent than regulations adopted by the State Water Control Board. Specific enabling legislation is requested.

K. Rocco Farm Foods, Inc., of Edinburg, VA has offered to participate in an EPA pilot program run by Virginia Tech to study implementation of biological nutrient removal at its sewage treatment plant.

Table D summarizes how this draft nutrient reduction plan meets the 40% nutrient reduction goal.

TABLE D

Nonpoint Source Nutrient Reductions for Shenandoah County - Scenario One

Based on Increased Coverage Beyond Current & Planned State Programs

	Year 2000 Projection		Reductions (lbs/year)		Cost per Added	Total Cost for
BMP Treatment	Coverage	Percent	Nitrogen	Phosphorus	Acre Treated	Incr. Coverage
Conservation Tillage	8,598	56.1%	18,090	1,941	$129.26	$270,272
Farm Plans	27,203	67.4%	19,145	5,076	$17.14	$172,413
Nutrient Management	36,505	90.5%	179,459	23,085	$3.25	$34,245
Highly Erodible Land Retirement	1,806	1.7%	19,611	2,926	$133.93	$139,292
Grazing Land Protection	1,633	2.6%	4,727	305	$72.38	$46,106
Stream Protection	11	----	16	1	$16.13	$16
Cover Crops	50	----	352	26	$17.25	$862
Grass Filter Strips	50	----	473	56	$189.38	$9,469
Woodland Buffer Filter Area	100	----	1,915	261	$153.18	$15,318
Forest Harvesting	2,125	100.0%	24,567	515		$0
Animal Waste Control Facilities	90	----	124,440	23,387		$0
Erosion & Sediment Control	86	100.0%	972	467		$0
Urban SWM/BMP Retrofits	0	0.0%	0	0		$0
Urban Nutrient Management	127	11.0%	164	14		$0
Septic Pumping	0	----	0	0		$0
Shoreline Erosion Protection	0	----	0	0		$0
Total Pounds Reduced:			393,932	58,060		$687,994
Adjustment for Urban Growth:			3,961	380		
Adjusted Reduction:			389,972	57,680		
Nonpoint Controllable Amount:			601,783	91,306		
Percent Reduction:			64.80%	63.17%		

Virginia Farm * A * Syst
Groundwater Protection Program

Newsletter No. 1.
March 1994

A farmstead is more than a home and a center for farming operations- it is also the wellhead for household water supplies. On a typical farmstead, several million gallons of groundwater are stored within 100 feet below farmstead facilities, such as fuel tanks, chemical and fertilizer storage tanks, and livestock holding areas. A great majority of farmers use this groundwater for drinking and other domestic uses. In some cases, the farmstead drinking water may be polluted due to above the ground activities and found not in compliance with drinking water standards.

Now a program to help agricultural producers and rural residents maintain and improve the quality of their drinking water is rapidly becoming available nationwide. The **Farmstead (Pollution) Assessment System (Farm * A* Syst)** is a national educational/technical program with the objective of helping farmstead and rural residents voluntarily assess water pollution risks to their household water supplies. The program is designed to increase a participant's knowledge and understanding of pollution risks in farmstead environments. The Farm * A * Syst package consists of worksheets and supporting fact sheets which guide a farmer in step-by-step analysis of potential sources of groundwater contamination. Fact sheets provide information on factors that influence pollution risks, health and/or legal concerns, and sources of additional information or assistance. Worksheets provide a numerical ranking system to evaluate pollution risks to an individual water supply. Upon completion of risk assessment, the farmer is encouraged to voluntarily take recommended actions that could reduce or eliminate identified pollution risk of water supplies and the general environment.

The Farm * A * Syst program was originally developed and pilot tested in Wisconsin and Minnesota. In a cooperative arrangement between the U.S. Environmental Protection Agency, USDA-Cooperative Extension Service, and USDA-Soil Conservation Service, support is provided to expand Farm * A * Syst to other states. The nationwide effort is coordinated by the national Farm * A * Syst Program located in Madison, Wisconsin. A network of state coordinators continuously interact by means of workshops and teleconferences to develop Farm * A * Syst material for their states and discuss implementation procedures. More than 30 states have either completed adaptation of the program materials or are in the process of doing so.

In late 1993, a multi-agency effort was initiated to develop a Farm * A * Syst Program for Virginia. This statewide effort is coordinated by the Biological Systems Engineering Department at Virginia Tech (formerly Agricultural Engineering) with active participation by the Virginia Division of Soil and Water Conservation and Virginia Cooperative Extension. Other cooperators include USDA-Soil Conservation Service, Virginia Department of Agriculture and Consumer Services, Virginia Farm Bureau Federation, and Virginia Association of Soil and Water Conservation Districts.

The primary objective of the Virginia project is to adopt and modify where necessary, national Farm * A * Syst program materials to Virginia conditions to result in a package that will compliment and enhance the effectiveness of ongoing water quality programs. The package, when completed, can be used by technical and educational agency personnel, or by individual farmstead owners themselves, with the ultimate goal of preventing and/or correcting groundwater, and related surface water, contamination problems. A multi-agency advisory committee (see list below) has been established to oversee the development of the Virginia Farm * A * Syst program. To date, the project investigators (see list below) have reviewed the national Farm * A * Syst program package and those developed in several states and have field tested the material at five farmstead sites (three counties in Virginia). Based on review of material and field testing, guidelines have been established for developing the Virginia Farm * A * Syst program which is currently underway. Components of the Virginia program will be introduced in the next newsletter which will be printed in June of 1994.

For additional information, call Blake Ross or Tamim Younos at Virginia Tech, Charlie Lunsford at VDSWC or other project investigators and advisory committee members. For national information, you may contact the National Staff at (608) 262-0024.

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3. Warren County Nutrient Reduction Status Report

In Warren County, a major point-source reduction occurred in 1989 when the Avtex Rayon Plant ceased operation. The plant closing reduced nitrogen by 422,198 pounds and phosphorus by 20,564 pounds. Total county point and non-point nitrogen was reduced by 62.6% and phosphorus by 44.7% Other than the closing of Avtex, shifts from row crop to pasture use of farm land have reduced nutrient loadings. As a consequence, it is projected that at the year 2000 Warren County will exceed the 40% reduction goal for nitrogen and have a phosphorus nutrient gap of 4,000 pounds.

The Warren County Board of Supervisors assigned a County staff member to participate in the regional assessment. This staff member developed a County Nutrient Reduction Plan that included further nutrient reduction, particularly with regard to improved septic systems and available opportunities for agricultural cost-share practices in the County. Two meetings were held with the Board of Supervisors on this plan and the Board determined that the specific issues of septic system management and other reduction proposals warranted the consideration of a County Committee which was formed by the Board for that purpose.

The Board adopted a resolution that supported nutrient and sediment reduction into tributaries and noted the County's past success in achieving nutrient reductions. The resolution also stated that the newly formed Committee will consider additional actions to be taken to reduce nutrient loadings in the County, while avoiding any mandates on Warren County citizens.

The agricultural BMPs which were determined during the assessment to be potentially available for implementation under a cost-share scenario in Warren County are included as an element of the Northern Shenandoah Assessment and are shown in the table on the following page. Implementation of these practices would place Warren County over 40% reduction in both nitrogen and phosphorus loadings at year 2000.

Nonpoint Source Nutrient Reductions for Warren County

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Percent	Reductions (lbs/year) Nitrogen	Phosphorus	Increased Ac of Coverage	Added Reductions Ach'd Nitrogen	Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	507	71.8%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	2,547	37.1%	867	302	0	0	0	$14.50	$0
Nutrient Management	acres	6,185	90.0%	15,909	2,897	5,302	13,637	2,484	$1.75	$9,278
Highly Erodible Land Retirement	acres	155	0.3%	1,061	250	0	0	0	$125.00	$0
Grazing Land Protection	acres	19,874	50.0%	57,477	3,710	19,750	57,181	3,686	$22.50	$444,375
Stream Protection	acres	783	-----	1,025	81	100	147	10	$70.00	$7,000
Cover Crops	acres	0	-----	0	0	0	0	0	$15.00	$0
Grass Filter Strips	*acres*	*0*	-----	*0*	*0*	*0*	*0*	*0*	*$185.00*	*$0*
Woodland Buffer Filter Area	acres	0	-----	0	0	0	0	0	$230.00	$0
Forest Harvesting	acres	828	100.0%	9,934	283	0	0	0		$0
Animal Waste Control Facilities	systems	0	-----	0	0	0	0	0		$0
Erosion & Sediment Control	acres	186	100.0%	1,779	1,019	0	0	0		$0
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0	0		$0
Urban Nutrient Management	acres	105	12.0%	127	12	18	21	2	TBD	TBD
Septic Pumping	systems	0	-----	0	0	0	0	0		$0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	0	0		$0
Total Pounds Reduced:				88,179	8,554		70,985	6,182		$460,653
Adjustment for Land Use Changes:				(48,108)	(7,645)					
Adjusted Reduction:				136,287	16,199					
Nonpoint Controllable Amount:				198,221	25,652					
Percent Reduction:				68.76%	63.15%					

4. Frederick County Nutrient Reduction Status Report

The Frederick County Board of Supervisors went on record as not supporting the language of the Regional Framework adopted by the Lord Fairfax Planning District Commission. A meeting was then held between the local and state co-coordinators of the Northern Shenandoah Assessment and the Frederick County Board of Supervisors.

At that meeting, the County Board members expressed their concern that there had been insufficient coordination between the assessment process and the agricultural County's agricultural community. In addition, the members expressed concern over the effect that the nutrient cap would have on future growth and development in the County.

The Board did agree that the state technical assistance team could put together a "strawman" list of agricultural practices that could potentially be available for implementation in the County. After that list was created, the state technical team coordinated efforts with the County's agricultural community through the Virginia Farm Bureau (state and local) to ensure that their interests were represented in the regional assessment. The agricultural BMPs that could potentially be available for implementation in the County under a cost-share scenario are included as an element of the Northern Shenandoah Assessment and are shown in the table on the following page.

Nonpoint Source Nutrient Reductions for Frederick County

Based on Increased Coverage Beyond Current & Planned State Programs

		Year 2000 Projection		Reductions (lbs/year)		Increased Ac	Added Reductions Ach'd		Cost per Added	Total Cost for
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	of Coverage	Nitrogen	Phosphorus	Acre Treated	Incr Coverage
Conservation Tillage	acres	18,532	68.4%	10,801	803	2,719	10,801	803	$21.00	$57,105
Farm Plans	acres	34,120	53.3%	19,280	5,522	6,921	2,362	799	$14.50	$100,350
Nutrient Management	acres	19,901	31.1%	52,456	6,356	16,241	42,672	5,193	$1.75	$28,421
Highly Erodible Land Retirement	acres	4,311	3.8%	47,985	6,856	1,125	13,145	1,874	$125.00	$140,625
Grazing Land Protection	acres	579	1.2%	1,609	107	475	1,320	88	$22.50	$10,688
Stream Protection	acres	0	-----	0	0	0	0	0	$70.00	$0
Cover Crops	acres	0	-----	0	0	0	0	0	$15.00	$0
Grass Filter Strips	acres	0	-----	0	0	0	0	0	$185.00	$0
Woodland Buffer Filter Area	acres	0	-----	0	0	0	0	0	$230.00	$0
Forest Harvesting	acres	1,490	100.0%	21,304	281	0	0	0		$0
Animal Waste Control Facilities	systems	6	-----	8,296	1,559	0	0	0		$0
Erosion & Sediment Control	acres	383	100.0%	4,165	2,059	0	0	0		$0
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0	0		$0
Urban Nutrient Management	acres	207	20.0%	261	23	103	130	12	TBD	TBD
Septic Pumping	systems	0	-----	0	0	0	0	0		$0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	0	0		$0
Total Pounds Reduced:				166,157	23,566		70,431	8,769		$337,189
Adjustment for Land Use Changes:				(77,635)	(2,225)					
Adjusted Reduction:				243,792	25,791					
Nonpoint Controllable Amount:				651,399	101,798					
Percent Reduction:				37.43%	25.34%					

5. City of Winchester and the Frederick-Winchester Sewer Authority Nutrient Reduction Status Report

The City of Winchester and the Frederick-Winchester Sewer Authority (FWSA) participated in the Potomac Strategy assessment process through a representative of the City public utilities department. Concurrently, the FWSA voluntarily participated in the BNR study that was sponsored by the Environmental Protection Agency and conducted by VPI&SU. The VPI&SU investigator conducted a BNR feasibility evaluation on the Opequon wastewater treatment plant, which already has a nitrification process installed. The FWSA has also undertaken a needs and capacity study at the Opequon facility to prepare for future expansions or upgrades.

As a result of these parallel issues, the FWSA Board held a meeting on September 16, 1996 to hear presentations by the state technical assistance team leader, the VPI&SU investigator and the engineering consultant who is conducting the needs and capacity study. At this meeting, the Board heard that the Opequon facility is efficiently designed for upgrade to BNR technology and that they could request cost-share funding for such an upgrade through the Strategy assessment process.

The nutrient reductions that would be achieved through the operation of BNR at the Opequon facility have been included in the Northern Shenandoah Assessment process. The estimated costs for such an upgrade span a wide range, and this range has been included in the cost figures for the Potomac Strategy. However, the FWSA Board has not yet reached a final decision on whether they will propose the Opequon for cost-share funding and BNR upgrade through the Potomac Strategy.

VI. Nutrient Loadings Under Proposed Northern Shenandoah Regional Assessment

T he followin table includes a summary of the proposed increases in BMP implementation by BMP practice with the associated added nitrogen and phosphorus reductions. The result of these recommended actions is a 54% reduction in nonpoint-source nitrogen loading and a 44% reduction in nonpoint-source phosphorus loading. The principle reductions are obtained through increased farm plans, nutrient management and grazing land protection.

Full implementation of the Northern Shenandoah Regional Strategy would achieve a 44% reduction in the total 1985 controllable nitrogen load and a 40% reduction in the total 1985 controllable phosphorus load. The nonpoint-source nutrient reductions that would be achieved, by BMP practice, for the region are provided in the following table. The nutrient reductions that would be achieved for each local jurisdiction under the proposed strategy are detailed in the three following tables.

Nonpoint Source Nutrient Reductions for Northern Shenandoah Region

Based on Implementation of Proposed Regional Strategy

		Year 2000 Projection		Reductions (lbs/year)		Increased Ac	Added Reductions Ach'd	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	of Coverage	Nitrogen	Phosphorus
Conservation Tillage	acres	36,833	67.8%	31,428	2,972	5,714	25,714	2,385
Farm Plans	acres	95,236	65.1%	54,396	15,274	35,990	16,815	4,909
Nutrient Management	acres	80,326	54.9%	309,168	41,137	44,497	150,654	20,560
Highly Erodible Land Retirement	acres	8,751	2.6%	96,846	14,063	3,990	48,029	6,691
Grazing Land Protection	acres	42,857	23.3%	123,932	7,998	40,262	116,512	7,514
Stream Protection	acres	1,794	-----	2,508	185	925	1,356	95
Cover Crops	acres	3,012	-----	21,202	1,575	500	3,520	261
Grass Filter Strips	acres	550	-----	5,208	616	550	5,208	616
Woodland Buffer Filter Area	acres	600	-----	11,489	1,569	600	11,489	1,569
Forest Harvesting	acres	4,830	100.0%	60,464	1,166	0	0	0
Animal Waste Control Facilities	systems	134	-----	99,264	18,971	1	100	23
Erosion & Sediment Control	acres	691	100.0%	7,330	3,743	0	0	0
Urban SWM/BMP Retrofits	acres	0	0.0%	0	0	0	0	0
Urban Nutrient Management	acres	514	13.0%	648	57	132	167	15
Septic Pumping	systems	0	-----	0	0	0	0	0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	0	0
Total Pounds Reduced:				823,883	109,326		379,562	44,639
Adjustment for Land Use Changes:				(168,766)	(11,877)			
Adjusted Reduction:				992,649	121,203			
Nonpoint Controllable Amount:				1,839,388	278,428			
Percent Reduction:				53.97%	43.53%			

Nonpoint Source Nutrient Loads for Northern Shenandoah Region

Based on Implementation of Proposed Regional Strategy

Year 1994 Progress to Date

	1985 Nonpoint Loads (thousands of lbs)		Year 1994 Reported Values (loads in thousands of lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Clarke County	388	60	327	-16%	53	-10%
Frederick County	651	102	521	-20%	90	-11%
Shenandoah County	602	91	403	-33%	62	-33%
Warren County	198	26	146	-26%	18	-32%
Northern Shenandoah	1,839	278	1,396	-24%	223	-20%

Year 2000 Projections

	1985 Nonpoint Loads (thousands of lbs)		Year 2000 Estimated Values (loads in thousands of lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Clarke County	388	60	163	-58%	35	-41%
Frederick County	651	102	408	-37%	76	-25%
Shenandoah County	602	91	214	-64%	37	-60%
Warren County	198	26	62	-69%	9	-63%
Northern Shenandoah	1,839	278	847	-54%	157	-44%

Point Source Nutrient Loads for Northern Shenandoah Region

Based on Implementation of Proposed Regional Strategy

Year 1994 Progress to Date

	1985 Point Loads (thousands of lbs)		Year 1994 Reported Values (loads in thousands of lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Clarke County	0	0	0	0%	0	0%
Frederick County	182	62	287	58%	38	-38%
Shenandoah County	195	45	297	53%	44	-2%
Warren County	526	34	104	-80%	13	-61%
Northern Shenandoah	902	140	688	-24%	95	-32%

Year 2000 Projections

	1985 Point Loads (thousands of lbs)		Year 2000 Estimated Values (loads in thousands of lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Clarke County	0	0	0	0%	0	0%
Frederick County	182	62	202	11%	35	-43%
Shenandoah County	195	45	291	49%	37	-18%
Warren County	526	34	191	-64%	25	-28%
Northern Shenandoah	902	140	684	-24%	96	-32%

Total Nutrient Loads for Northern Shenandoah Region

Based on Implementation of Proposed Regional Strategy

Year 1994 Progress to Date

	1985 Controllable Loads (thousands of lbs)		Year 1994 Reported Values (loads in thousands of lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Clarke County	388	60	327	-16%	53	-10%
Frederick County	834	164	808	-3%	128	-22%
Shenandoah County	796	136	700	-12%	106	-22%
Warren County	724	60	249	-66%	31	-48%
Northern Shenandoah	2,742	419	2,084	-24%	318	-24%

Year 2000 Projections

	1985 Controllable Loads (thousands of lbs)		Year 2000 Estimated Values (loads in thousands of lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
Clarke County	388	60	163	-58%	35	-41%
Frederick County	834	164	610	-27%	111	-32%
Shenandoah County	796	136	505	-37%	73	-46%
Warren County	724	60	253	-65%	34	-43%
Northern Shenandoah	2,742	419	1,531	-44%	253	-40%

VII. Costs for the Proposed Northern Shenandoah Assessment

The total regional cost for proposed nonpoint-source nutrient reduction practices identified through the Northern Shenandoah Assessment is $2,436,000. The standard government cost-share percentage for these practices is 75%. Therefore, the request for state cost-share would be $1,827,000. In addition, it has been estimated that the administration of these cost-share funds, and the need for increased farm plans and nutrient management plans, would necessitate two additional staff at the Lord Fairfax Soil and Water Conservation District at a cost of approximately $80,000. Although two of the four counties stated that they be help fund these positions, it is not yet known whether a full 50% of the $80,000 would be provided through local funding.

If the FWSA chooses to request state cost-sharing for a BNR upgrade at Opequon, the costs of that upgrade could range between $570,000 and $2,850,000 (or possibly higher). The cost-share percentage that has been discussed during these deliberations, and others across the basin, is a 50% cost-share.

This brings the total cost for implementation of identified practices in the region to between $3,086,000 and $5,366,000.

VIII. Regional Assessment Summary

Unresolved Issues

As of this draft of the Potomac Strategy, there are issues and decisions relative to the Northern Shenandoah Assessment which are unresolved.

The first is the uncertainty that exists with regard to nutrient loadings at wastewater treatment plants in the region. Much of this uncertainty is a result of a lack of data on the incidental denitrification that may take place at plants that have installed a nitrification process. To address this uncertainty, the state technical assistance team leader will continue to work with treatment plant operators to attempt to obtain better nutrient loading data. This will also help to determine the benefits that can be expected through the implementation of any further nutrient reduction options.

The second unresolved issue is the degree to which the Warren County Board of Supervisors will adopt any further nutrient reduction measures as a result of investigations undertaken by the local Potomac Strategy Committee that they recently formed.

The third issue is the extent to which Frederick County will become more involved in the Potomac Strategy process as a result of encouragements by their Farm Bureau members, who have stated that they desire to be represented in the process through their local governing body.

The fourth unresolved issue is whether the FWSA will commit to working with the state toward a BNR upgrade through the cost-sharing approach of the Potomac Strategy.

Total Reductions Under the Northern Shenandoah Assessment

Full implementation would achieve a 44% reduction in the 1985 controllable nitrogen load and a 40% reduction in the 1985 controllable phosphorus load.

Potomac Basins Tributary Strategies Tracking

Northern Shenandoah Meetings

Inv	Affiliation	Name	Title	11-Mar	18-Apr	5-Jun	17-Jun	12-Sep
Local Governments								
x	Berryville, Town of	Richard G. Sponseller	Mayor					
x	Berryville, Town of	R. John Hogan	Manager	x		x	x	
	Berryville, Town of	Glenn Tillman	Public Utilities Dir.	x	x			
x	Boyce, Town of	John S. Fullerton	Mayor					
x	Boyce, Town of	Patricia J. Kadel	Administrator					
x	Clarke County	A. R. Dunning	Chairman, Board of Supervisors					
	Clarke County	Gary Konkel	Member, Board of Supervisors	x				
x	Clarke County	David L. Ash	Administrator					
	Clarke County	Bud Nagelvoort	Clarke County Citizen's County		x	x		x
	Clarke County	Allison Teefer	Planning Director's Office		x	x	x	x
x	Edinburg, Town of	Daniel J. Harshman	Mayor					
x	Frederick County	James J. Longerbeam	Chairman, Board of Supervisors					
x	Frederick County	John R. Riley	Administrator					
	Frederick County	Robert W. Watkins	Planning Director	x				
	Frederick County	Mike Ruddy		x	x	x	x	x
	Frederick County	Kris Tierny	Planning and Development Office		x			x
x	Front Royal, Town of	Stanley W. Brooks	Mayor					
x	Front Royal, Town of	M. Lyle Lacy	Manager					x
	Front Royal, Town of	Eugene R. Tewalt	Public Works Director			x		
	Front Royal, Town of	Charles Pomeroy	Public Utilities Director		x	x		
	Front Royal, Town of	Tim Fristoe						x
·	Front Royal, Town of	Kimberly Fogle	Planning Office					x
	Lord Fairfax SCS	Henry Staudinger		x	x			
x	Middletown, Town of	John A. Copeland	Mayor					
x	Mount Jackson, Town of	Dewey W. Jordan	Mayor					
x	Mount Jackson, Town of	Gene Bodkin	Planning Commission Chairman					
x	New Market, Town of	Thomas F. Constable	Mayor					
x	New Market, Town of	S. Bradley Corcoran	Manager					
x	Shenandoah County	Beverley H. Fleming	Chairman, Board of Supervisors					
	Shenandoah County	David A. Nelson	Supervisor	x	x			x
x	Shenandoah County	Phoebe Kilby	Asst. Administrator/Planning Director	x	x	x	x	x

Potomac Basins Tributary Strategies Tracking

Northern Shenandoah Meetings

Inv	Affiliation	Name	Title	11-Mar	18-Apr	5-Jun	17-Jun	12-Sep
x	Stephens City, Town of	Ray E. Ewing	Mayor					
x	Stephens City, Town of	Michael Kehoe	Manager, Public Works/Utilities Director					x
x	Strasburg	Harry Applegate	Mayor	x	x		x	
x	Strasburg	Kevin M. Fauber	Manager					
x	Toms Brook, Town of	William A. Minton	Mayor					
x	Warren County	James L. McManaway	Chairman, Board of Supervisors					
x	Warren County	J. Ronald George	Administrator					
	Warren County	David E. Clark	Assistant County Administrator					x
	Warren County	Doug Stanley	Zoning Administrator				x	
	Warren County	Meryl Christiansen		x			x	x
x	Winchester, City of	Gary W. Chrisman	Mayor					
x	Winchester, City of	Ed Daley	Manager					
	Winchester, City of	Tim Youmans	Planning Office					x
	Winchester, City of	Jesse Moffett	City Engineer		x	x	x	x
x	Woodstock, Town of	William C. Moyers	Mayor					
x	Woodstock, Town of	Larry D. Bradford	Manager					
	Woodstock, Town of	James Didawick	Public Works Office	x		x		x
Legislators								
x	VA House of Delegates	Hon. Jay Katzen	Delegate					
.	VA House of Delegates	Ms. Michelle Legg	Aide				x	
x	VA House of Delegates	Hon. Raymond R. Guest	Delegate					
x	VA House of Delegates	Hon. Joe T. May	Delegate					
x	VA House of Delegates	Hon. Glenn M. Weatherholtz	Delegate					
x	VA House of Delegates	Hon. Beverly J. Sherwood	Delegate					
x	VA State Senate	Hon. H. Russell Potts	Senator					
x	VA State Senate	Hon. Kevin G. Miller	Senator					
Soil and Water Conservation Districts								
x	Lord Fairfax SWCD	Cheryl L. Crowell	Chairman	x	x		x	x
	Lord Fairfax SWCD	Edward Ward		x	x		x	x
	Lord Fairfax SWCD	Gary DeOms		x	x			x
	Lord Fairfax SWCD	Rob Arner				x		x

Potomac Basins Tributary Strategies Tracking

Northern Shenandoah Meetings

Inv	Affiliation	Name	Title	11-Mar	18-Apr	5-Jun	17-Jun	12-Sep
	Lord Fairfax SWCD	Ben Rezba						x
	Lord Fairfax SWCD	Jim Hepner						x
	Lord Fairfax SWCD	Garland Hudgins						x
	Lord Fairfax SWCD	Mike Berry						x
	Lord Fairfax SWCD	Amanda Campbell						x
	Lord Fairfax SWCD	Frank Sherwood						x
PDCs and Other Regional Groups								
	Lord Fairfax PDC	Thomas J. Christoffel	Executive Director	x				
	Lord Fairfax PDC	Jeffrey Slack			x			
	Lord Fairfax PDC	Kimberly Boyd			x	x	x	
	Lord Fairfax PDC	Rob Kinsley						x
	Central Shenandoah PDC	Sara Hollberg	Regional Planner		x			
State and Federal Agencies								
	VA Chesapeake Bay Local Assistance	Margie Reynolds	Lower Potomac Team Leader	x				
	VA Cooperative Extension	Corey Childs		x		x	x	
	VA Dept of Conservation & Recreation	Kathleen W. Lawrence	Director	x				
	VA Dept of Conservation & Recreation	Bill Browning	Assistant Director, S&W	x				
	VA Dept of Conservation & Recreation	Jay Marshall		x	x		x	
	VA Dept of Conservation & Recreation	Charles Wade		x	x			x
	VA Dept of Conservation & Recreation	John Mlinarcik		x				
	VA Dept of Conservation & Recreation	Diane McCarthy		x	x			
	VA Dept of Conservation & Recreation	Robert Connelly		x	x			x
	VA Dept of Environmental Quality	Alan E. Pollock		x				
	VA Dept of Environmental Quality	Collin Powers	Northern Shenandoah Team Leader	x	x	x	x	x
	VA Dept of Environmental Quality	Brian Keith Fowler	Harrisonburg Regional Office				x	x
	VA - JLARC	Bob Rotz						x
	VA Polytechnic Institute	Kurt Stephenson		x				
Citizen and Business Groups								
	Citizen - Winchester, VA	Louis M. Costello						x

Prepared by DEQ 10/2/96

Potomac Basins Tributary Strategies Tracking

Northern Shenandoah Meetings

Inv	Affiliation	Name	Title	11-Mar	18-Apr	5-Jun	17-Jun	12-Sep
	Citizen/Farmer-Berryville, VA	John Hardesty						x
	Citizan/Tree Farmer-Woodstock	Paul Harris						x
	Frederick County Farm Bureau	Paul Anderson						x
	Friends of the North Fork	Roberta Hinkins		x	x		x	
	Friends of the North Fork	Garland Hudgins				x	x	
	Friends of the Shenandoah	John Gibson		x	x			
	River Rental Outfitters	Trace Noel		x	x			
	State Scenic River Advisory Board	Frances C. Endicott		x	x	x	x	x

APPENDIX J

Northern Virginia Region:
Strawman Tributary Assessment

POTOMAC TRIBUTARY NUTRIENT REDUCTION STRATEGY

Strawman Assessment of
Current Load Reductions, Future Nutrient Control Options, and Costs
for the

Northern Virginia Region

Arlington County
Fairfax County
Fauquier County
Loudoun County
Prince William County
Stafford County
City of Alexandria
City of Fairfax
City of Falls Church
City of Manassas
City of Manassas Park
Town of Clifton
Town of Dumfries
Town of Hamilton
Town of Haymarket
Town of Herndon
Town of Hillsboro
Town of Leesburg
Town of Lovettsville
Town of Middleburg
Town of Occoquan
Town of Purcellville
Town of Quantico
Town of Round Hill
Town of The Plains
Town of Vienna
Alexandria Sanitation Authority
Dale City Service Corp.
Loudoun County Sanitation Authority
Prince William County Service Authority
Upper Occoquan Sewage Authority

October 1996

NORTHERN VIRGINIA (NOVA) REGION NUTRIENT REDUCTION STRAWMAN ASSESSMENT

Regional Goal

As a signatory of the 1987 Chesapeake Bay Agreement, the Commonwealth is working towards a 40% reduction of the controllable nutrient load (nitrogen and phosphorus) to the Bay by the year 2000. Individual Tributary Strategies are being developed as the means to reach this goal, and in Virginia's portion of the Potomac basin this has been facilitated by subdividing the drainage area into four regions (Northern and Southern Shenandoah, Northern Virginia, and Lower Potomac). A 40% reduction target was determined for each region, with the ultimate intent of fulfilling the Bay Program commitment when the four regional plans are combined.

The NoVA Region includes the Counties of Arlington, Fairfax, Fauquier, Loudoun, Prince William, and Stafford, along with the Cities and Towns within those borders. In addition to these jurisdictions, the assessment process involved 5 wastewater treatment service authorities, 3 planning district commissions, and 5 soil and water conservation districts. Approximately 1.7 million people reside in the NoVA Region, nearly one-third of the state's population. The land cover is about 42% forested, 34% farmland and pasture, and 24% urban/suburban land. The baseline nutrient load to be reduced has been established using 1985 point source discharges, along with runoff values from an average rainfall year applied to 1985 land use cover. The baseline controllable nutrient loads from the NoVA Region are 12.5 million lbs/year nitrogen; 660,000 lbs/year phosphorus. These loads come from agricultural and developed land, with point sources and nonpoint sources contributing on a percentage basis as follows:

Table 1. NoVA Region Baseline Nutrient Loads by Source Category

	Point Source	Nonpoint Source	
		Agricultural	Urban
Nitrogen Load	66%	23%	11%
Phosphorus Load	16%	60%	24%

The NoVA Region's targets are to reduce the nitrogen load by 5 million lbs/year, and decrease the phosphorus load by 263,000 lbs/year.

Assessment Process

It has been determined that the nutrient reduction goal is unlikely to be reached using existing resources, accounting for ongoing and planned nutrient reduction activities. It is estimated that on the current course, by the year 2000 the NoVA Region's nitrogen load will approximately 3% higher

In general, the assessment shows that accounting for the above cropland shifts, combined with implementation of agricultural best management practices (BMPs) and urban stormwater controls, as of 1994 the Region had reduced the baseline NPS loads by about 12% for nitrogen, and 15% for phosphorus. The cropland shift results in a sizeable nutrient load reduction, but is not considered a BMP in the same sense that crop production on that land may have continued along with the use of conservation tillage, nutrient management, farm planning, etc. Where BMPs have been used, the Region has been successful in essentially "holding the line" on NPS loads, despite rapid population growth and development in the area. Based on 1990 census data and Virginia Employment Commission figures, the NoVA Region's 2000 population is projected to be nearly 26% greater than the 1985 figure. This is one of the Region's (and the entire basin's) greatest challenges -- to reduce the baseline load while accommodating growth.

The assessment suggests that expanding BMP coverage even further for agricultural land will aid in closing the gap. There will be continued installation of urban stormwater management controls, and these will help offset loads that would result from new development and land use changes. However, unless structures are retrofitted to address a load that existed in 1985, the urban BMPs do not reduce the baseline. Due to the high cost of these urban retrofits, and the relatively low efficiency in terms of nutrient reduction, the assessment has not favored significant increases in the use of this control. Information was sparse for the Region regarding retrofits in-place or planned, and the assessment would benefit from an increase in this type of data.

Point Sources

The Region's nutrient loads are greatly influenced by 12 significant point sources, discharging nearly two-thirds of the Region's controllable nitrogen load. Only one plant in the Region is operating in a Biological Nutrient Removal (BNR) mode, one is achieving significant incidental nitrogen reduction while only attempting to nitrify, and several are planning upgrades to add nitrification. In 1994, the facilities collectively discharged 7% more nitrogen than in the baseline year, but this nominal load increase accompanied a 26% rise in the volume of wastewater treated. This indicates that improvements at the plants have prevented the nitrogen load from increasing at the same rate as the volume of flow.

For phosphorus, the situation is much different because the majority of these plants operate phosphorus removal systems near the limit of technology. Plants discharging under the stringent requirements of the Dulles Area Watershed Policy, the Occoquan Policy, and the Potomac Embayment Standards have made notable improvements in their capability to remove phosphorus. The Region's point source phosphorus load was reduced by about 39%, and the level of treatment now being achieved is expected to continue.

The assessment suggests that all the plants in the NoVA Region with a design capacity of 0.5 million gallons/day (MGD) be retrofitted with BNR or an equivalent technology. However, the Upper Occoquan facility merits further review regarding this control option due to concerns over adverse water quality impacts in Occoquan Reservoir, and harmful in-plant consequences, if their effluent is denitrified. Achieving BNR treatment levels (annual averages of 7 mg/l nitrogen; 1.5 mg/l phosphorus, or lower if required by permit) is estimated to reduce the Region's point source nitrogen load by 39%, and the phosphorus load by 23%.

Status Towards the 40% Reduction Goal

Under this "strawman" assessment, the 2000 reductions for the NoVA Region are estimated at 32% for nitrogen and 25% for phosphorus. Both figures are short of the 40% reduction goal. Discussions with the NoVA local governments have been initiated to identify possible measures that could close this gap, even beyond the expanded BMP coverage and point source retrofits suggested by the "strawman."

Information is being exchanged regarding conservation easements, agricultural land conversions from cropland to pasture/hayland, installation of animal waste control structures, implementation of BMPs outside the state cost-share program, and some urban localities are reviewing data availability on stormwater retrofits. If these measures can be quantified in terms of load reduction, they will contribute to the assessment, but are not expected to provide all the reduction needed to meet the regional goal. Many options have the potential to "close the gap", but involve use of costly practices with diminishing returns in terms of pounds removed per dollar spent.

Point source retrofits for nitrogen removal could approach the limits of technology at a subset of plants where it is most cost effective to do so, but this is not considered equitable in light of the level of effort sought throughout the basin. If the practical limits of the "strawman" are accepted as the Region's contribution to the Potomac Strategy, then additional cost effective reductions may be achieved in other regions via trading mechanisms, if such a system were formed.

Summary of NoVA Region Assessment Recommendations:

1) Increase use of Farm Plans, from a projected 70% coverage on agricultural land up to 77%. Additional cost = $200,700 (BMP service life is 4-5 years).

2) Expand Nutrient Management coverage, from a projected 12% value up to 29%. Additional cost = $56,200/year (practice renewed annually).

3) Encourage retirement of highly erodible agricultural land, from a projected 5,800 acres to 8,400 acres. Additional cost = $330,800 (land idled for 10 years).

4) Provide grazing land protection on 7% of pasture, up from a projected figure of 4%. Additional cost = $438,900 (BMP service life is 7-10 years).

5) Expand stream protection programs to cover 2,200 acres, up from a projected 1,450 acres.

Additional cost = $15,800 (BMP service life is 7-10 years).

6) Utilize winter cover crops on 930 acres of cropland, up from a projected 600 acres. Additional cost = $4,800/year (practice renewed annually).

7) Install grass filter strips on 500 acres, up from a projected value of 38 acres. Additional cost = $86,400 (BMP service life is 7-10 years).

8) Establish woodland buffer filter areas on 710 acres, up from a projected level of 11 acres. Additional cost = $160,800 (BMP service life is 7-10 years).

9) Attain 100% utilization of forest harvesting BMPs on all silviculture, and achieve 100% compliance with state Erosion & Sediment Control Law.

10) Determine additional number of animal waste control structures needed, as well as number of dairy operations going out of production and associated herd sizes.

11) Increase use of urban stormwater management/BMP retrofits to control runoff from 4,240 acres, up from a figure of 3,085 acres. Additional cost = =$236,900 (BMP service life is 15-20 years).

12) Promote urban nutrient management to achieve coverage on 7,300 acres, up from a projected 3,700 acres. Cost to be determined.

13) Carry out planned septic pumping programs, to prevent failure of an estimated 127 units.

14) Retrofit all wastewater treatment plants with a design capacity of 0.5 MGD or greater with year-round BNR, or an equivalent technology. Capital cost = $112.8 million (figure is only for treatment needed beyond current or pending permit requirements, in January 1996 dollars; service life of systems is 20 years). Determine applicability to the Upper Occoquan wastewater reclamation plant.

15) Review and confirm future daily flow projections and design capacities at NoVA Region treatment plants. At plants not already doing so, institute effluent monitoring for total nitrogen and total phosphorus, using standard sampling protocols and analytical methods.

16) Review and confirm cost figures for BNR retrofits. Owners and their consultants should develop pre-design engineering cost estimates for unit processes essential for BNR level treatment. Report costs only for retrofits needed to go beyond current or pending mandatory treatment requirements.

17) For regional acceptance of model results, the federal/interstate Chesapeake Bay Program (CBP) must continue to be responsive to the information needs of the local governments.

The CBP's 1997 Reevaluation of its Nutrient Reduction Strategy program should be structured to produce results that further explain the habitat and living resource benefits that the nutrient reduction goal will achieve, as well as further demonstrate the validity and credibility of the predictive modeling tools used.

18) State and local representatives should continue the effort to further develop the Regional Pilot Program (RPP) adopted by the Washington Council of Governments (COG) Board in June 1994, and reaffirmed October 9, 1996, consistent with any schedule and content determined by the COG Board and any action of the General Assembly. The RPP has recommended conditions under which it should be implemented, and these would be elements of a two-part Memorandum of Understanding: 1) cost share grants are provided to address funding needs identified for each plant; 2) plant retrofits proceed, and the MOU would define criteria for successful pilot testing, address specific operational issues, and address full-scale implementation of nitrogen removal, as laid out in the RPP.

19) The Virginia Association of Municipal Wastewater Agencies' (VAMWA) Nutrient Position Paper has received overwhelming support from the VAMWA membership at all levels (Boards, Commissions, Councils, Executives, and staff). Therefore, the VAMWA position should be considered by state officials as the primary implementation mechanism for point source nutrient reductions. VAMWA's Position Paper offers support for installation of BNR technology at plants within the Potomac basin conditioned on several commitments by the Commonwealth, principally:

   A) At least 50% grant funding of for construction of nutrient removal systems. The General Assembly is asked to create a joint study committee to identify new sources of funding for this cost-share program.
   B) Implementation through agreement, not by permit. This is consistent with Virginia's voluntary, cooperative tributary strategy program approach.
   C) Future "cap" controls based on equity and sound science.

Details associated with these recommendations appear in the following tables:

Table 2. Total Nutrient Loads under Current and Planned State Programs

Table 3. Total Nutrient Loads Based on Increased Coverage Beyond Current and Planned State Programs with Year-Round BNR at All Wastewater Plants

Table 4a. NPS Nutrient Reductions, based on increased coverage beyond current and planned state programs.

Tables 4b-4g. NPS Nutrient Reductions by County, based on inc. coverage beyond current/planned state programs.

Tables 5a & 5b. Point Source Nutrient Loading Estimates with Year-Round BNR Operating

Table 6a & 6b. Cost Figures for Point Source BNR Retrofits

Table 2.

NoVA Region Total Nutrient Loads under Current and Planned State Programs (by County: 1985 baseline, 1994 Progress, Year 2000 Projection).

	Nitrogen Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Arlington	1,769,930	1,732,965	693,186	754,904	-43.6%	631,500	-36.4%
Fairfax	6,405,687	5,702,554	2,281,021	(807,958)	14.2%	(1,164,912)	20.4%
Fauquier	1,653,869	980,782	392,313	84,949	-8.7%	126,447	-12.9%
Loudoun	2,393,461	1,240,317	496,127	183,943	-14.8%	115,096	-9.3%
Prince William	2,205,279	1,678,224	671,289	1,593	-0.1%	(18,729)	1.1%
Stafford	685,647	355,930	142,372	62,763	-17.6%	2,857	-0.8%
Blue Plains (VA)	814,169	814,169	325,668	(327,675)	40.2%	(121,892)	15.0%
Northern Virginia	15,928,042	12,504,940	5,001,976	(47,482)	0.4%	(429,633)	3.4%

	Phosphorus Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Arlington	56,823	55,899	22,360	42,582	-76.2%	42,368	-75.8%
Fairfax	156,090	136,316	54,526	23,032	-16.9%	30,116	-22.1%
Fauquier	160,115	133,034	53,214	11,116	-8.4%	17,042	-12.8%
Loudoun	257,504	190,943	76,377	22,326	-11.7%	13,355	-7.0%
Prince William	115,356	104,351	41,740	21,152	-20.3%	28,561	-27.4%
Stafford	36,590	31,001	12,401	8,218	-26.5%	14,735	-47.5%
Blue Plains (VA)	6,846	6,846	2,738	(6,209)	90.7%	(11,875)	173.5%
Northern Virginia	789,324	658,389	263,356	122,218	-18.6%	134,302	-20.4%

Table 3.

Total Nutrient Loads Based on Increased Coverage Beyond Current and Planned State Programs with Year-Round BNR at All Wastewater Plants (by County: 1985 baseline, 1994 Progress, Year 2000 Projection).

	Nitrogen Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Arlington	1,769,930	1,732,965	693,186	754,904	-43.6%	921,842	-53.2%
Fairfax	6,405,687	5,702,554	2,281,021	(807,958)	14.2%	2,213,891	-38.8%
Fauquier	1,653,869	980,782	392,313	84,949	-8.7%	160,201	-16.3%
Loudoun	2,393,461	1,240,317	496,127	183,943	-14.8%	350,831	-28.3%
Prince William	2,205,279	1,678,224	671,289	1,593	-0.1%	519,034	-30.9%
Stafford	685,647	355,930	142,372	62,763	-17.6%	13,946	-3.9%
Blue Plains (VA)	814,169	814,169	325,668	(327,675)	40.2%	(121,931)	15.0%
Northern Virginia	15,928,042	12,504,940	5,001,976	(47,482)	0.4%	4,057,814	-32.4%

	Phosphorus Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
Arlington	56,823	55,899	22,360	42,582	-76.2%	42,579	-76.2%
Fairfax	156,090	136,316	54,526	23,032	-16.9%	31,360	-23.0%
Fauquier	160,115	133,034	53,214	11,116	-8.4%	20,841	-15.7%
Loudoun	257,504	190,943	76,377	22,326	-11.7%	35,926	-18.8%
Prince William	115,356	104,351	41,740	21,152	-20.3%	29,968	-28.7%
Stafford	36,590	31,001	12,401	8,218	-26.5%	15,846	-51.1%
Blue Plains (VA)	6,846	6,846	2,738	(6,209)	90.7%	(11,854)	173.2%
Northern Virginia	789,324	658,389	263,356	122,218	-18.6%	164,666	-25.0%

Table 4a. **Nonpoint Source Nutrient Reductions for Northern Virginia Region**

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Year 2000 Projection Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus	Increased Ac of Coverage	Added Reductions Ach'd Nitrogen	Added Reductions Ach'd Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	65,738	85.9%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	150,104	76.5%	69,368	18,450	13,840	6,752	1,724	$14.50	$200,674
Nutrient Management	acres	56,352	28.7%	66,017	5,930	32,120	38,409	3,528	$1.75	$56,210
Highly Erodible Land Retirement	acres	8,420	2.3%	92,072	13,539	2,646	34,027	4,873	$125.00	$330,750
Grazing Land Protection	acres	11,838	7.2%	37,726	2,526	5,163	16,423	1,100	$85.00	$438,855
Stream Protection	acres	2,204	-----	3,426	249	754	1,176	85	$21.00	$15,834
Cover Crops	acres	931	-----	7,230	558	318	2,343	180	$15.00	$4,770
Grass Filter Strips	acres	505	-----	5,442	669	467	5,013	616	$185.00	$86,395
Woodland Buffer Filter Area	acres	710	-----	15,434	2,191	699	15,232	2,163	$230.00	$160,770
Forest Harvesting	acres	4,678	100.0%	67,038	1,136	0	0	0	$0.00	$0
Animal Waste Control Facilities	systems	29	-----	43,902	8,573	0	0	0	$18,500.00	$0
Erosion & Sediment Control	acres	6,396	100.0%	83,810	41,867	0	0	0	$0.00	$0
Urban SWM/BMP Retrofits	acres	4,240	1.5%	10,165	1,110	1,156	2,772	303	$205.00	$236,923
Urban Nutrient Management	acres	7,327	12.5%	11,117	999	3,621	5,532	497	TBD	TBD
Septic Pumping	systems	127	-----	29,427	0	0	0	0	$0.00	$0
Shoreline Erosion Protection	linear feet	9,614	-----	14,744	9,593	0	0	0	$0.00	$0
Total Pounds Reduced:				556,917	107,392		127,678	15,068		$1,531,181
Adjustment for Urban Growth:				(308,969)	(31,889)					
Adjusted Reduction:				865,886	139,281					
Nonpoint Controllable Amount:				4,306,736	555,591					
Percent Reduction:				20.11%	25.07%					

Table 4b. **Nonpoint Source Nutrient Reductions for Arlington County**

Based on Increased Coverage Beyond Current & Planned State Programs

		Year 2000 Projection		Reductions (lbs/year)		Increased Ac	Added Reductions Ach'd		Cost per Added	Total Cost for
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	of Coverage	Nitrogen	Phosphorus	Acre Treated	Incr Coverage
Conservation Tillage	acres	0	0.0%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	0	0.0%	0	0	0	0	0	$14.50	$0
Nutrient Management	acres	0	0.0%	0	0	0	0	0	$1.75	$0
Highly Erodible Land Retirement	acres	0	0.0%	0	0	0	0	0	$125.00	$0
Grazing Land Protection	acres	0	0.0%	0	0	0	0	0	$85.00	$0
Stream Protection	acres	0	-----	0	0	0	0	0	$21.00	$0
Cover Crops	acres	0	-----	0	0	0	0	0	$15.00	$0
Grass Filter Strips	acres	0	-----	0	0	0	0	0	$185.00	$0
Woodland Buffer Filter Area	acres	0	-----	0	0	0	0	0	$230.00	$0
Forest Harvesting	acres	0	0.0%	0	0	0	0	0	$0.00	$0
Animal Waste Control Facilities	systems	0	-----	0	0	0	0	0	$18,500.00	$0
Erosion & Sediment Control	acres	87	100.0%	1,177	588	0	0	0	$0.00	$0
Urban SWM/BMP Retrofits	acres	166	1.0%	410	45	28	69	8	$205.00	$5,759
Urban Nutrient Management	acres	1,811	20.0%	2,803	252	1,645	2,546	229	TBD	TBD
Septic Pumping	systems	3	-----	668	0	0	0	0	$0.00	$0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	0	0	$0.00	$0
Total Pounds Reduced:				5,057	885		2,615	236		$5,759
Adjustment for Urban Growth:				0	0					
Adjusted Reduction:				5,057	885					
Nonpoint Controllable Amount:				91,684	9,005					
Percent Reduction:				5.52%	9.83%					

Table 4c. **Nonpoint Source Nutrient Reductions for Fairfax County**

Based on Increased Coverage Beyond Current & Planned State Programs

		Year 2000 Projection		Reductions (lbs/year)		Increased Ac	Added Reductions Ach'd		Cost per Added	Total Cost for
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	of Coverage	Nitrogen	Phosphorus	Acre Treated	Incr Coverage
Conservation Tillage	acres	0	0.0%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	1,681	80.0%	511	122	420	128	30	$14.50	$6,093
Nutrient Management	acres	1,810	86.1%	0	0	0	0	0	$1.75	$0
Highly Erodible Land Retirement	acres	210	2.7%	2,295	307	50	727	105	$125.00	$6,250
Grazing Land Protection	acres	58	1.0%	193	13	0	0	0	$85.00	$0
Stream Protection	acres	40	-----	64	5	0	0	0	$21.00	$0
Cover Crops	acres	79	-----	607	47	0	0	0	$15.00	$0
Grass Filter Strips	acres	95	-----	1,074	132	95	1,074	132	$185.00	$17,575
Woodland Buffer Filter Area	acres	175	-----	3,999	569	175	3,999	569	$230.00	$40,250
Forest Harvesting	acres	709	100.0%	12,022	200	0	0	0	$0.00	$0
Animal Waste Control Facilities	systems	2	-----	3,156	617	0	0	0	$18,500.00	$0
Erosion & Sediment Control	acres	2,398	100.0%	31,114	15,539	0	0	0	$0.00	$0
Urban SWM/BMP Retrofits	acres	2,544	1.6%	6,094	665	948	2,270	248	$205.00	$194,262
Urban Nutrient Management	acres	2,876	15.0%	4,332	389	959	1,444	130	TBD	TBD
Septic Pumping	systems	39	-----	9,103	0	0	0	0	$0.00	$0
Shoreline Erosion Protection	linear feet	3,205	-----	4,915	3,198	0	0	0	$0.00	$0
Total Pounds Reduced:				79,478	21,803		9,641	1,214		$264,430
Adjustment for Urban Growth:				8,802	738					
Adjusted Reduction:				70,677	21,065					
Nonpoint Controllable Amount:				925,593	102,946					
Percent Reduction:				7.64%	20.46%					

Table 4d. **Nonpoint Source Nutrient Reductions for Fauquier County**

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Year 2000 Projection Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus	Increased Ac of Coverage	Added Reductions Ach'd Nitrogen	Added Reductions Ach'd Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	22,682	81.3%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	47,686	70.0%	25,736	6,236	8,517	4,596	1,114	$14.50	$123,492
Nutrient Management	acres	17,031	25.0%	19,660	1,766	10,693	12,344	1,109	$1.75	$18,713
Highly Erodible Land Retirement	acres	660	0.6%	6,515	1,038	160	2,224	319	$125.00	$20,000
Grazing Land Protection	acres	7,675	15.0%	25,175	1,749	3,049	10,076	676	$85.00	$259,165
Stream Protection	acres	240	-----	411	30	72	121	9	$21.00	$1,512
Cover Crops	acres	80	-----	650	50	60	482	37	$15.00	$900
Grass Filter Strips	acres	105	-----	1,138	140	99	1,070	132	$185.00	$18,315
Woodland Buffer Filter Area	acres	130	-----	2,841	404	130	2,841	404	$230.00	$29,900
Forest Harvesting	acres	1,065	100.0%	14,408	278	0	0	0	$0.00	$0
Animal Waste Control Facilities	systems	12	-----	18,544	3,628	0	0	0	$18,500.00	$0
Erosion & Sediment Control	acres	81	100.0%	1,074	537	0	0	0	$0.00	$0
Urban SWM/BMP Retrofits	acres	78	1.1%	185	20	0	0	0	$205.00	$0
Urban Nutrient Management	acres	93	10.0%	140	13	0	0	0	TBD	TBD
Septic Pumping	systems	12	-----	2,803	0	0	0	0	$0.00	$0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	0	0	$0.00	$0
Total Pounds Reduced:				119,282	15,888		33,754	3,799		$471,997
Adjustment for Urban Growth:				(40,919)	(4,953)					
Adjusted Reduction:				160,201	20,841					
Nonpoint Controllable Amount:				980,782	133,034					
Percent Reduction:				16.33%	15.67%					

Table 4e. **Nonpoint Source Nutrient Reductions for Loudoun County**

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Percent	Reductions (lbs/year) Nitrogen	Phosphorus	Increased Ac of Coverage	Added Reductions Ach'd Nitrogen	Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	30,728	93.2%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	74,794	80.0%	26,066	8,789	3,623	1,263	426	$14.50	$52,531
Nutrient Management	acres	23,373	25.0%	25,270	2,975	14,298	15,459	1,820	$1.75	$25,022
Highly Erodible Land Retirement	acres	6,560	3.5%	72,189	10,732	2,102	26,224	3,751	$125.00	$262,750
Grazing Land Protection	acres	3,675	4.0%	10,874	726	1,959	5,811	388	$85.00	$166,515
Stream Protection	acres	1,800	-----	2,732	198	557	837	61	$21.00	$11,697
Cover Crops	acres	540	-----	4,023	310	258	1,861	143	$15.00	$3,870
Grass Filter Strips	acres	135	-----	1,310	160	135	1,310	160	$185.00	$24,975
Woodland Buffer Filter Area	acres	200	-----	3,910	553	189	3,708	524	$230.00	$43,470
Forest Harvesting	acres	1,077	100.0%	15,935	312	0	0	0	$0.00	$0
Animal Waste Control Facilities	systems	9	-----	12,301	2,390	0	0	0	$18,500.00	$0
Erosion & Sediment Control	acres	1,119	100.0%	13,852	6,907	0	0	0	$0.00	$0
Urban SWM/BMP Retrofits	acres	382	1.3%	841	92	42	93	10	$205.00	$8,699
Urban Nutrient Management	acres	612	15.0%	847	76	204	282	25	TBD	TBD
Septic Pumping	systems	26	-----	5,379	0	0	0	0	$0.00	$0
Shoreline Erosion Protection	linear feet	0	-----	0	0	0	0	0	$0.00	$0
Total Pounds Reduced:				195,530	34,220		56,848	7,308		$599,529
Adjustment for Urban Growth:				(182,743)	(17,407)					
Adjusted Reduction:				378,274	51,627					
Nonpoint Controllable Amount:				1,160,799	183,817					
Percent Reduction:				32.59%	28.09%					

Table 4f. Nonpoint Source Nutrient Reductions for Prince William County

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Year 2000 Projection Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus	Increased Ac of Coverage	Added Reductions Ach'd Nitrogen	Added Reductions Ach'd Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	7,636	87.5%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	18,663	80.0%	10,637	2,178	1,166	665	136	$14.50	$16,909
Nutrient Management	acres	10,498	45.0%	11,519	753	5,311	5,827	381	$1.75	$9,294
Highly Erodible Land Retirement	acres	260	0.7%	2,571	337	65	944	136	$125.00	$8,125
Grazing Land Protection	acres	330	2.5%	1,139	77	143	494	33	$85.00	$12,155
Stream Protection	acres	80	-----	140	10	80	140	10	$21.00	$1,680
Cover Crops	acres	0	-----	0	0	0	0	0	$15.00	$0
Grass Filter Strips	acres	115	-----	1,300	160	83	938	116	$185.00	$15,355
Woodland Buffer Filter Area	acres	135	-----	3,085	439	135	3,085	439	$230.00	$31,050
Forest Harvesting	acres	1,014	100.0%	13,264	208	0	0	0	$0.00	$0
Animal Waste Control Facilities	systems	4	-----	6,600	1,292	0	0	0	$18,500.00	$0
Erosion & Sediment Control	acres	1,426	100.0%	19,246	9,623	0	0	0	$0.00	$0
Urban SWM/BMP Retrofits	acres	815	1.3%	2,006	219	138	339	37	$205.00	$28,203
Urban Nutrient Management	acres	1,627	20.0%	2,519	227	814	1,259	113	TBD	TBD
Septic Pumping	systems	27	-----	6,514	0	0	0	0	$0.00	$0
Shoreline Erosion Protection	linear feet	3,205	-----	4,915	3,198	0	0	0	$0.00	$0
Total Pounds Reduced:				85,454	18,720		13,691	1,401		$122,770
Adjustment for Urban Growth:				(93,776)	(11,770)					
Adjusted Reduction:				179,230	30,491					
Nonpoint Controllable Amount:				856,843	97,836					
Percent Reduction:				20.92%	31.17%					

Table 4g. **Nonpoint Source Nutrient Reductions for Stafford County**

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Percent	Reductions (lbs/year) Nitrogen	Phosphorus	Increased Ac of Coverage	Added Reductions Ach'd Nitrogen	Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	4,692	67.6%	0	0	0	0	0	$21.00	$0
Farm Plans	acres	7,280	80.0%	6,418	1,125	114	100	18	$14.50	$1,649
Nutrient Management	acres	3,640	40.0%	9,567	436	1,818	4,779	218	$1.75	$3,182
Highly Erodible Land Retirement	acres	730	5.9%	8,501	1,126	269	3,909	562	$125.00	$33,625
Grazing Land Protection	acres	100	3.0%	344	23	12	41	3	$85.00	$1,020
Stream Protection	acres	45	-----	79	6	45	79	6	$21.00	$945
Cover Crops	acres	232	-----	151	151	0	0	0	$15.00	$0
Grass Filter Strips	acres	55	-----	622	77	55	622	77	$185.00	$10,175
Woodland Buffer Filter Area	acres	70	-----	1,600	228	70	1,600	228	$230.00	$16,100
Forest Harvesting	acres	812	100.0%	11,409	138	0	0	0	$0.00	$0
Animal Waste Control Facilities	systems	0	-----	0	0	0	0	0	$18,500.00	$0
Erosion & Sediment Control	acres	1,285	100.0%	17,348	8,674	0	0	0	$0.00	$0
Urban SWM/BMP Retrofits	acres	256	2.5%	630	69	0	0	0	$205.00	$0
Urban Nutrient Management	acres	307	10.0%	476	43	0	0	0	TBD	TBD
Septic Pumping	systems	21	-----	4,959	0	0	0	0	$0.00	$0
Shoreline Erosion Protection	linear feet	5,065	-----	8,118	5,291	0	0	0	$0.00	$0
Total Pounds Reduced:				70,220	17,384		11,129	1,110		$66,696
Adjustment for Urban Growth:				(331)	1,504					
Adjusted Reduction:				70,552	15,881					
Nonpoint Controllable Amount:				291,036	28,954					
Percent Reduction:				24.24%	54.85%					

Table 5a. Point Source Nitrogen Loading Estimate

Plant	1985 Flow (MGD)	1985 TN Baseload (lbs/yr)	2000 Flow (MGD)	2000 TN Load w/BNR (lbs/year)
Leesburg STP	1.26	71,700	5.00	106,500
Purcellville STP	0.27	15,400	0.50	10,700
Blue Plains (VA Flow)	17.30	816,300	41.00	936,100
Alexandria STP	35.60	1,994,000	43.20	920,500
Aquia STP	1.14	64,900	5.70	121,500
Arlington STP	26.56	1,641,300	34.00	724,500
Dale City #1 STP	2.00	91,300	4.00	85,200
Dale City #8 STP	0.84	38,400	2.00	42,600
Lower Potomac STP	32.96	1,906,300	47.00	1,001,500
L. Hunting Creek STP	3.82	279,100	0.00	0
Mooney STP	7.58	609,200	15.00	319,600
Quantico STP	1.45	82,500	1.60	34,100
UOSA STP	9.41	597,500	33.40	711,700
Total	140.19	8,207,900	232.40	5,014,500 (-39%)

Table 5b. Point Source Phosphorus Loading Estimate

Plant	1985 Flow (MGD)	1985 TP Baseload (lbs/yr)	2000 Flow (MGD)	2000 TP Load w/BNR (lbs/year)
Leesburg STP	1.26	2,600	5.00	22,800
Purcellville STP	0.27	5,300	0.50	2,300
Blue Plains (VA Flow)	17.30	6,800	41.00	18,700
Alexandria STP	35.60	16,300	43.20	6,600
Aquia STP	1.14	2,000	5.70	2,100
Arlington STP	26.56	46,900	34.00	5,200
Dale City #1 STP	2.00	1,100	4.00	1,200
Dale City #8 STP	0.84	800	2.00	400
Lower Potomac STP	32.96	14,000	47.00	11,400
L. Hunting Crk. STP	3.82	2,200	0.00	0
Mooney STP	7.58	3,700	15.00	5,000
Quantico STP	1.45	900	1.60	400
UOSA STP	9.41	900	33.40	5,100
Total	140.19	103,500	232.40	81,200 (-23%)

Table 6a. Point Source Cost Figures for Year-Round BNR Retrofit (in $1,000)

Plant[1]	Capital	O&M	EAC[2]
Leesburg STP	$3,446	$231	$636
Purcellville STP	$1,988	$61	$295
Blue Plains (VA Flow)	$3,242	$797	$1,177
Alexandria STP[3]	$20,000	$757	$3,106
Aquia STP	$4,275	$189	$691
Arlington STP	$7,847	$406	$1,328
Dale City #1 STP	$5,740	$211	$885
Dale City #8 STP	$4,030	$140	$613
Lower Potomac STP	$26,533	$375	$3,491
Mooney STP	$7,115	$509	$1,345
Quantico STP	$0	$157	$371
UOSA STP	$28,576	$1,261	$4,618
Total	$112,790	$5,094	$18,556

Notes: 1) Several localities are served by regional plants (e.g., Fairfax flows treated at Lower Potomac STP/39.63 MGD in 1995, Blue Plains STP/20.57 MGD, Arlington STP/2.18 MGD, Alexandria STP/19.35 MGD, and Upper Occoquan STP/9.72 MGD). Decisions to retrofit many of these plants would affect users outside the boundaries of the locality where the plant is situated.

2) EAC = equivalent annual cost; the annual expenditure to cover operation & maintenance, plus the debt for financing the capital cost over a 20 year design life at an interest rate of 10%.

3) Capital cost figure given by Alexandria Sanitation Authority; revises information in the April 26, 1996 load estimation document.

Table 6b. Point Source Unit Costs for Year-Round BNR Retrofit

Plant	EAC/MGD	EAC/lb TN
Leesburg STP	$127,200	$4
Purcellville STP	$589,900	$17
Blue Plains (VA Flow)	$28,700	$2
Alexandria STP	$57,500	$2
Aquia STP	$115,100	$8
Arlington STP	$33,200	$2
Dale City #1 STP	$221,200	$15
Dale City #8 STP	$306,600	$9
Lower Potomac STP	$52,100	$2
Mooney STP	$56,000	$2
Quantico STP	$185,600	$12
UOSA STP	$85,500	$2

Potomac Basins Tributary Strategies Tracking

Northern Virginia Meetings

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep
Local Governments						
x	Alexandria, City of	Kerry J. Donley	Mayor			
x	Alexandria, City of	Warren Bell	City Engineer	x		x
	Alexandria, City of	Larry Gavan		x	x	x
x	Alexandria Sanitation Authority	James Canaday	Director			x
x	Alexandria Sanitation Authority	Glenn B. Harvey		x	x	x
x	Arlington County	James B. Hunter	Chairman, County Board			
	Arlington County	Lisa Grandle	Parks & Recreation Office	x		
x	Arlington County	Jeff Harn			x	x
	Arlington County	Jill Neuville	Director, Env. Services	x		
	Arlington County	Dennis Wisler				x
	Arlington County	William Frost	Public Works Department	x	x	x
x	Clifton, Town of	James C. Chesley	Mayor			
x	Dale City Service Corporation	Norris Sisson	President			x
	Dale City Service Corporation	Scott Ahern		x	x	
x	Dale City Service Corporation	Phillip A. Lewis		x	x	x
x	Dumfries, Town of	Samuel W. Bauckman	Mayor			
x	Dumfries, Town of	Dave Kotecki	Public Works Director	x	x	
	Fairfax County	Tony Griffin				x
x	Fairfax County	Katherine K. Hanley	Chairman, Board of Supervisors	x		x
	Fairfax County	William J. Leidinger	County Executive	x		
	Fairfax County	John W. diZerega	Public Works Director	x		x
x	Fairfax County	Jimmie Jenkins	Public Works Dept.	x	x	x
	Fairfax County	John Koenig	Public works Dept.			x
	Fairfax County	Valerie Tucker	Public Works Dept.	x		
	Fairfax County	Bill Henry	Public Works Dept.			x
	Fairfax County	Leo Ratchfold			x	
x	Fairfax, City of	John Mason	Mayor			
x	Fairfax, City of	Joe Lerch	Planning Office	x	x	x
x	Falls Church, City of	Alan Branghman	Mayor (current)			
x	Falls Church, City of	Jeffrey Tarbert	Mayor (former)			
x	Fauquier County	David C. Mangum	Chairman, Board of Supervisors	x		
	Fauquier County	Linda Unkefer	County Engineer	x	x	x
	Fauquier County	Danny Hatch	Soil Scientist	x		
x	Hamilton, Town of	Lloyd E. Matthews	Mayor			
x	Haymarket, Town of	John R. Kapp	Mayor	x		

Prepared by DEQ 10/2/96

Potomac Basins Tributary Strategies Tracking

Northern Virginia Meetings

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep		
x	Herndon, Town of	Thomas Davis Rust	Mayor					
x	Herndon, Town of	Ed Moore	Public Works/Utilities Director	x		x		
x	Hilsboro, Town of	Kenneth W. Rousseau	Mayor					
x	Leesburg, Town of	James E. Clem	Mayor					
	Leesburg, Town of	Tom Mason	Public Works/Utilities Director	x				
x	Leesburg, Town of	R. W. Shoemaker	Public Works/Utilities Director	x		x		
x	Loudoun County	Dale Polen Myers	Chairman, Board of Supervisors					
	Loudoun County	James G. Burton	Member, Board of Supervisors	x		x		
	Loudoun County	Memory Porter	Administrative Assistant			x		
	Loudoun County	Irish Grandfield	Planner			x		
	Loudoun County Sanitation Authority	Tim Coughlin				x		
	Loudoun County Sanitation Authority	Dale Hammes			x			
x	Loudoun County Sanitation Authority	Ken Shelton	General Manager	x				
	Loudoun County Sanitation Authority	Tom Broderick			x	x		
x	Lovettsville, Town of	Elaine Walker	Mayor					
x	Manassas Park, City of	Ernest L. Evans	Mayor					
x	Manassas Park, City of	William Weakley	Public Works Director		x	x		
x	Manassas, City of	Robert L. Browne	Mayor					
x-	Manassas, City of	Michael Moon	Public Works Director	x	x			
x	Middleburg, Town of	Caroline Bowersock	Mayor					
x	Occoquan, Town of	Larry Casperson	Mayor					
	Upper Occoquan Service Authority	Laura Conrad		x	x			
	Upper Occoquan Service Authority	Millard Robbins	Executive Director					
x	The Plains, Town of	Blake Gallagher	Mayor					
x	Prince William County	Kathleen K. Seefeldt	Chairman, Board of Supervisors					
	Prince William County	Madan Mohan		x		x		
	Prince William County	Raj Bideri	Public Works Dept.		x			
	Prince William County	Jim Chao	Public Works Dept.	x	x			
x	Prince William County	Oscar Guzman		x		x		
x	Prince William Co Sanitation Authority	John Sloper	General Manager					
	Prince William Co. Sanitation Authority	Rick Thoesen				x		
x	Prince William Co Sanitation Authority	Steve Bennett		x	x	x		
x	Purcellville, Town of	John Marsh	Mayor					
x	Purcellville, Town of	Karin McKnight	Public Works Director	x				
x	Quantico, Town of	Howard Bolognese	Mayor	x				
	Quantico, Town of	Mitchel Raftelis	Vice Mayor	x				

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Potomac Basins Tributary Strategies Tracking

Northern Virginia Meetings

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep		
x	Round Hill, Town of	Jeffrey H. Wolford	Mayor					
x	Stafford County	Linda V. Musselman	Chairman, Board of Supervisors					
x	Stafford County	Robert E. Bos	Public Works/Utilities Director	x	x	x		
	Stafford County	Barry Fitz-James			x			
	Stafford County	Dan Schardein			x			
x	Upper Occoquan Sanitation Authority	Millard Robbins	Executive Director					
x	Upper Occoquan Sanitation Authority	Laura Conrad				x		
	Upper Occoquan Sanitation Authority	James Bannwart				x		
x	Vienna, Town of	Charles A. Robinson	Mayor	x				
	Vienna, Town of	Jennifer Steingasser	Senior Planner	x		x		

Soil and Water Conservation Districts

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep		
	John Marshall SWCD	Dana R. Bayless	Conservation Specialist	x	x	x		
	John Marshall SWCD	Nicolaas A. Kortlandt	Chairman	x				
x	Loudoun SWCD	James J. Boland	Chairman					
	Loudoun SWCD	John R. Boyd	Associate Director	x				
	Loudoun SWCD	Peter R. Holden	Environmentalist	x	x	x		
	Loudoun SWCD	Kenneth Lowery		x				
	Loudoun SWCD	Joseph M. Rogers	Dir. Sec/Tr	x				
x	Northern VA SWCD	A. Dewey Bond	Chairman			x		
	Northern VA SWCD	Diane Hoffman				x		
x	Prince William SWCD	Thomas R. House	Chairman					
	Prince William SWCD	James Bonar	Conservation Specialist	x	x			
	Prince William SWCD	Kevin Martin	WQ/Urban Cons. Specialist	x	x			
	Prince William SWCD	Ralph W. McDowell	Vice Chairman	x		x		
x	Tri-County/City SWCD	George F. Beals	Chairman	x				
	Tri-County/City SWCD	Bobby Crisp	Vice Chairman			x		
	Tri-County/City SWCD	Ruth A. Carlone		x	x			
	Tri-County/City SWCD	L. Gordon Linkous	District Manager	x				

PDCs and Other Regional Groups

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep		
x	Metro WashCOG	David Shepp		x	x			
	Metro WashCOG	Tanya Spano						x
x	Northern Virginia PDC	Kimberly Davis	Env. Programs Dir	x		x		

Potomac Basins Tributary Strategies Tracking

Northern Virginia Meetings

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep
	Northern Virginia PDC	David Bulova	Coastal Program Manager	x	x	x
	Northern Virginia PDC	Normand Goulet			x	x
	Northern Virginia PDC	JoAnn Spevacek				x
x	Rappahannock Area PDC	Stephen H. Manster	Executive Director			
	Rappahannock Area PDC	Amy Garber				x
x	Rappahannock-Rapidan PDC	Gary Christie	Executive Director			
Legislators						
x	Virginia House of Delegates	David B. Albo				
x	Virginia House of Delegates	James F. Almand				
	Delegate Almand's Office	Amy Appelbaum	Aide	x		
x	Virginia House of Delegates	David G. Brickley				
x	Virginia House of Delegates	*Vincent F. Callahan*				
x	Virginia House of Delegates	Julia A. Connally				
x	Virginia House of Delegates	Karen L. Darner				
x	Virginia House of Delegates	James H. Dillard				
x	Virginia House of Delegates	Richard L. Fisher				
x	Virginia House of Delegates	Robert E. Harris				
x	Virginia House of Delegates	Robert D. Hull				
x	Virginia House of Delegates	Jay Katzen				
	Delegate Katzen's Office	Marge Van Deman	Aide	x		
x	Virginia House of Delegates	Gladys B. Keating				
x	Virginia House of Delegates	Robert G. Marshall				
	Delegate Marshall's Office	Gail Mockaitis	Aide			x
x	Virginia House of Delegates	Joe T. May				
x	Virginia House of Delegates	Roger J. McClure				
x	Virginia House of Delegates	William C. Mims				
x	Virginia House of Delegates	Brian J. Moran				
x	Virginia House of Delegates	James K. O'Brien				
x	Virginia House of Delegates	Harry J. Parrish				
	Delegate Parrish's Office	Diana Dutton	Aide	x		
x	Virginia House of Delegates	Kenneth R. Plum				
	Delegate Plum's Office	Barbara Shearer	Aide			x
x	Virginia House of Delegates	Linda T. Puller		x		
	Delegate Puller's Office	Kate Morosoff	Aide			x

Potomac Basins Tributary Strategies Tracking

Northern Virginia Meetings

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep
x	Virginia House of Delegates	John A. Rollison				
x	Virginia House of Delegates	James M. Scott				
x	Virginia House of Delegates	Marian Van Landingham				
x	Virginia House of Delegates	Vivian E. Watts				
x	Virginia State Senate	Patricia S. Ticer				
x	Virginia State Senate	Warren E. Barry				
x	Virginia State Senate	John H. Chichester				
x	Virginia State Senate	Charles J. Colgan		x		
x	Virginia State Senate	Joseph V. Gartlan				
x	Virginia State Senate	Janet D. Howell				
x	Virginia State Senate	Kevin G. Miller				
x	Virginia State Senate	H. Russell Potts				
x	Virginia State Senate	Richard L. Saslaw				
x	Virginia State Senate	Charles L. Waddell				
x	Virginia State Senate	Mary Margaret Whipple				x
x	Virginia State Senate	Jane H. Woods				x
State and Federal Agencies						
	Prince William Extension Service	Marc Aveni	Tech Assist Team Member	x	x	x
	VA Chesapeake Bay Local Assistance	Danielle K. Deemer		x	x	x
	VA Chesapeake Bay Local Assistance	Keith White		x	x	x
	VA Dept of Conservation & Recreation	Mark Bennett	S. Shenandoah Team Leader		x	
	VA Dept. of Conservation & Recreatio	Deborah B. Cross	Field Operations Manager	x		x
	VA Dept. of Conservation & Recreatio	Diane McCarthy			x	x
	VA Dept. of Conservation & Recreatio	E. J. Fanning		x	x	
	VA Dept. of Conservation & Recreatio	Douglas Carter		x	x	x
	VA Dept. of Environmental Quality	Gregory L. Clayton	Regional Director	x		
	VA Dept. of Environmental Quality	Alan Laubscher		x		
	VA Dept. of Environmental Quality	Mike McKenna		x		
	VA Dept. of Environmental Quality	Thomas A. Faha	Env. Engineer Consultant	x	x	x
	VA Dept. of Environmental Quality	John M. Kennedy	Northern VA Team Leader	x	x	x
	VA Dept. of Environmental Quality	Alan E. Pollock		x		x
	VA-JLARC	Eric Messick				x
	VA-JLARC	William Murray				x

Potomac Basins Tributary Strategies Tracking

Northern Virginia Meetings

Inv	Affiliation	Name	Title	4-Apr	30-May	17-Sep		
	VA Tech	Kurt Stephenson				x		
	VA Tech & SU-STAC Representative	Leonard Shabman				x		
	VA Tech	*Waldon Kerns*		x				
Citizen and Business Groups								
	Friends of the Rappahannock	John Tippett	Executive Director	x				
	Chesapeake Bay Commission	Russell W. Baxter	Virginia Director	x				

APPENDIX K

Lower Potomac:
Tributary Strategy

POTOMAC TRIBUTARY STRATEGY

LOWER POTOMAC REGION

Town of Colonial Beach
King George County
Northumberland County
Westmoreland County

Draft
September 27, 1996

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Background

At the request of the Secretary of Natural Resources, and in anticipation of the requirements of the recently enacted HB 1411, a series of meetings took place in the Potomac River watershed over a six-month period from March to September 1996 with state staff, local government elected officials and staff, Planning District Commission staff, representatives of Soil and Water Conservation Districts, and other representatives of various citizen groups. The purpose of the meetings was to forge a consensus on the most practical and cost-effective combination of measures which will result in a 40% reduction in nutrients, nitrogen and phosphorus, in Virginia's Potomac Basin by the year 2000, and to determine the funding mechanisms preferred by the meeting participants. To facilitate this process, the Basin was divided into four regions. The Lower Potomac Region is composed of the counties of King George, Northumberland and Westmoreland and the town of Colonial Beach.

Steps taken in the Lower Potomac region were a review of the 1985 baseline, 1994 progress and projected year 2000 nutrient load estimates prepared by the Department of Conservation and Recreation (DCR) and Department of Environmental Quality (DEQ); identification of any further programs or actions, including voluntary efforts, which were not accounted for in these estimates; determination of the additional actions necessary in this region to close the basin-wide 40% "gap" and maintain the "cap"on nutrients into the future; and determination of the preferred funding mechanisms. Based upon information provided by the meeting participants, state staff were able to refine the nutrient load estimate figures. Specifically, values for cover crops, shoreline protection measures and farm plans, also known as soil and water quality conservation plans, were adjusted based on feedback from the regional participants.

Estimated nutrient load calculations project over 30% reduction in this region from the year 1985 to the year 2000 in the annual controllable nitrogen loads, and nearly 57% reduction in controllable phosphorus from point and nonpoint sources combined (see Table 1). While phosphorus reductions are projected to have exceeded the basin-wide 40% goal, nitrogen loadings still must be reduced. The tables in appendix A provide a county-by-county breakdown of the nutrient reductions for point and nonpoint sources.

Table 1: **Lower Potomac Region Total Nutrient Reductions**
Based on Implementation of Current & Planned State Programs

	Nitrogen Load* (lbs/yr)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
King George	443,673	249,423	99,769	35,041	-14.0%	43,262	-17.3%
Northumberland	465,468	304,227	121,691	91,366	-30.0%	112,166	-36.9%
Westmoreland	822,082	544,509	217,804	137,081	-25.2%	177,562	-32.6%
Lower Potomac	1,731,224	1,098,158	439,263	263,489	-24.0%	332,990	-30.3%

	Phosphorus Load* (lbs/yr)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
King George	29,046	25,721	10,288	9,466	-36.8%	13,680	-53.2%
Northumberland	32,631	29,962	11,985	15,104	-50.4%	20,788	-69.4%
Westmoreland	64,238	59,683	23,873	23,558	-39.5%	30,461	-51.0%
Lower Potomac	125,915	115,366	46,146	48,129	-41.7%	64,929	-56.3%

* Nutrient loads for 1985 noted in this document differ from those in the August 1995 draft Potomac Basin document due to recalculation with more county specific land use information.

The regional nutrient reduction scenario crafted by the Lower Potomac regional participants relies on increased activity in a number of different areas; however, reductions from increased use of agricultural BMPs are paramount. This is appropriate since approximately ninety-five percent of the 1985 nutrient controllable loads within the Lower Potomac region can be traced back to nonpoint sources. Of that figure, over eighty percent of the total controllable nutrient loads are from cropland. The remaining nutrient loads are split nearly evenly across the other land use categories of non-rural, point source, and the other agricultural activities beside crop production.

In recent years, this region has been in the forefront of efforts to combat nonpoint source pollution and to protect the water quality of the Chesapeake Bay and its tributaries. Each of the three counties and the one incorporated town, Colonial Beach, has adopted a Chesapeake Bay Preservation Act program in which the entire jurisdiction is subject to the performance criteria of the Preservation Act Regulations. Therefore, these localities each have in place management measures which require periodic septic pumpout, no-net increase in stormwater pollutant loadings from new development and a 10% reduction in pollutant loading from redevelopment sites, and requirements for minimum disturbance during development. The Chesapeake Bay Preservation Act Regulations also require land within preservation areas and upon which agricultural activities are being conducted to have a soil and water conservation plan. In addition, the state fully expects 100% coverage and enforcement of erosion and sediment control measures during land development activities and 100% application of forest harvesting BMPs by the year 2000. These management measures, if fully implemented, will provide a sound framework for maintenance of the cap on nutrient loadings once the 40% goal has been reached for the Potomac River basin.

Options for Nutrient Control

To determine which additional nonpoint source measures will offer the most nutrient reduction in the future, meeting participants considered both the relative impact each measure or BMP will have in the region, and the feasibility of meeting a percentage figure which represents a "comparable level of effort", defined as approximately 73% of the limit of technology, among the four regions in the Potomac watershed. Tables 2 and 3, and shown by county breakdown in Appendix B, outline one possible combination of reduction measures to reach this level of effort for nonpoint source contributors only. It should be noted that all reductions shown under this comparable level of effort scenario beyond those projected under current funding levels of state and federal programs will be achieved through expansion of nonpoint source best management practices and/or measures. Expansion of these practices or measures results in a 39.4% change in the annual controllable nitrogen load and a 63.2% change in the annual controllable phosphorus load from point and nonpoint sources combined. Therefore, any reductions that may be attributable to potential changes at the WWTPs in this region, Colonial Beach and Dahlgren plants, could be used to augment and/or offset those nonpoint source reduction measures shown under this level of effort scenario. It is possible that with further upgrades or other modifications at the WWTPs, the region could meet or exceed 40%. Further discussion of the region's WWTPs is contained later in this document.

Dollar cost values noted in Table 2 and in appendix B consider all currently known costs to implement the BMPs listed without consideration of possible benefits beyond nutrient reduction, monetary or otherwise, in implementing these measures. Additional resources beyond implementation costs listed may be needed and could include personnel and technical assistance beyond current levels to develop, review, and/or update plans or BMP designs, allocate funds; and verify implementation of plans or installation of BMPs.

Table 2: **Nonpoint Source Nutrient Reductions for Lower Potomac Region**

Based on Increased Coverage Beyond Current & Planned State Programs

		Year 2000 Projection		Reductions (lbs/year)		Cost per Added	Total Cost for
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Acre Treated	Incr Coverage
Conservation Tillage	acres	38,765	70.6%	135,492	12,143	$21.00	$177,595
Farm Plans	acres	52,866	80.7%	47,548	8,320	$14.50	$0
Nutrient Management	acres	35,734	54.5%	102,336	4,684	$1.75	$21,295
Highly Erodible Land Retirement	acres	3,515	4.8%	44,045	5,505	$160.00	$184,000
Grazing Land Protection	acres	416	5.6%	1,438	97	$22.50	$0
Stream Protection	acres	0	-----	0	0	$70.00	$0
Cover Crops	acres	4,372	-----	36,725	2,842	$15.00	$0
Grass Filter Strips	acres	770	-----	8,698	1,071	$185.00	$61,052
Woodland Buffer Filter Area	acres	240	-----	5,484	780	$230.00	$55,200
Forest Harvesting	acres	1,492	100.0%	18,811	227		$0
Animal Waste Control Facilities	systems	5	-----	8,250	1,615		$0
Erosion & Sediment Control	acres	167	100.0%	2,253	1,127		$0
Urban SWM/BMP Retrofits	acres	115	0.9%	284	31		$0
Urban Nutrient Management	acres	139	10.0%	215	19		$0
Septic Pumping	systems	40	-----	9,497	0		$0
Shoreline Erosion Protection	linear feet	33,132	-----	53,102	34,605		$0
Total Pounds Reduced:				474,177	73,066		$499,139
Adjustment for Land Use Changes:				15,904	2,193		
Adjusted Reduction:				458,273	70,872		
Nonpoint Controllable Amount:				1,069,696	105,624		
Percent Reduction:				42.84%	67.10%		

Table 3: **Lower Potomac Region Total Nutrient Reductions**

Based on Increased Coverage Beyond Current & Planned State Programs

	Nitrogen Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
King George	443,673	249,423	99,769	35,041	-14.0%	65,032	-26.1%
Northumberland	465,468	304,227	121,691	91,366	-30.0%	145,380	-47.8%
Westmoreland	822,082	544,509	217,804	137,081	-25.2%	221,724	-40.7%
Lower Potomac	1,731,224	1,098,158	439,263	263,489	-24.0%	432,136	-39.4%

	Phosphorus Load (lbs)			Year 1994 Progress		Year 2000 Projections	
	1985 Load	Controllable	Reduc Goal	lbs Reduc	% Change	lbs Reduc	% Change
King George	29,046	25,721	10,288	9,466	-36.8%	15,801	-61.4%
Northumberland	32,631	29,962	11,985	15,104	-50.4%	23,325	-77.8%
Westmoreland	64,238	59,683	23,873	23,558	-39.5%	33,802	-56.6%
Lower Potomac	125,915	115,366	46,146	48,129	-41.7%	72,928	-63.2%

Consensus Assessment Results

After determination of the relative impact and feasibility of increase in various BMPs, the participants then determined the conditions necessary for the desired increase in activity to occur. The results of this group process constitute the regional assessment, and are discussed in the following paragraphs.

Conservation tillage is the practice of either planting crops into the previous existing land cover without tillage (no-till) or by using tillage implements that leave most crop residue on the soil along with the newly seeded crop (minimum tillage). The regional participants agreed that an increase is feasible in the number of acres employing conservation versus conventional tillage methods from the 1994 figure of 51% (of all potential treatment coverage that could occur for the BMP) to a figure of 70.6% in the year 2000. They also agreed that an increase in this practice would have a high impact in the region, relative to other possible nutrient reduction measures that could be taken. The group went on to note that this goal of 70.6% is feasible on average over the long term, although there could be an occasional growing season when market forces could disrupt the typical two-year, three-crop rotation practices commonly in use in this region. In these years, this level of implementation would not occur.

In addition, over the long term, significant shifts in type of crop production could also impact crop rotation practices. However, group participants believe that recent agricultural indicators point to continued promotion of conservation tillage for the crop production and rotation practices expected for the next several years in this region. Participants expect vegetable farming to increase in the region, and they agreed that promotion and demonstration of no-till methods of vegetable farming would yield significant benefits in nutrient reduction.

Nutrient management is a comprehensive plan that manages the amount, placement, timing and application of animal wastes, fertilizer, sludge and/or residual soil nutrients to minimize nutrient loss potential while maintaining farm productivity. The regional participants agreed that an increase in the number of acres employing nutrient management measures from a 1994 figure of 21% to a figure of 54.5% in the year 2000 is feasible, given certain conditions. Those conditions are that cost-share funds, 50% or better, be provided for nutrient management BMPs such as, but not limited to: tissue testing, split applications of nitrogen (especially on leachable soils), soil testing, cover crops, and use of banding equipment for fertilizer.

In addition, tissue testing requires laboratory analysis methods taking, on average, three days to complete. Therefore, this and the costs associated with testing are viewed as barriers to more wide-spread use of the practice. Research is on-going to develop an inexpensive in-field tissue test, although some experts believe that a practical and relatively accurate field test applicable to Virginia crop production is still a decade away. Meeting participants suggested that the state could provide resources to help promote development of an in-field tissue testing procedure that was accurate for more than one crop.

The regional participants also recommended that methods be devised to more accurately document the number of acres under both voluntary nutrient management and conservation tillage which are not now completely accounted for. They estimated that there may be significant acres in this region which fall into this voluntary category. It was suggested that a grant or other funding source be found to refine the Voluntary BMP Survey to focus on this region. Participants also agreed there was a need to develop a database, in a format which would be useful to the public, of information obtained from water quality monitoring efforts.

The regional participants agreed that since much of the land farmed in the region is rented, there is a need to determine how to better target the farm manager or land user, in addition to the farm owner, for education in nutrient management and other conservation farming techniques. They agreed there is a need to increase the communication and involvement between local governments and the agricultural water quality specialists who develop farm plans in Chesapeake Bay Preservation Areas.

In general, the group believed that the existing use of state and federal resources should be studied to eliminate overlap and to increase productivity and efficiency of delivery to end-users. While there may be a need for increased staffing in this region, two factors make it difficult to say with certainty that additional staff resources will in fact be needed. First, the Nutrient Certification Program established by the Department of Conservation and Recreation is in its infancy, and the effect that private nutrient management consultants may have on nutrient reductions in the region has not yet been established. Second, the Chesapeake Bay Local Assistance Board has given Notice of Intent to consider amending the Chesapeake Bay Preservation Act Designation and Management Regulations to accomplish (among other objectives) more water quality protection practices on the land.

Woodland buffer filter areas, also known as forest buffers, requires creating or restoring a vegetative strip of primarily trees and associated plant material adjacent to a stream or other receiving waters, typically 50 to 150 feet wide, that will filter stormwater runoff of sediment and nutrients before the runoff reaches a receiving water body. The regional participants agreed that establishment of woodland buffer filter areas would have a high impact on nutrient reduction. The group suggested the Department of Game and Inland Fisheries' wildlife management plans and/or other similar programs within the framework of the state's agricultural tax incentive program include establishment of suitable food patches in the buffers to attract deer and other wildlife. Hunters would then pay fees to hunt in these wildlife management zones bordering waterways. The group agreed that provision of cost-share funds or other financial incentive measures would encourage farmers to plant marshlands in millet or other grains attractive to water fowl. The scenario proposes the acreage devoted to woodland buffer filter areas be increased from the zero currently designated as such in 1994 to 240 acres by the year 2000.

The regional participants also agreed that urban nutrient management, modification of lawn fertilizer use by homeowners and others, was a critical component of an effective nutrient reduction strategy in this region, since residential development (particularly waterfront residential) is expected to continue. The group believes that educational efforts such as workshops, recycling efforts, and the master gardener program are valuable approaches, and should be encouraged and funded. The group also supports the idea of requiring, or aggressively promoting, soil testing by commercial lawn care companies before they apply fertilizer to their customers' properties. The group agreed that the media should be used aggressively to educate the public on conservation practices.

Measures which the regional participants judged to have less potential impact include highly erodible land retirement and grass filter strips. Highly erodible land retirement requires taking land out of crop production and/or grazing and planting it with a permanent vegetative cover such as grasses, shrubs and/or trees. The scenario proposes an increase in acreage under the highly erodible land retirement program from 3% in 1994 to 4.8% in the year 2000. Participants stated that the range of 4% to 5% for land retirement would be the maximum possible. Several participants suggested that even where land is already under contract for land retirement, if market crop prices rise enough, some farmers will opt to retire their contracts early to take advantage of the high market prices.

Grass filter strips, also known as grassed buffers, are similar to woodland buffer filter areas except that grasses and/or shrubs are planted rather than trees. Grass filter strips would increase from 332 acres in 1994 to 770 acres by the year 2000 in this scenario. Meeting participants agreed that this increase was possible, but the impact of this measure is low relative to other nutrient reduction measures for this region.

The regional participants agreed that agricultural ponds may function to control stormwater runoff, and that the restoration of funding for their construction should be studied.

Urban stormwater management (SWM/BMP) retrofits require modification of existing stormwater management facilities and/or drainage systems in already developed areas to add or enhance water quality components of the retrofitted facility. The regional participants did not believe a significant increase was feasible in urban SWM/BMP retrofits because of the scarcity of highly urbanized land in the region and the high costs associated with these retrofits.

Planting of cover crops, such as rye, wheat or barley, without fertilizer in the early fall traps leftover nitrogen so it will not runoff or leach into receiving waters. Regional participants do not expect a significant increase in the use of cover crops beyond what is expected under current programs and practices in this region, therefore the scenario assumes no increased nutrient reduction from this practice. Furthermore, some participants expressed concern that the recent decision by the State Cost Share Board to eliminate the small grain cover crop practices from the BMP cost-share program, beginning in 1998, may reduce the practice below existing levels of usage. Participants agreed that cost-share funding for small grain cover crop practices should be retained.

Point Sources

As stated earlier in this document, all reductions shown under this comparable level of effort scenario, beyond those projected under current funding levels of state and federal programs, will be achieved through expansion of nonpoint source best management practices or measures. Therefore, any reductions that may be attributable to potential changes at the WWTPs in this region-Colonial Beach and Dahlgren-could be used to augment those nonpoint source reduction measures shown under this scenario. In any case, future population growth and the associated increased loads from the wastewater treatment plants will require continual upgrades to maintain the cap.

King George County, in accordance with a consent Order from the State Water Control Board, is planning an upgrade and expansion of the Dahlgren wastewater treatment plant. The expansion will be from an existing design flow of 0.325 mgd to 0.5 mgd. The upgrade and expansion will improve current operations and effluent quality. It will also enable the County to accommodate several development projects without the addition of new small treatment plants. The VPDES permit requirements for the expanded facility include a total phosphorus limit of 2.0 mg/l and an ammonia nitrogen limit of 1.35 mg/l.

Presently, the design and plans for the expanded facility are extended aeration mode using concentric rings. This is an enlargement of the current design and operation. DEQ has recommended that the expansion be made such that some denitrification can be achieved. The extended aeration mode should accommodate some denitrification, particularly when the flows are well below the design capacity.

The Dahlgren Naval Surface Warfare Center (DNSWC) STP discharges to Upper Machodoc Creek in King George County. The VPDES permit for the STP was reissued on November 2, 1994. The reissued permit allowed the Navy to continue to operate the existing STP at a design flow of 0.4 mgd and to expand the STP to 0.72 mgd. The new upgraded facility is currently under construction and the expansion is scheduled to be completed by September 1998. The design is for an activated sludge operation with two constructed wetlands acting as polishing units. The upgraded facility should be able to achieve nitrification and some denitrification. The permit requires a monthly average ammonia limit of 6.2 mg/l, no total nitrogen and phosphorus monitoring. The level of denitrification achieved and the extent of total nitrogen loadings will be monitored when the new expanded facility goes on-line.

In January 1995, Colonial Beach upgraded its wastewater facilities by replacing a trickling filter with a 2.0 mgd extended aeration activated sludge system. The new sewage treatment plant must meet limits for ammonia from April through September. Additionally, the treatment plant's current performance indicates that from the standpoint of concentrations and current flow levels, approximately the same treatment level is being achieved as would be achieved with seasonal biological nutrient removal (BNR).

Under the interstate Chesapeake Bay Program, Virginia has been involved in a federally funded technical support study on the use of biological nutrient removal (BNR) at wastewater treatment plants in the Potomac basin. The purpose of the study is to assess the suitability of retrofitting the larger wastewater treatment plants in the basin with BNR. The evaluations will be keyed to maximizing the use of existing plant components rather than relying on substantial new construction and radical process changes. Regional participants agreed it would be desirable for the two municipal wastewater treatment plants, Colonial Beach and Dahlgren, to take part in the study. A Colonial Beach representative has stated that the Town will take part in the study.

Preferred Funding Options

In August, regional participants met with staff from Virginia Polytechnic Institute (VPI) to discuss methods for meeting the costs of nutrient reduction. The discussion was based on a paper, "Financing Virginia's Tributary Strategies, Methods for Meeting the Costs of Nutrient Reduction," under the lead of Dr Leonard Shabman and as contracted by the Department of Conservation and Recreation.

Regional participants were then surveyed to determine the financing methods they believe are the most equitable, cost efficient and practical ways to pay for the nutrient reduction actions to be set forth in the basin-wide Potomac Tributary Strategy. The results of the survey are depicted in Table 4 and respondents' comments are included in Appendix C. In Table 5, the funding mechanisms are ranked in ascending order according to the degree of support or opposition they received from the regional participants. Where two funding mechanisms received support in equal measure, the funding mechanism which more participants "strongly favored" was ranked higher than the one participants simply "favored."

The ranking indicates that regional participants favor a voluntary funding measure, the sale of dedicated license plates, above all other measures. However, all survey respondents favored multiple measures, which indicates an understanding that basin-wide nutrient reduction involves significant costs, not easily funded through one or two methods alone.

The category of dedicated fees and charges received strong support, with sewer and septic system fees, stormwater fees, and impact fees receiving the next highest levels of support after dedicated license plates. The use of a real estate transfer tax was the next most favored mechanism among the participants. All mechanisms listed as options on the survey form received some measure of support, with the exception of a property tax surcharge and the use of income tax receipts. These measures were opposed by a majority of participants. This order of ranking is consistent with the view expressed by many regional participants that the amount of funding contribution should be in proportion to usage, with some contribution from all sources.

Table 4: **Funding Mechanisms Survey Results for Lower Potomac Region**

Funding Mechanism	Ranking			
General Revenues	Strongly Favor	Favor	Oppose	Strongly Oppose
Income Tax Receipts	0	5	5	3
Sales Tax Receipts	4	5	4	0
Property Tax Surcharge	0	3	5	5
Real Estate Transfer Tax	3	8	3	0
Dedicated Fees and Charges	Strongly Favor	Favor	Oppose	Strongly Oppose
Nutrient Discharge Fees	7	2	3	1
Stormwater Fees	5	6	1	1
Impact Fee	4	7	2	0
Water Use Charges	2	5	5	1
Sewer & Septic System Fees	4	8	2	0
Fertilizer Fees	4	6	2	0
Output Fees	3	3	5	1
Selective Corporate Tax	2	7	2	0
Recreational License Fees	4	6	3	1
Recreational Equipment Taxes	3	6	3	1
Voluntary Funding Schemes	Strongly Favor	Favor	Oppose	Strongly Oppose
Dedicated License Plate	5	7	1	0
Lottery	4	5	2	2
Income Tax Checkoff	4	6	3	1

Table 5: **Ranking Order of Funding Mechanisms by Lower Potomac Region**
Mechanisms ranked in ascending order of support and opposition

Funding Mechanism	**Ranking**	
General Revenues	Mechanisms Supported	Mechanisms Opposed
Income Tax Receipts		2
Sales Tax Receipts	8	
Property Tax Surcharge		1
Real Estate Transfer Tax	5	
Dedicated Fees and Charges	Mechanisms Supported	Mechanisms Opposed
Nutrient Discharge Fees	7	
Stormwater Fees	3	
Impact Fee	4	
Water Use Charges	11	
Sewer & Septic System Fees	2	
Fertilizer Fees	6	
Output Fees	Equal number support and oppose	
Selective Corporate Tax	10	
Recreational License Fees	6	
Recreational Equipment Taxes	9	
Voluntary Funding Schemes	Mechanisms Supported	Mechanisms Opposed
Dedicated License Plate	1	
Lottery	8	
Income Tax Checkoff	6	

Appendix A - Nutrient Load Reductions by County
Based on Implementation of Current & Planned State Programs

Table A1: Lower Potomac Region Point Sources

Year 1994 Progress to Date

	1985 Point Load (lbs)		Year 1994 Reported Values (lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
King George	5,692	1,949	11,385	100.0%	931	-52.2%
Northumberland	0	0	0	0.0%	0	0.0%
Westmoreland	22,770	7,793	24,201	6.3%	5,707	-26.8%
Lower Potomac	28,462	9,742	57,494	25.0%	6,638	-31.9%

Year 2000 Projections

	1985 Point Load (lbs)		Year 2000 Estimates (lbs)			
	Nitrogen	Phosphorus	Nitrogen	% Change	Phosphorus	% Change
King George	5,692	1,949	28,462	400.0%	1,522	-21.9%
Northumberland	0	0	0	0.0%	0	0.0%
Westmoreland	22,770	7,793	26,137	14.8%	6,165	-20.9%
Lower Potomac	28,462	9,742	54,599	91.8%	7,687	-21.1%

Table A2: Nonpoint Source Nutrient Reductions for King George County

Based on Implementation of Current & Planned State Programs

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	6,955	57.1%	3,370	304	7,243	58.9%	5,130	462
Farm Plans	acres	10,399	71.4%	11,074	1,939	11,730	80.0%	12,249	2,145
Nutrient Management	acres	3,194	21.9%	9,531	429	6,815	46.5%	20,263	914
Highly Erodible Land Retirement	acres	396	2.0%	4,000	465	400	2.0%	4,051	473
Grazing Land Protection	acres	111	2.1%	383	26	111	2.2%	383	26
Stream Protection	acres	0	-----	0	0	0	-----	0	0
Cover Crops	acres	784	-----	6,588	510	1,217	-----	10,225	791
Grass Filter Strips	acres	56	-----	633	78	56	-----	633	78
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	296	61.0%	3,745	45	486	100.0%	6,140	74
Animal Waste Control Facilities	systems	0	-----	0	0	0	-----	0	0
Erosion & Sediment Control	acres	20	52.0%	184	92	38	100.0%	512	256
Urban SWM/BMP Retrofits	acres	13	0.3%	33	4	39	1.0%	96	11
Urban Nutrient Management	acres	0	0.0%	0	0	47	10.0%	73	7
Septic Pumping	systems	12	-----	1,175	0	12	-----	2,937	0
Shoreline Erosion Protection	linear feet	5,378	-----	8,620	5,617	8,964	-----	14,367	9,362
Total Pounds Reduced:				49,336	9,510			77,058	14,598
Adjustment for Land Use Changes:				8,601	1,062			11,026	1,346
Adjusted Reduction:				40,735	8,448			66,032	13,252
Nonpoint Controllable Amount:				243,731	23,772			243,731	23,772
Percent Reduction:				16.71%	35.54%			27.09%	55.75%

Table A3: Nonpoint Source Nutrient Reductions for Northumberland County

Based on Implementation of Current & Planned State Programs

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	8,169	51.1%	24,583	2,198	9,278	56.7%	31,368	2,808
Farm Plans	acres	14,700	79.3%	17,121	2,998	15,588	83.3%	17,223	3,015
Nutrient Management	acres	5,198	28.0%	16,305	729	6,138	32.8%	19,182	863
Highly Erodible Land Retirement	acres	561	2.8%	6,541	743	565	2.8%	6,592	751
Grazing Land Protection	acres	28	1.9%	97	6	56	4.3%	193	13
Stream Protection	acres	0	-----	0	0	0	-----	0	0
Cover Crops	acres	1,483	-----	12,457	964	2,079	-----	17,467	1,352
Grass Filter Strips	acres	17	-----	192	24	27	-----	307	38
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	223	61.0%	2,815	34	366	100.0%	4,615	56
Animal Waste Control Facilities	systems	1	-----	1,650	323	1	-----	1,650	323
Erosion & Sediment Control	acres	27	52.0%	253	126	52	100.0%	702	351
Urban SWM/BMP Retrofits	acres	9	0.3%	23	3	28	0.9%	69	7
Urban Nutrient Management	acres	0	0.0%	0	0	33	10.0%	52	5
Septic Pumping	systems	10	-----	966	0	10	-----	2,415	0
Shoreline Erosion Protection	linear feet	6,869	-----	11,009	7,174	11,448	-----	18,348	11,957
Total Pounds Reduced:				94,013	15,323			120,184	21,538
Adjustment for Land Use Changes:				2,646	219			8,018	750
Adjusted Reduction:				91,367	15,104			112,166	20,788
Nonpoint Controllable Amount:				304,227	29,962			304,227	29,962
Percent Reduction:				30.03%	50.41%			36.87%	69.38%

Table A4: Nonpoint Source Nutrient Reductions for Westmoreland County

Based on Implementation of Current & Planned State Programs

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	12,218	47.3%	42,156	3,765	13,787	52.6%	51,756	4,628
Farm Plans	acres	24,016	75.7%	27,926	4,895	25,548	79.5%	28,141	4,931
Nutrient Management	acres	5,398	17.0%	16,172	720	10,612	33.0%	31,348	1,405
Highly Erodible Land Retirement	acres	1,397	4.2%	16,642	1,871	1,400	4.2%	16,692	1,879
Grazing Land Protection	acres	72	5.0%	247	17	249	24.8%	861	58
Stream Protection	acres	0	-----	0	0	0	-----	0	0
Cover Crops	acres	237	-----	1,993	154	1,075	-----	9,033	699
Grass Filter Strips	acres	259	-----	2,930	361	357	-----	4,029	496
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	391	61.0%	4,914	59	640	100.0%	8,056	97
Animal Waste Control Facilities	systems	4	-----	6,600	1,292	4	-----	6,600	1,292
Erosion & Sediment Control	acres	40	52.0%	374	187	77	100.0%	1,040	520
Urban SWM/BMP Retrofits	acres	16	0.3%	41	4	48	0.9%	119	13
Urban Nutrient Management	acres	0	0.0%	0	0	58	10.0%	90	8
Septic Pumping	systems	17	-----	1,658	0	17	-----	4,145	0
Shoreline Erosion Protection	linear feet	7,632	-----	12,232	7,971	12,720	-----	20,387	13,286
Total Pounds Reduced:				133,885	21,297			182,297	29,311
Adjustment for Land Use Changes:				(4,626)	(175)			1,368	478
Adjusted Reduction:				138,511	21,472			180,929	28,833
Nonpoint Controllable Amount:				521,739	51,890			521,739	51,890
Percent Reduction:				26.55%	41.38%			34.68%	55.57%

Table A5: Nonpoint Source Nutrient Reductions for Lower Potomac Region

Based on Implementation of Current & Planned State Programs

		Year 1994 Progress		Reductions (lbs/year)		Year 2000 Projection		Reductions (lbs/year)	
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Coverage	Percent	Nitrogen	Phosphorus
Conservation Tillage	acres	27,343	50.7%	70,109	6,267	30,308	55.2%	88,255	7,898
Farm Plans	acres	49,115	75.8%	56,121	9,833	52,866	80.7%	57,613	10,091
Nutrient Management	acres	13,789	21.3%	42,008	1,879	23,565	36.0%	70,793	3,182
Highly Erodible Land Retirement	acres	2,354	3.2%	27,183	3,080	2,365	3.2%	27,335	3,102
Grazing Land Protection	acres	210	2.6%	727	49	416	5.6%	1,438	97
Stream Protection	acres	0	-----	0	0	0	-----	0	0
Cover Crops	acres	2,505	-----	21,039	1,628	4,372	-----	36,725	2,842
Grass Filter Strips	acres	332	-----	3,755	463	440	-----	4,969	612
Woodland Buffer Filter Area	acres	0	-----	0	0	0	-----	0	0
Forest Harvesting	acres	910	61.0%	11,475	138	1,492	100.0%	18,811	227
Animal Waste Control Facilities	systems	5	-----	8,250	1,615	5	-----	8,250	1,615
Erosion & Sediment Control	acres	87	52.0%	811	406	167	100.0%	2,253	1,127
Urban SWM/BMP Retrofits	acres	39	0.3%	97	11	115	0.9%	284	31
Urban Nutrient Management	acres	0	0.0%	0	0	139	10.0%	215	19
Septic Pumping	systems	40	-----	3,799	0	40	-----	9,497	0
Shoreline Erosion Protection	linear feet	19,879	-----	31,861	20,763	33,132	-----	53,102	34,605
Total Pounds Reduced:				277,233	46,131			379,539	65,448
Adjustment for Land Use Changes:				6,621	1,105			20,412	2,574
Adjusted Reduction:				270,612	45,026			359,127	62,874
Nonpoint Controllable Amount:				1,069,696	105,624			1,069,696	105,624
Percent Reduction:				25.30%	42.63%			33.57%	59.53%

Appendix B - Comparable Level of Effort Nutrient Load Reductions by County

Based on Increased Coverage Beyond Current & Planned State Programs

Table B1: Nonpoint Source Nutrient Reductions for King George County

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Percent	Reductions (lbs/year) Nitrogen	Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	8,966	73.0%	13,189	1,186	$21.00	$36,184
Farm Plans	acres	11,730	80.0%	10,212	1,787	$14.50	$0
Nutrient Management	acres	8,431	57.5%	23,918	1,098	$1.75	$2,827
Highly Erodible Land Retirement	acres	850	4.3%	10,590	1,413	$160.00	$72,000
Grazing Land Protection	acres	111	2.2%	383	26	$22.50	$0
Stream Protection	acres	0	-----	0	0	$70.00	$0
Cover Crops	acres	1,217	-----	10,225	791	$15.00	$0
Grass Filter Strips	acres	166	-----	1,876	231	$185.00	$20,350
Woodland Buffer Filter Area	acres	80	-----	1,828	260	$230.00	$18,400
Forest Harvesting	acres	486	100.0%	6,140	74		$0
Animal Waste Control Facilities	systems	0	-----	0	0		$0
Erosion & Sediment Control	acres	38	100.0%	512	256		$0
Urban SWM/BMP Retrofits	acres	39	1.0%	96	11		$0
Urban Nutrient Management	acres	47	10.0%	73	7		$0
Septic Pumping	systems	12	-----	2,937	0		$0
Shoreline Erosion Protection	linear feet	8,964	-----	14,367	9,362		$0
Total Pounds Reduced:				96,345	16,501		$149,761
Adjustment for Urban Growth:				8,542	1,127		
Adjusted Reduction:				87,802	15,374		
Nonpoint Controllable Amount:				243,731	23,772		
Percent Reduction:				36.02%	64.67%		

Table B2: **Nonpoint Source Nutrient Reductions for Northumberland County**

Based on Increased Coverage Beyond Current & Planned State Programs

BMP Treatment	units	Year 2000 Projection Coverage	Year 2000 Projection Percent	Reductions (lbs/year) Nitrogen	Reductions (lbs/year) Phosphorus	Cost per Added Acre Treated	Total Cost for Incr Coverage
Conservation Tillage	acres	11,455	70.0%	42,209	3,782	$21.00	$45,719
Farm Plans	acres	15,588	83.3%	14,546	2,544	$14.50	$0
Nutrient Management	acres	11,234	60.0%	33,596	1,536	$1.75	$8,919
Highly Erodible Land Retirement	acres	915	4.6%	11,677	1,482	$160.00	$56,000
Grazing Land Protection	acres	56	4.3%	193	13	$22.50	$0
Stream Protection	acres	0	-----	0	0	$70.00	$0
Cover Crops	acres	2,079	-----	17,467	1,352	$15.00	$0
Grass Filter Strips	acres	137	-----	1,550	191	$185.00	$20,350
Woodland Buffer Filter Area	acres	80	-----	1,828	260	$230.00	$18,400
Forest Harvesting	acres	366	100.0%	4,615	56		$0
Animal Waste Control Facilities	systems	1	-----	1,650	323		$0
Erosion & Sediment Control	acres	52	100.0%	702	351		$0
Urban SWM/BMP Retrofits	acres	28	0.9%	69	7		$0
Urban Nutrient Management	acres	33	10.0%	52	5		$0
Septic Pumping	systems	10	-----	2,415	0		$0
Shoreline Erosion Protection	linear feet	11,448	-----	18,348	11,957		$0
Total Pounds Reduced:				150,918	23,858		$149,388
Adjustment for Urban Growth:				5,538	534		
Adjusted Reduction:				145,380	23,325		
Nonpoint Controllable Amount:				304,227	29,962		
Percent Reduction:				47.79%	77.85%		

Table B3: **Nonpoint Source Nutrient Reductions for Westmoreland County**

Based on Increased Coverage Beyond Current & Planned State Programs

		Year 2000 Projection		Reductions (lbs/year)		Cost per Added	Total Cost for
BMP Treatment	units	Coverage	Percent	Nitrogen	Phosphorus	Acre Treated	Incr. Coverage
Conservation Tillage	acres	18,343	70.0%	80,094	7,175	$21.00	$95,691
Farm Plans	acres	25,548	79.5%	22,790	3,989	$14.50	$0
Nutrient Management	acres	16,069	50.0%	44,822	2,050	$1.75	$9,549
Highly Erodible Land Retirement	acres	1,750	5.3%	21,778	2,610	$160.00	$56,000
Grazing Land Protection	acres	249	24.8%	861	58	$22.50	$0
Stream Protection	acres	0	-----	0	0	$70.00	$0
Cover Crops	acres	1,075	-----	9,033	699	$15.00	$0
Grass Filter Strips	acres	467	-----	5,272	649	$185.00	$20,350
Woodland Buffer Filter Area	acres	80	-----	1,828	260	$230.00	$18,400
Forest Harvesting	acres	640	100.0%	8,056	97		$0
Animal Waste Control Facilities	systems	4	-----	6,600	1,292		$0
Erosion & Sediment Control	acres	77	100.0%	1,040	520		$0
Urban SWM/BMP Retrofits	acres	48	0.9%	119	13		$0
Urban Nutrient Management	acres	58	10.0%	90	8		$0
Septic Pumping	systems	17	-----	4,145	0		$0
Shoreline Erosion Protection	linear feet	12,720	-----	20,387	13,286		$0
Total Pounds Reduced:				226,914	32,706		$199,990
Adjustment for Urban Growth:				1,824	532		
Adjusted Reduction:				225,091	32,173		
Nonpoint Controllable Amount:				521,739	51,890		
Percent Reduction:				43.14%	62.00%		

Appendix C - Funding Mechanisms Survey Comments by Lower Potomac Region

Respondent #1

- Rather see funding come from voluntary and *especially* dedicated fees and charges--These general revenues would be high in generating funds but would it also mean *added* taxes to the general public; or *reallocate* what we're already paying now? Then this would be more favorable.

- This (Dedicated Fees and Charges) is where the money should come from to apply BMPs.

- (Voluntary Funding Schemes) Specifically *new* monies, not dumped into general fund and then reallocated, so we're not getting new money added to what was previously designated.

Respondent #2

- The income tax is very unfair because it punishes the salaried worker. I strongly recommend the lottery or an increase in the sales tax!

Respondent #3

- (Dedicated license plate) already being done.

Respondent #4

- Nutrient discharge fees will be nearly impossible to administer. Fertilizer fees should also include homeowner-grades through the companies that sell it.

Respondent #5

- Because Potomac is first phase of overall tributaries reduction--these taxes would/could continue to increase as each tributary is brought into program--watershed tax zones could be created but would be difficult to administer. Therefore, without knowing cost of full program--and we won't for years--it will be hard to say how (much) final taxes the program will need and people will be required to pay.

- (Dedicated Fees and Charges) These types of taxes seem to be more easily directed at those who are impacting quality of water.
- (Recreational License Fees and Recreational Equipment Taxes) Why tax those that enjoy the resource versus those who impact water quality.

- (Voluntary Funding Schemes) Any more of these?

Respondent #6

- You must tax users first; all Virginians same (some ?); locals advising on committee.

Respondent #7

- Keep it simple. These resources are part of the common wealth and everyone has some level of responsibility to contribute.

- (Sewer and Septic System Fees and Fertilizer Fees) Put a segment of the responsibility on the major users of the resource.

- (Nutrient Discharge Fees) Costly monitoring?

- (Dedicated License Plate) Could make the best use of these funds from a voluntary basis to address the major basin problems. I have a Bay plate and this is where I would like my contribution to go.

Respondent #8

- Funding should be in proportion to usage with some contribution from all sources.

Respondent #9

- (Real Estate Transfer Tax) Have an exception for up to one transfer every 8 or 10 years--average length of home ownership.

- (Fertilizer Fees) May be high generally but relax on farmers.

Appendix D - List of Participants

Local Governments

Town of Colonial Beach
Martin Long, Town Manager
Wendy Lytle, Lab Technician
Cal Taylor, WWTP Operator

King George County
Mary Ann Cameron, Planning Commission
Jack Green, Land Use Administrator
Charles Sakowicz,
Director of Community Development

Northumberland County
John E. Burton, County Administrator
Kenneth Eades, Assistant County Administrator
Daniel W. Pritchard,
Chairman, Board of Supervisors
A. Joseph Self, Board of Supervisors

Westmoreland County
Steven C. Gunnells, Planning Director
W.W. Hynson,
Vice-Chairman, Board of Supervisors
William O. Sydnor,
Chairman, Board of Supervisors
Charles Thomas, Planning Commission
Robert J. Wittman, Board of Supervisors

Planning District Commissions

Northern Neck PDC
Joyce Bradford, Executive Director
Stuart McKenzie, Environmental Planner
Josie Wold, Wetlands Engineer

RADCO PDC
Sandra Rives, Planner

Soil and Water Conservation Districts

Northern Neck
Nicholas P. Ptucha, District Director
Wellington H. Shirley, Jr., District Manager

Tri-County/City
George F. Beals, Chairman
Bobby B. Crisp, Vice-Chairman
Jean Fraysse, Director
L. James Gibbs, Director

Legislators

W. Tayloe Murphy, Jr., House of Delegates

Citizens Groups

Chesapeake Bay Commission
Russell W. Baxter, Executive Director

Chesapeake Bay Foundation
Kim Coble, Virginia Senior Scientist
Estie Thomas, Natural Resources Planner

Federal Agencies

Ron Wisniewski,
Natural Resources Conservation Service

State Agencies

Team Leader
Margaret H. Reynolds,
Chesapeake Bay Local Assistance Department

Resource Team
J.R. Bell,
Department of Environmental Quality
Wayne Davis,
Department of Conservation and Recreation
Tom Faha,
Department of Environmental Quality
Darryl Glover,
Chesapeake Bay Local Assistance Department
Ken Harper,
Department of Conservation and Recreation
Sam Johnson,
Virginia Cooperative Extension Office

Resource Team (continued)

John M. Kennedy,
Department of Environmental Quality
Kathleen W. Lawrence,
Department of Conservation and Recreation
Diane M. McCarthy,
Department of Conservation and Recreation
Terry Moss,
Department of Conservation and Recreation
Michael P. Murphy,
Department of Environmental Quality
Alan E. Pollock,
Department of Environmental Quality
Leonard A. Shabman,
Virginia Polytechnic Institute and State University

Potomac Basins Tributary Strategies Tracking

Lower Potomac Meetings

Inv	Affiliation	Name	Title	18-Mar	6-May	17-Jun	26-Aug
	Local Governments						
x	Colonial Beach, Town of	C. Wayne Kennedy	Mayor				
	Colonial Beach, Town of	Martin Long	Town Manager		x		
	Colonial Beach WWTP	Wendy Lytle			x		
	Colonial Beach WWTP	Cal Taylor	Operator		x	x	x
	King George County	Mary Ann Cameron	Planning Commission/RADCO	x	x		
	King George County	Jack Green	Land Use Administrator		x	x	x
x	King George County	Joseph W. Grzelka	Chairman, Board of Supervisors				
	King George County	Charles A. Sakowicz	Director, Community Development	x	x	x	
	Northumberland County	John E. Burton	Administrator	x	x	x	
	Northumberland County	Kenneth Eades	Zoning Administrator	x	x	x	x
x	Northumberland County	Daniel W. Pritchard	Chairman, Board of Supervisors	x			
	Northumberland County	A. Joseph Self	Board of Supervisors	x			
	Westmoreland County	Steven C. Gunnells	Planning Director		x	x	x
x	Westmoreland County	William O. Sydnor	Chairman, Board of Supervisors	x			
	Westmoreland County	Robert J. Wittman	Member, Board of Supervisors		x	x	
	Westmoreland County Board of Supervisors	W. W. Hynson	Vice Chairman	x	x	x	x
	Westmoreland County Planning Commission	Charles Thomas	Member		x	x	x
	Soil and Water Conservation Districts						
x	Northern Neck SWCD	W. H. Dawson	Chairman				
	Northern Neck SWCD	Nicholas P. Ptucha		x	x		x
	Northern Neck SWCD	Wellington H. Shirley	District Manager		x		
x	Tri-County/City SWCD	George F. Beals	Chairman	x	x	x	
	Tri-County/City SWCD	Bobby B. Crisp	Vice Chairman	x	x	x	x
	Tri-County/City SWCD	Jean Fraysse		x	x		x
	Tri-County/City SWCD	L. James Gibbs		x			
	PDCs and Other Regional						
	Northern Neck PDC	Joyce Bradford	Executive Director	x	x		
	Northern Neck PDC	Stuart McKenzie	Planner			x	x
	Northern Neck PDC	Josie Wold	Engineer	x	x	x	
	RADCO	Sandra Rives-Swope	Planner	x	x	x	

Prepared by DEQ 10/2/96

Potomac Basins Tributary Strategies Tracking

Lower Potomac Meetings

Inv	Affiliation	Name	Title	18-Mar	6-May	17-Jun	26-Aug
Legislators							
x	Va House of Delegates	W. Tayloe Murphy	Delegate	x			
x	Va House of Delegates	William J. Howell	Delegate				
x	Va Senate	John Chichester	Senator				
x	Va Senate	Kevin Miller	Senator				
State and Federal Agencies							
	VA Cooperative Extension Office	Sam Johnson		x	x	x	x
	VA Chesapeake Bay Local Assistance Dept.	Darryl M. Glover			x	x	x
	VA Chesapeake Bay Local Assistance Dept.	Margie Reynolds	Lower Potomac Team Leader	x	x	x	x
	VA Dept.of Conservation & Recreation	Kathleen W. Lawrence	Director	x			
	VA Dept.of Conservation & Recreation	Wayne Davis	Field Operations Manager	x	x	x	x
	VA Dept.of Conservation & Recreation	Ken Harper		x			
	VA Dept.of Conservation & Recreation	Terry Moss		x		x	x
	VA Dept.of Conservation & Recreation	Diane McCarthy			x	x	x
	VA Dept of Environmental Quality	John M. Kennedy				x	
	VA Dept of Environmental Quality	Alan E. Pollock		x			
	VA Dept of Environmental Quality	J. R. Bell		x	x	x	x
	VA Dept of Environmental Quality	Thomas A. Faha	Env. Engineer Consultant		x		x
	VA JLARC	Mr. Steve Ford					x
	NRCS - Fredericksburg	Ron Wisniewski		x	x		x
Citizen and Business Groups							
	Chesapeake Bay Commission	Russell W. Baxter	Virginia Director	x	x		x
	Chesapeake Bay Foundation	Kim Coble		x			
	Chesapeake Bay Foundation	Estle Thomas			x		x
	Recycling Markets Development Council	Michael P. Murphy		x			
	STAC	Prof. Leonard Shabman	Representative				x