Baywide Nutrient Reduction Strategy Progress Report

Chesapeake Bay Program

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1989 ANNUAL PROGRESS REPORT
BAYWIDE NUTRIENT REDUCTION STRATEGY

CHESAPEAKE BAY PROGRAM

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NPS Subcommittee
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Summary

This first progress report under the 1988 Baywide Nutrient Reduction Strategy describes implementation progress and analytic refinements promised in the original strategy. The Nonpoint Source Subcommittee NPS Nutrient Reduction Task Force has developed a range of NPS land use loading factors which will be utilized in the recalibration of the Watershed Model. The Task Force will continue work with the modeling program to develop methodology for load reduction estimations resulting from BMP installations. Utilizing the Watershed Model to consolidate jurisdictional information into a consistent report will provide the final results by August 1990 whichwill enhance the capability of responding to issues in the 1991 reevaluation process. Land use information developed for the Watershed Model provides the location of major NPS nutrient sources. The Task Force will continue to evaluate the location and extent of other NPS sources, such as groundwater, shoreline erosion, on-lot treatment systems and atmospheric loads. Information from the Section 319 NPS assessment documents will provide additional information on the origins of NPS loads.

Information on the progress of BMP installation for cropland erosion and animal waste management is summarized for the Chesapeake Bay Basin along with point source progress. Progress is being made at an annual rate greater than that projected in the Baywide Nutrient Reduction Strategy.

The Task Force reviewed NPS monitoring station information and focused on NPS monitoring activities. Each state has an individualized NPS monitoring program which is summarized in the text. It is clear that additional monitoring data is needed to realize the full potential of the various models used in the NPS control programs, while the need continues to establish a uniform NPS monitoring protocol throughout the basin.

Introduction

In 1988, the Water Quality Task Group developed the Basinwide Nutrient Reduction Strategy. The strategy describes state point and nonpoint source (NPS) programs designed to meet the agreement goal of reducing nutrient loads entering the Bay by 40% by the year 2000. Based on 1985 "baseline" loadings to the Bay of nitrogen and phosphorus, the Task Group established interim load reductions goals for both nutrients between now and 2000. To achieve these goals, the states are implementing a variety of actions and programs. The nutrient reduction strategy, however, is not static and calls for annual progress reports and a reevaluation of the strategy in 1991.

The strategy needed additional information and more consistent base line data. After identifying the need to fill this gap, the Task Group called for annual reports to detail the progress, gather supplementary data and resolve consistency problems. These progress reports by the jurisdictions, therefore, will:

1) Provide information on the point and nonpoint source management programs and document progress toward the year 2000 target;

2) Report on new information that fills in the gaps identified during the strategy development; and,

3) Incorporate any necessary adjustments to the approaches outlined in the basinwide strategy.

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During the process of developing the Baywide Nutrient Reduction Strategy, the Task Group identified key areas where the jurisdictions need to arrive at a common means of organizing and using existing information and data and areas where additional information is needed.

The Task Group identified a lengthy list of issues requiring resolution prior to the completion of the 1991 reevaluation process. The full list of issues is contained in Table 4-1 of the Basinwide Nutrient Reduction Strategy, July 1988.

Most of the baywide milestones identified in the strategy dealt with nonpoint sources. The Nonpoint Source Subcommittee, therefore, was given the lead to prepare the annual progress reports called for in the strategy. The Nonpoint Source Subcommittee formed a NPS Nutrient Reduction Task Force to address specific issues set forth in the development of NPS data for the Watershed Model and to prepare the annual progress reports required by the strategy.

NPS Loads and the Watershed Model

During development of the Baywide Nutrient Reduction Strategy, the jurisdictions found that they each were using different data sets, dissimilar methodologies to calculate loads from land uses and a variety of land use combinations to describe NPS loads. Some jurisdictions made transport calculations and assumptions while others did not. These differences led to the inclusion of requests for information needs and annual reports to track the progress to resolve the disparities.

The Watershed Model calibration process also requires similar data and information . Since the Watershed Model is the most reliable way to estimate NPS loads, the Task Force decided to use the model to locate and quantify these loads for the basin. To assure the model would accurately simulate the loads, the Task Force and Chesapeake Bay Liaison Office staff have provided most of the critical input into the model, such as land use, load factor ranges and point source data. They are also involved in the initial calibration process and will provide much of the additional information for model completion. Involvement with the model assures the Task Force of consistent, reliable NPS information for the basin. By using the model, the data will be reported in a consistent format that can be compared among and within sub-basins throughout the watershed.

This annual report provides the reader with the status of the progress to resolve the 1989 issues outlined below. The report discusses progress of point and nonpoint nutrient reductions within the basin and summarizes the modeling process and its importance in addressing the issues leading to the 1991 reevaluation.

Issues not fully resolved in this report will be subject to continuing Task Force refinement which they will document in the 1990 annual report.

Steps Toward Refining the Nutrient Strategy
Baywide Milestones for 1989

- Continue development of consistent baseline data (both fall line and basinwide).

- Develop consistent methodologies for estimating loads and/or load delivery calculations for:
  - point sources, including projected increases;
  - cropland and pastureland;
  - nutrient management impacts;
  - transport conversions;
  - animal waste production and storage; and,
  - developed land uses.

- Survey and locate to the extent possible all significant nutrient sources in the Bay basin, both point source and nonpoint source (including agriculture, urban, forest and shoreline erosion), and identify actions needed to improve the resolution and accuracy of our estimates.

- Identify and evaluate the necessity of new and expanded monitoring programs, for example:
  - upland watersheds;
  - nonpoint source loads below the fall line;
  - edge of field;
  - point source nutrients;
  - atmospheric inputs; and,
  - shoreline erosion.

- Develop consistent accounting for loads delivered via groundwater flows.

- Develop consistent approaches for defining controllable and uncontrollable nonpoint source components.

- Identify informational and other needs to be addressed by the Nonpoint and Living Resources subcommittees as well as other work groups.

- Evaluate the effectiveness and feasibility of application of biological nutrient removal (BNR) at plants throughout the Basin.

- Develop specific point and nonpoint source implementation plans for each state.

Section 1
Modeling Progress

To better quantify NPS loads and the effect of all loads on the Bay, the Chesapeake Bay Program, beginning with the research phase in 1978, has placed high priority on the development of drainage basin and tidal mainstem models of the Bay. The modeling effort originated with development of the Watershed Model during the research phase. The Watershed Model simulates streamflow and point and nonpoint source nutrient loads over the entire Bay drainage basin, an area of 64,000 square miles.

The Chesapeake Bay Liaison Office (CBLO) decided to upgrade the original Watershed Model in steps starting with the inclusion of winter conditions, additional land uses, 1985 land use as a base, revised loading factors and calibration to the years 1984 and 1985. Phased refinements provide a framework for continued improvement. The framework allows response to specific concerns and issues regarding predicted NPS loadings, ensures sensitivity to varied and changing land uses and management practices and permits refinements to model representation of NPS processes. The initial calibration will be completed in November 1989 with additional modification by August 1990.

Variable hydrologic impacts from land uses, the assessment of animal waste contributions and snowmelt simulation are required improvements to the model to adequately represent NPS processes. With refined NPS parameters and updated data files, the Watershed Model will be calibrated for the 1984-1985 period to closely match observed data The enhanced model will also be applied to the 1974-78 period to test its representation of these earlier periods.

Figure 1.

Flowchart of the Modeling Process

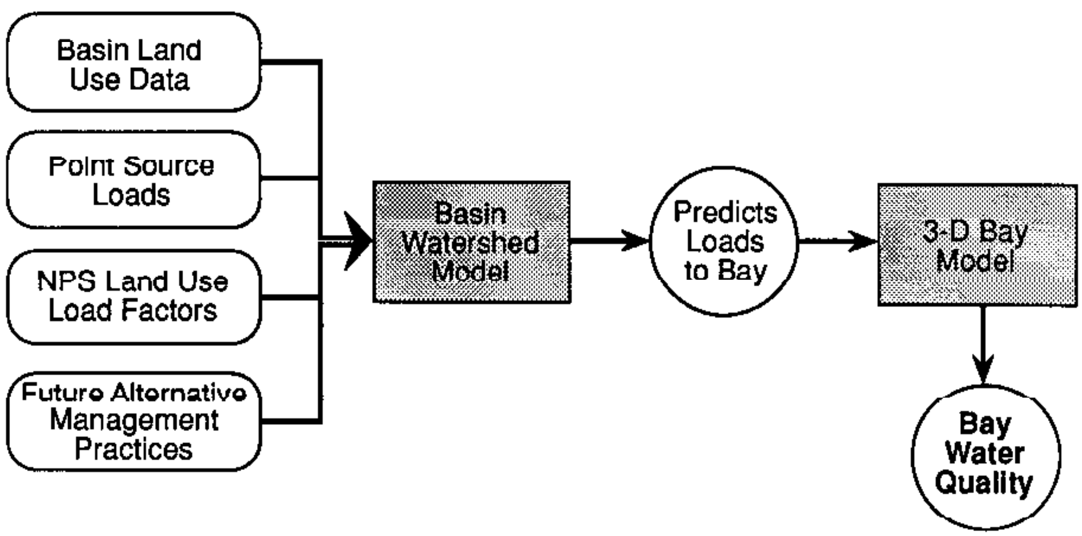


Figure 1. *The flow diagram depicts the basic data needs of the Watershed Model and the process leading to simulation of Bay water quality. Managers will use this linkage of the models to evaluate various management alternatives for the 1991 reevaluation.*

Nutrients associated with sediments are a significant means of nutrient input to the Bay. By August 1990, the model will partition the total nutrient load into sorbed (nutrients bound to soil particles) and dissolved components. This partitioning will be used in the stream simulation to evaluate the impact of settling and other attenuation processes on predicted fall line loadings.

Successful completion and operation of the revised Watershed Model and the 3-D model are the key elements on which the 1991 reevaluation of the Nutrient Reduction strategy will be based. Figure 1 shows a schematic representation of the modeling process.

Section 2
Consistent Methodologies for Load and Delivery Calculations

The Task Force coordinated the jurisdictions' NPS load documentation efforts with the Watershed Model thereby assuring progress toward the development of consistent methodologies and the realistic application of NPS information. This information is being used in the Watershed Model which will generate consistent NPS loads for the basin.

The consistency and accuracy of the Watershed Model NPS loads is extremely important to the Task Force, since these loads drive the 3-D model of the Chesapeake Bay. The 3-D model, in turn, will simulate the outcome of nutrient reduction strategies/programs in the estuary. NPS loading data generated by the watershed model will aid the jurisdictions and CBLO in reporting annual NPS abatement progress. Both models are recognized as valuable management tools.

The strategy originally defined a large portion of baseflow, all forest sources, air deposition and cropland not needing treatment as uncontrollable sources. The Task Force decided the controllable and uncontrollable categories of NPS should be revisited and redefined if necessary. As a result of this effort, the Task Force has established consistent baseline nutrient sources by redefining all NPS sources as the following categories: cropland; cropland with manure/sludge; pasture; pasture with manure/sludge; animal waste—barnyard/feedlot/loafing areas; forest; urban; on-site wastewater treatment (septic systems); and, estuarine shoreline erosion. The Task Force selected these categories to reflect both quantitative nitrogen and phosphorus categories and sources manageable under NPS programs. They include all land-based nutrient sources, regardless of the nutrient species or pathways. The loads from these source categories include all solid, sediment-associated and soluble forms of nitrogen and phosphorus found in surface and groundwater, and are tentatively considered "controllable."

The definition of source categories may change pending further information on groundwater flows, atmospheric loads, and nutrient management BMP impact on surface and groundwaters. Recent data from the Toxic Release Inventory indicates that atmospheric deposition may be a major uncontrolled source of nitrogen to the Bay. All of these factors will be considered as we continue to refine the Watershed Model.

During Watershed Model calibration, the Task Force has worked closely with both the watershed modeling contractor, Aqua Terra, and the Modeling Subcommittee to develop annual load ranges within which the model should calibrate. Table 1 compiles many sources of NPS data to obtain sediment and nutrient ranges for the land uses in the basin. The load ranges assure that the model closely represents observations from a wide range of field studies. In all cases, due to the nature of monitoring programs and studies, the NPS loading data includes atmospheric deposition. The hydrodynamic portion of the Watershed

Model will be run for the calibration years as well as an average year rather than projecting best case or worst case scenarios as the original model did.With completion of the Phase I model calibration approaching, the Task Force will continue to assure the accuracy of data for the model refinements. This process is scheduled for completion in the fall of 1990. During this time the Task Force will work with the modelers and CBLO to obtain BMP effectiveness data for the reduction of erosion and sediment discharges and changes in N and P movement in both surface and groundwaters, assuring that the model will reflect these changes in the scenario runs.

Table 1 Watershed Model Losading Factor Ranges by Land Uses

Land Use	NH3-N	NO3-N	Total N	PO4-P	Total-P	BOD	Sediment
Forest	0.13-0.20	0.45-3.6	0.09-11.6	0.01-0.14	0.01-0.80	6.1-25.45	50-1000
Pasture	0.09-0.62	0.62-1.25	1.34-7.60	----	0.07-4.1	9.2-48.06	200-2000
Urban	0.53-3.12	0.20-6.85	1.20-24.03	0.26-1.51	0.23-11.00	4.0-124.0	100-2000
Cropland High-Till	0.58-?	0.39-?	0.60-7.90	0.24-0.37	0.21-0.37	----	200-2000
Cropland Low-Till	----	----	4.4-36.2	0.46-?	0.07-6.4	----	200-2000
Manure Acres	50-1500	17-290	80-3000	22-1100	18-720	30-2000	NA

* Table references located at end of report.

Section 3
Nutrient Sources

Nonpoint Sources

The Baywide Nutrient Reduction Strategy also charges the NPS Task Force to "survey and locate to the extent possible all significant nutrient sources in the Bay basin." The principle means of surveying NPS nutrient sources is through model simulation of NPS loads from different land uses. The amount and location of each land type are critical elements of both the Watershed Model and the control programs operating in all jurisdictions. Each jurisdiction now has additional NPS water quality documentation contained in a NPS Assessment Report in accordance with Section 319 of the 1987 Clean Water Act.

CBLO utilized several sources of county level land use information throughout the basin. The Census Bureau supplied agricultural land use data and the U.S. Forest Service provided state forestry surveys. The resulting preliminary 1978 land use data set was sent to the state offices of the USDA Soil Conservation Service (SCS) for revision, verification and confirmation of the data. The data set had four categories of land use on a county by county basis: cropland, pasture, woodland/forest and urban.

The revised 1978 land use data set was updated to obtain a 1985 land use data set. State offices of the SCS updated land use from the 1978 values to 1985 figures except in Pennsylvania where the Bureau of Soil and Water Conservation updated the data. In both cases, the offices used the same four categories.

The Watershed Model requires further definition of the cropland data by dividing them into low-till and hi-till categories. Figures were derived for the 1978 data using estimates sent by the SCS to the No-till Farmer magazine. The model uses the following percentage of conservation tillage in each state for 1978: Delaware 41%, Maryland 33%, New York 5%, Pennsylvania 17%, Virginia 28% and West Virginia 37%.

The Conservation Technology Information Center data provided the same information for the 1985 land use on a county level. CBLO processed the data to eliminate any duplication of acres due to double cropping and calculated the percent of cropland under conservation tillage for each county.

During the Phase I recalibration of the Watershed Model, the necessity for water acres accounting became evident. The USGS Land Use/Land Cover provided the information for all areas except New York. The 1982 USDA/SCS National Resources Inventory (NRI) supplied the New York water acres.

The original Watershed Model did not address the potential nutrient loads going into streams or the Bay from animal waste. The addition of a manure acres category, which were partitioned from the pasture acres, will allow the model to simulate animal concentrations within a segment. As farmers install animal waste BMPs, these acres will revert back to pasture acres for modeling purposes. This practice allows the model to account for animal waste storage and runoff control practices and reveal changes.

The Chesapeake Bay Liaison Office (CBLO) has compiled data for 1978 and 1985 (Table 2) to supply uniform land use data for the Watershed Model.

Table 2 Revised Land Use Totals for the Watershed Model

Year	Cropland Low Till	Cropland High Till	Pasture	Forest	Urban	Water	Manure
				acres			
1978	1,838,454	6,092,969	3,716,515	25,272,092	3,688,227	526,111	0
1985	3,988,502	4,248,889	3,739,158	24,457,144	4,160,082	526,115	14,473

New source categories that will be included to refine NPS loading numbers are: construction sites (under the urban category), on-site wastewater treatment concentrations, zones of significant shoreline erosion. NPS loading values for these three categories are not yet complete. As the Watershed Model produces loads, the results will be reported by source of pollutant, including atmospheric deposition.

Unfortunately, no quantitative data has been found to adequately characterize basinwide groundwater-delivered loads. Virginia will initiate a small study in the coming year to collect some of these data. The work by USGS addresses some elements of this question on the Delmarva peninsula. The Susquehanna River Basin Commission, the Interstate Commission on the Potomac River Basin, the Maryland Department of the Environment and the USGS in Pennsylvania and Maryland have ongoing monitoring programs which give insight into groundwater loads through base flow, tile drain and well monitoring. The agencies must complete sampling, analyze the data and integrate surface nutrient data before the results are clear. Groundwater loads, along with their location and associated land use, will be intensively studied in the next year to further refine the groundwater component of the model.

Point Sources

CBLO compiled point source nutrient loads from the Permit Compliance System (PCS) Discharge Monitoring Report data for the Bay states to complete the loading data needs for the Watershed Model. CBLO preferentially used PCS data for the monthly loadings in the model and used state data whenever PCS was not available. Data extracted from the CBLO Point Source Atlas provided information when no other data was available.

Section 4
Effectiveness of Biological Nutrient Removal throughout the Basin

Biological Nutrient Removal (BNR), which utilizes improved management of biological processes in wastewater treatment technology, has indicated that nitrogen and phosphorus control may be achieved at a lower cost than conventional nutrient removal technologies. There are, however, a limited number of plants with sufficient operating history to elucidate potential cost savings, treatment effectiveness and the reliability of BNR systems. To address these concerns, EPA and the states of Maryland and Virginia conducted studies and initiated BNR demonstration projects to assess the effectiveness and cost of BNR and other technologies to control point source nutrient discharges.

An EPA report entitled "Assessment of Cost and Effectiveness of Biological Dual Nutrient Removal Technologies in the Chesapeake Bay Drainage Basin" provides a basis for estimating costs for retrofitting and operating existing municipal treatment plants in the Bay drainage basin with BNR. This report evaluated the design, performance and costs of three BNR processes (Bardenpho, A2O and UCT) assessing two levels of effluent treatment; an effluent phosphorus concentration of 2.0 mg/l and nitrogen concentration of 8.0 mg/l; and, an effluent phosphorus concentration of 0.5 mg/l and nitrogen concentrations of 3.0 mg/l.

The report concluded that all three processes are capable of meeting a phosphorus concentration of 2.0 mg/l and a nitrogen concentration of 8.0 mg/l on a long-term basis. Only Bardenpho, with continuous chemical dosing to precipitate phosphorus and effluent filtration to remove fine solids (with associated phosphorus and nitrogen), is capable of meeting an effluent phosphorus concentration of 0.5 mg/l and nitrogen concentration of 3.0 mg/l. All three processes consistently achieved the nitrogen effluent levels only during warm weather months due to the difficulty of maintaining nitrification during colder weather.

BNR demonstration projects in Maryland have provided important information about treatment effectiveness during warm and cold weather and costs to retrofit and operate plants with BNR. The projects have also provided information on BNR design to make recommendations on the feasibility and applicability of different BNR processes.

The demonstration projects have achieved average total phosphorus effluent concentrations ranging from < 0.7 to 1 mg/l and average total nitrogen effluent concentrations from 2.0 to 7 mg/l. At one location, the plant reduced nutrient and BOD5 effluent concentrations without the usual increase in energy costs and even slightly reduced these costs.

Research scientists are arranging seminars and workshops with the Maryland Center for Environmental Training to inform engineers, regulatory personnel and STP staff of the project results.

Maryland Department of the Environment (MDE) produced the "Biological Nutrient Removal Study" which provides Maryland with information on the capability and cost-effectiveness of modifying 24 municipal STPs to remove phosphorus and nitrogen biologically. In the study, MDE evaluated each plant to determine the best practical method for adding BNR to the existing treatment process. Along with the methodology evaluation, MDE also provided preliminary cost estimates for modifications.

Virginia has also conducted demonstrations at several locations. The State Water Control Board hired a consultant to evaluate different levels of nutrient removal at 26 Virginia POTWs. The report, scheduled for completion in October 1989 will assist municipal owners and state and federal agencies in assessing the cost of a point source nutrient reduction program for the Chesapeake Bay watershed. The report will appraise BNR and other technologies.

The District of Columbia has undertaken a feasibility study of alternative nitrogen removal systems at the Blue Plains STP. The study is examining the effectiveness of various nitrogen removal systems including BNR and its resultant impact on Bay water quality.

Section 5

Nutrient Reduction Progress, Point and Nonpoint Sources

NPS Reduction

The Chesapeake Bay NPS programs have traced agricultural NPS progress since 1985 under a BMP tracking requirement in the implementation grants. This process was refined in the "Chesapeake Bay Nonpoint Source Programs" report published in January 1988. Using 1985 as the base year, the publication reported NPS progress for 1985 and 1986 by tracking the installation of BMPs and the resultant reductions in erosion and stored animal waste.

CBLO developed base year data using 1982 information from the USDA/SCS NRI to calculate the amount of erosion from cropland needing treatment. These data were standardized to base year 1985 by removing the acres treated under the USDA programs and state programs in 1983 and 1984. Using animal numbers from the Bureau of Census/Agricultural Census, CBLO adjusted the data to obtain storable tons of manure. These two sources were considered potential NPS loads and are reduced by each BMP installed. There has been no attempt to numerically transport these potential loads from the fields to the Bay, since the reductions for each BMP are at the field and can be subtracted directly from the potential source.

For accounting purposes, the tracking system does not count a BMP until it is certified as complete with the cost share paid and removes BMPs when the contract life has expired. This practice ensures that the system counts only properly constructed and functioning BMPs. At a minimum, the states supply the following information for each BMP: location of the BMP by county and watershed; BMP type (either the SCS practice code or a state practice code); acres benefitted (total land area protected by the BMP); tons removed (the amount of soil that no longer erodes from the acres benefitted); tons of animal waste stored; total cost of the BMP; cost share funds paid for the BMP; and, other cost share funds.

CBLO annually obtains and processes USDA Agricultural Conservation Program BMP installation information to compile tracking information for the Bay portion of each state and county. The office combines these data with the state Chesapeake Bay Program data and use them to develop reduction percentages for stored animal waste and tons of erosion reduced from highly erodible cropland. Efforts are now underway to acquire additional data showing reductions achieved for BMP installed without cost share assistance. The states and SCS are setting up a system to transfer SCS progress reporting data to the states for inclusion in the tracking system.

During development of the NPS portion of the Baywide Nutrient Reduction Strategy, each state used different methods to estimate load reductions. Each also used different NPS land use categories, making it difficult to calculate NPS reductions without tracking information for each land use. By using nutrient values for a ton each of soil and animal waste, the values may be added and related to each state's agricultural source loads. Since the calculated nutrients are those associated with the soil, the system is more efficient in tracking phosphorus reduction. As the states implement more nutrient management plans, the potential for reduction of soluble nutrients, such as nitrogen, will increase greatly.

Figure 2 and 3 show the nutrient reduction progress being made by the two agricultural assitance programs within the basin. They also indicate the basinwide Nutrient Reduction Strategy Phase I, II and III reduction goals for NPS through the year 2000.

Point Source Reduction

CBLO also tracks point sources throughout the basin; the results indicate that projections made for the strategy are holding true for nitrogen and are decreasing at a greater rate than expected for phosphorus. The Phase I nitrogen load increased as predicted. Nitrogen increased because the only Phase I nitrogen control action scheduled was its removal at Virginia's York and Maryland's Dorsey Run STPs. Maryland is conducting nitrogen removal demonstration projects at Maryland City and Bowie STPs and both states are conducting site-specific engineering studies to determine which municipal treatment plants are best suited for nitrogen removal.

The Phase I phosphorus load decreased substantially more than projected due to implementation of phosphorus bans in Maryland, Virginia and the District of Columbia. Figures 4 and 5 show the current status for point sources. Average annual projected loads

Figure 2

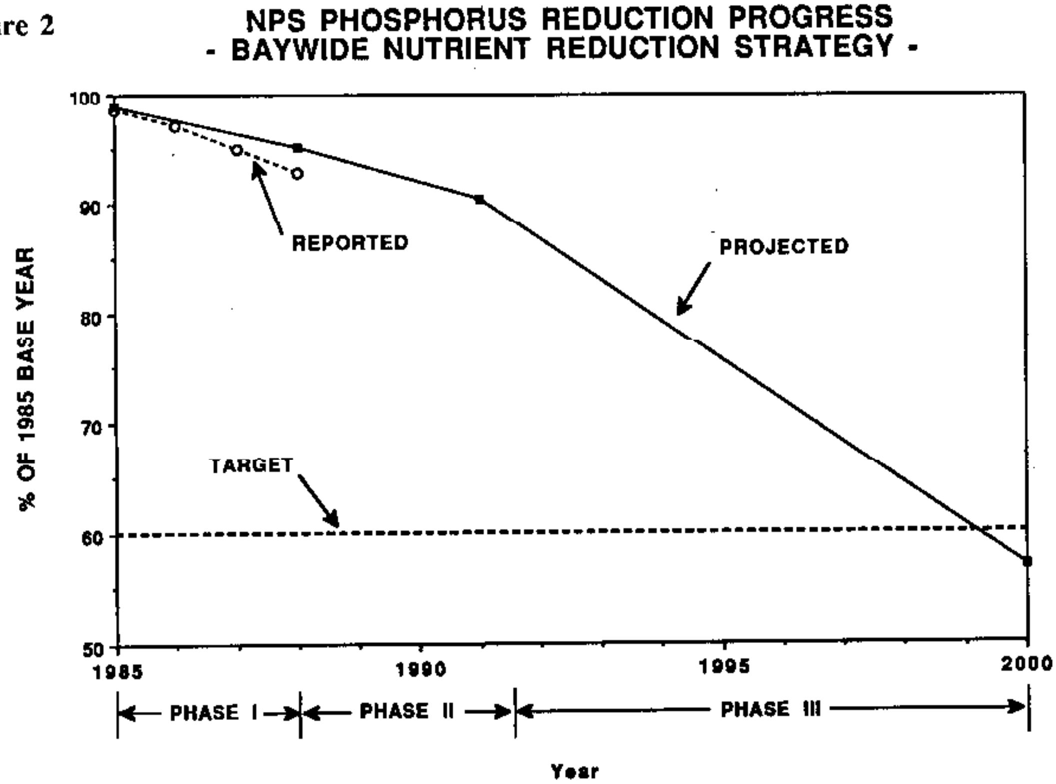


Figure 3

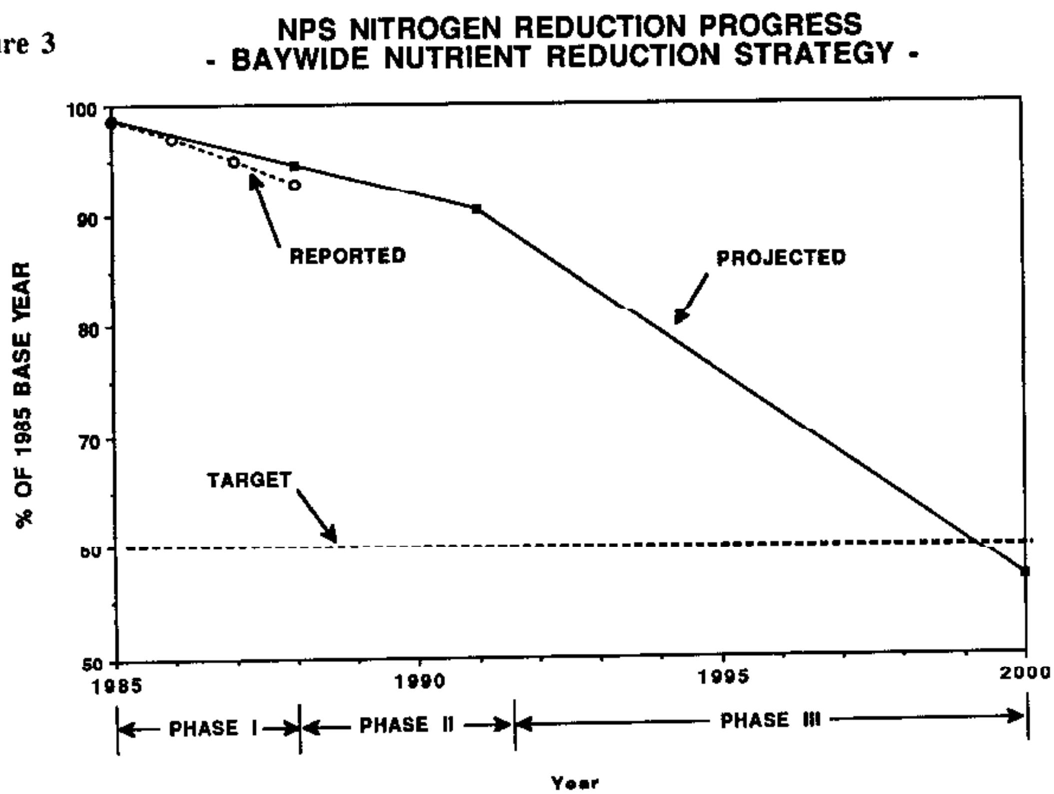


Figure 4

POINT SOURCE PHOSPHORUS LOADS IN BAYWIDE NUTRIENT REDUCTION STRAGTEGY

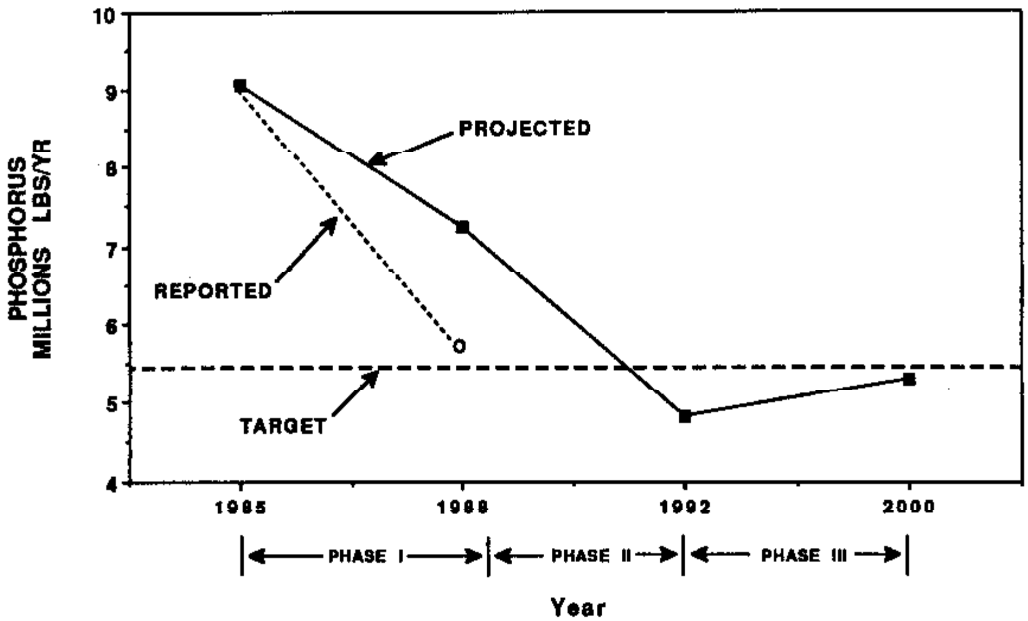
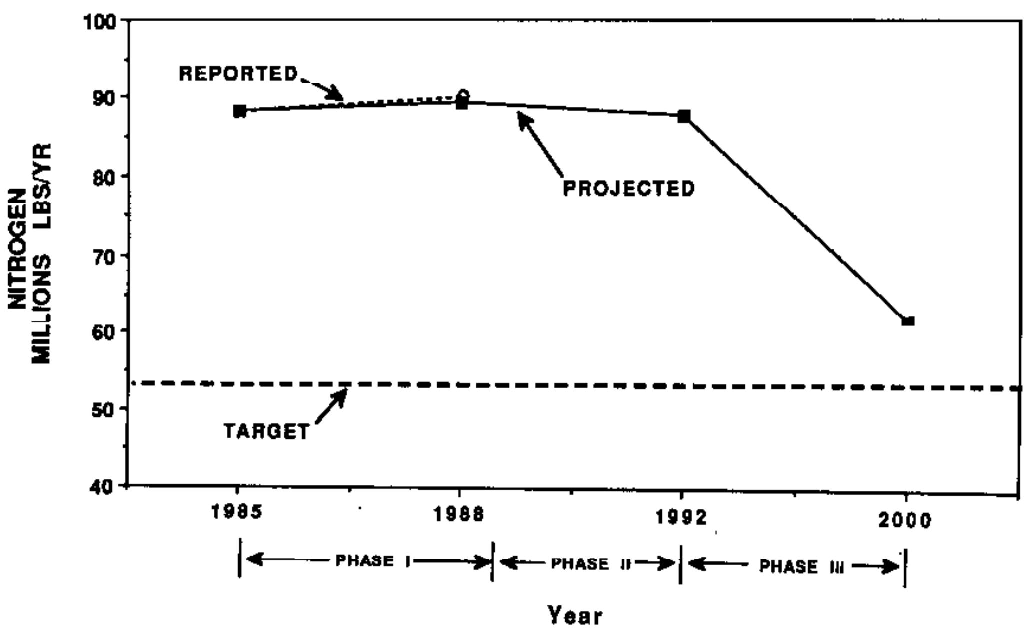


Figure 5

POINT SOURCE NITROGEN LOADS IN BAYWIDE NUTRIENT REDUCTION STRATEGY



are compared to an estimated annual load based on data for one month (June 1988). This month establishes a baseline that reflects all upgrades and credits their total load reduction during Phase I.

Over the long-term, the tracking of nutrient reduction for both point and nonpoint sources will remain an important activity. The states and the District have started tracking systems for non-agricultural BMPs. Virginia is now tracking forestry operations, shoreline erosion and changes in urban land in an eleven county pilot program. The District is tracking urban BMPs while Maryland is developing reporting systems for urban, forestry and shoreline erosion. As the modelers continue to modify the Watershed Model, the data from all BMP installation and point source treatment plant changes will be entered into the model and the output will reflect changes in water quality. The results will allow a jurisdiction to evaluate it's reduction strategy on a real time basis, subject only to implementation reporting time lags.

Section 6

New and Expanded NPS Monitoring Programs and Information from Living Resources and Future Task Force Activities

The Task Force and CBLO staff confirmed the lack of NPS water quality monitoring data the basin as they gathered data for the Watershed Model and to prepare this report. They found current data in two general categories; first, data from short-term, storm event monitoring of field-scale plot for single land used with and without BMPs, these studies usually provided annual nutrient and sediment loads; the second category consisted of stream or river stations with discrete time period data, with some storm flow values interspersed throughout the data set. There were very few long-term water quality data sets that contained both low flow and an adequate number of storm flow data points. Storm flow data are necessary to fully describe the NPS loads that are being delivered from the land.

Figures 6, 7 and 8 show the surface water and NPS monitoring locations in each state. Currently, each state has its own approach to the monitoring of nonpoint source pollution. A common theme among all Section 319 NPS assessment reports has been the lack of adequate storm-related water quality monitoring data. Most state NPS management plans identified additional monitoring as critical to a better understanding of NPS problems and solutions. The states under the Bay Program have already begun to address this issue.

Pennsylvania

The Susquehanna River Basin Commission (SRBC) conducts water quality monitoring at 12 locations on the Susquehanna and its tributaries. This five-year sampling program will conclude at the end of 1989. Data analysis is underway with a program report expected by the end of 1990. The five years of data collection covered a wide range of weather conditions, providing the opportunity to gather both base flow and storm samples. Project outputs will include refined estimates of baseline loads, seasonal variability of loads, base flow (groundwater) loads and a means to calibrate the Watershed Model for the entire river basin and several intermediate locations. The Pennsylvania Department of Environmental Resources (PADER) is discussing the scope of future monitoring with SRBC. Pending the outcome of this project, short-term monitoring needs will likely be met through the PADER water quality network. This network will detect general trends in water quality. After several years of BMP implementation, a thorough monitoring program will be re-established to evaluate the impact of the BMPs. In the interim, upon termination of funding by USDA, emphasis will be placed on continuing small watershed monitoring in the Conestoga Watershed to obtain statistically reliable results.

The Interstate Commission on Potomac River Basin (ICPRB) and the U.S. Geological Service (USGS) initiated a single station monitoring program on the Monocacy River in 1989. This program is similar to the SRBC program and the agencies will carry out sampling for several years.

The USGS has been conducting field and small watershed monitoring under the Rural Clean Water Program (RCWP) and the Chesapeake Bay Program (CBP). Variable factors, such as weather and farm management practices, have caused difficulties in obtaining consistent results and detecting significant load differences in pre-BMP and post-BMP phases. This effort has been extended to facilitate the detection of nutrient load reductions in the post-BMP phase. The Agricultural Research Service, USDA (ARS) and SRBC outside the auspices of the CBP are evaluating additional field and small watershed sampling programs for data value.

Maryland

Maryland's nonpoint source monitoring activities include several types of sites, ranging from the state's largest rivers draining hundreds of square miles to small field sites draining only a few acres. The longest running monitoring activity in the state is the Maryland Department of the Environment's (MDE) CORE monitoring network, in operation since the early 1970s. MDE collects monthly samples at 37 stream and river monitoring stations located throughout Maryland. Monitoring of these stations provides a characterization of long-term water quality conditions in the state.

In 1984, with the passage of Maryland's Chesapeake Bay initiatives, MDE initiated the Chesapeake Bay River Input Monitoring Program to document water quality conditions and nutrient loadings from four major watersheds—the Susquehanna, Potomac, Patuxent and Choptank. This monitoring program, unlike previous programs, is designed to emphasize sampling during storms, when most of the river loads are delivered to the Bay.

In addition to these large-scale efforts, MDE is conducting intensive watershed studies on the Patuxent and Monocay systems. These studies provide detailed monitoring data and related information needed to analyze, understand and document water quality changes in response to point and nonpoint source pollution controls in those watersheds. Water quality monitoring of these watersheds includes river, stream and edge-of-field sampling. Computer models under development of both watersheds will permit MDE to evaluate quantitatively the relative benefits of proposed control alternatives. Maryland's watershed models are closely coordinated with the large-scale Bay Watershed Model to ensure that the models and results are compatible and complimentary.

A great deal of research on nonpoint source pollution is also funded by Maryland. The Governor's Research Fund for Chesapeake Bay, established in 1985, has supported a variety of work by the University of Maryland and others on a range of research problems, including the effectiveness of agricultural BMPs, riparian buffer zones and other aspects of nonpoint source pollution.

Recently, Maryland initiated a Watershed Targeting Project with the cooperative efforts of the Departments of Natural Resources, Agriculture and Environment, the Office of State Planning and local governments. The project will focus state and other resources on four watersheds in Maryland and track water quality improvements through monitoring of both water quality and living resources. An important component of this project is a public education effort designed to increase public involvement and awareness of the importance of controlling nonpoint source pollution control.

Virginia

The Virginia Department of Conservation and Recreation/Division of Soil and Water Conservation (DSWC) sponsors two watershed studies to assess the effectiveness of agricultural BMPs in the coastal plain and piedmont of Virginia. The studies concentrate on animal waste and cropland practices for relatively small watersheds (2800 and 3600 acres). Continuous stream flow monitoring, nutrient, biological and pesticide sampling as well as groundwater monitoring will provide additional information for the region.

The DSWC has completed three years of monitoring pre-BMP conditions and prepared a data report, although is is continuing data analysis of the pre-BMP phase to appraise current water quality conditions. At the same time, the division is implementing several computer models on the watersheds to assist in the projection of results.

The DSWC has also developed a large digital database called VirGIS (Virginia Geographic Information System) which contains soil, land use, elevation, political boundaries and other NPS information at a 1:24,000 scale for 0.25 and 2.47 acre cells. This system currently covers over 10 million acres of Virginia bay drainage and is expanding each year. The database, coupled with monitoring, will provide additional detailed information for the CPB modeling and assessment work. The DSWC has also devised a digital database for shoreline information which contains 3150 "advisories" issued since 1980. The database includes bank height, UTM coordinates, annual erosion rates, soil profiles and other data. Integration of this information with the results of the shoreline bank nutrient study should provide the much-needed capability to project direct nutrient and sediment loadings to the Bay.

EPA has approved Virginia's newly developed Section 319 plans. The plans provide a coordinated NPS pollution control approach both statewide and within the Bay watershed.

Virginia DSWC and the state SCS have developed a new cooperative agreement to devise a planning program for watersheds of 40,000 to 60,000 acres statewide. They are delineating and digitizing these watersheds for resource conservation planning activities. This planning effort will provide a new site-specific approach to NPS pollution prevention for the Bay.

Monitoring and Living Resources Recommendations

Results from the new and expanded NPS monitoring programs will enhance the potential for upscaling existing physical process models (CREAMS, GLEAMS, etc.) and downscaling the watershed (Monocacy and Patuxent) models. Additional NPS monitoring will be required to calibrate management models to baseline conditions in watersheds where data are lacking. Managers can also use the models to test scenarios before designing future monitoring programs. To assure consistemt NPS monitoring results, a basinwide NPS monitoring protocol is needed to serve as the minimum standard for all NPS monitoring activities. It should be patterned after the protocol for the main bay monitoring stations.

Critical living resource areas within the basin and the Bay need to be located, allowing managers to formulate nutrient reduction strategies for specific areas. Establishing nutrient criteria and critical life stages for the protected plants and animals is also necessary to develop specific reduction strategies beyond the overall reduction requirements for the Bay.

Future Task Force Activities

The Task Force is continuing to work on the remaining 1989 issues, the issues required for the 1990 annual report and the data needed to complete the recalibration of the Watershed Model. The topics listed for the 1990 report are:

- Quantify and characterize non-agricultural (urban, forest and shoreline erosion) nonpoint source loadings into the Bay basin;
- Develop consistent load reduction accounting methodologies for BMPs (to include the effective "working life" of various BMPs);
- Complete development of the basinwide Watershed Model;
- Identify performance capability and refine cost information for wastewater treatment processes such as BNR;
- Complete refinement of habitat requirements for living resources that will be used with the 3-D model;
- Evaluate approaches that may be used for nitrogen reduction (e.g., available technology, regulatory actions and incentive programs);
- Evaluate the effectiveness of the voluntary programs for implementation of BMPs; and,
- Implement new and expanded monitoring programs for point and nonpoint sources pollutants.

Figure 6

PENNSYLVANIA WATER QUALITY STATIONS

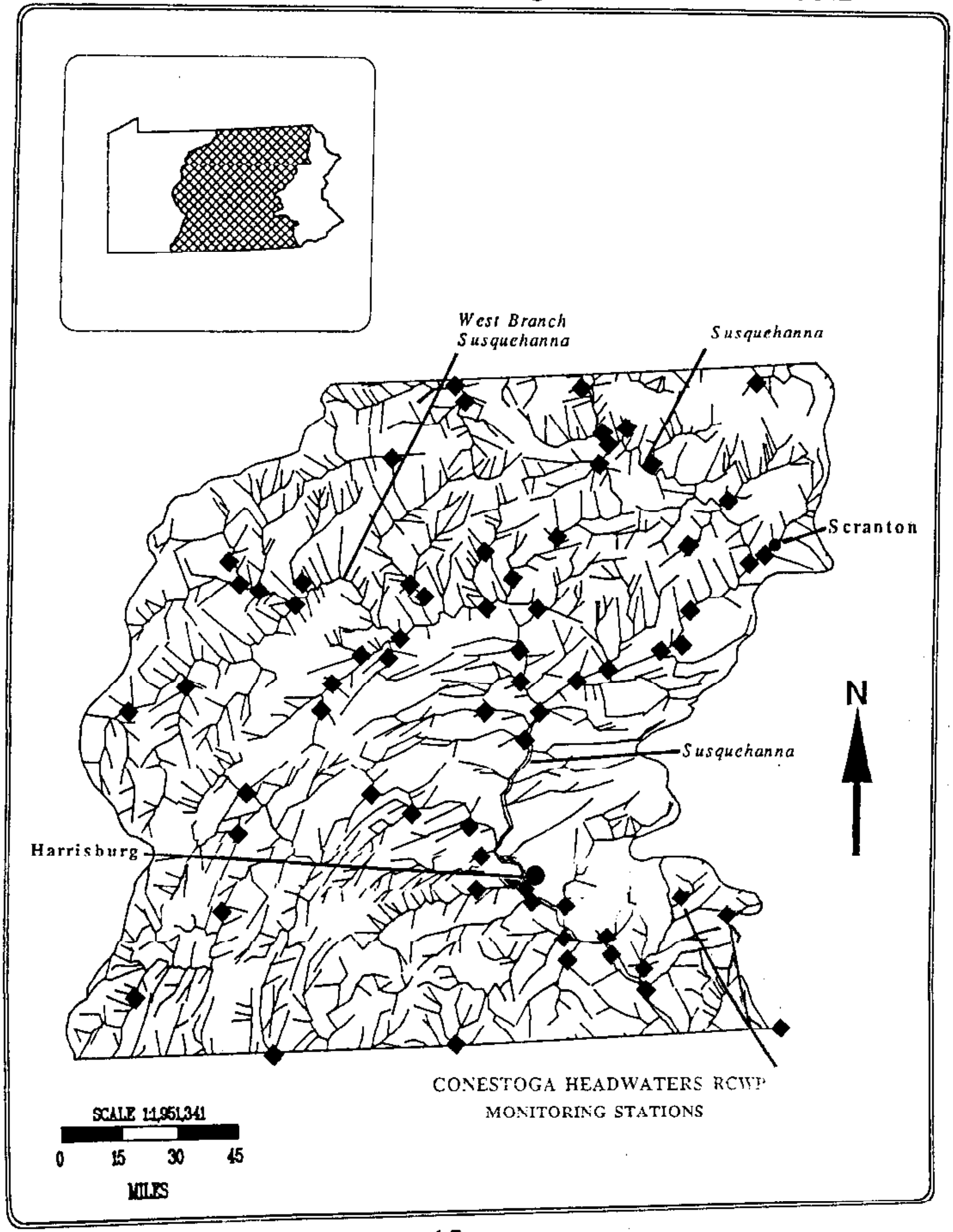


Figure 7

MARYLAND NONTIDAL TRIBUTARY WATER QUALITY MONITORING STATIONS

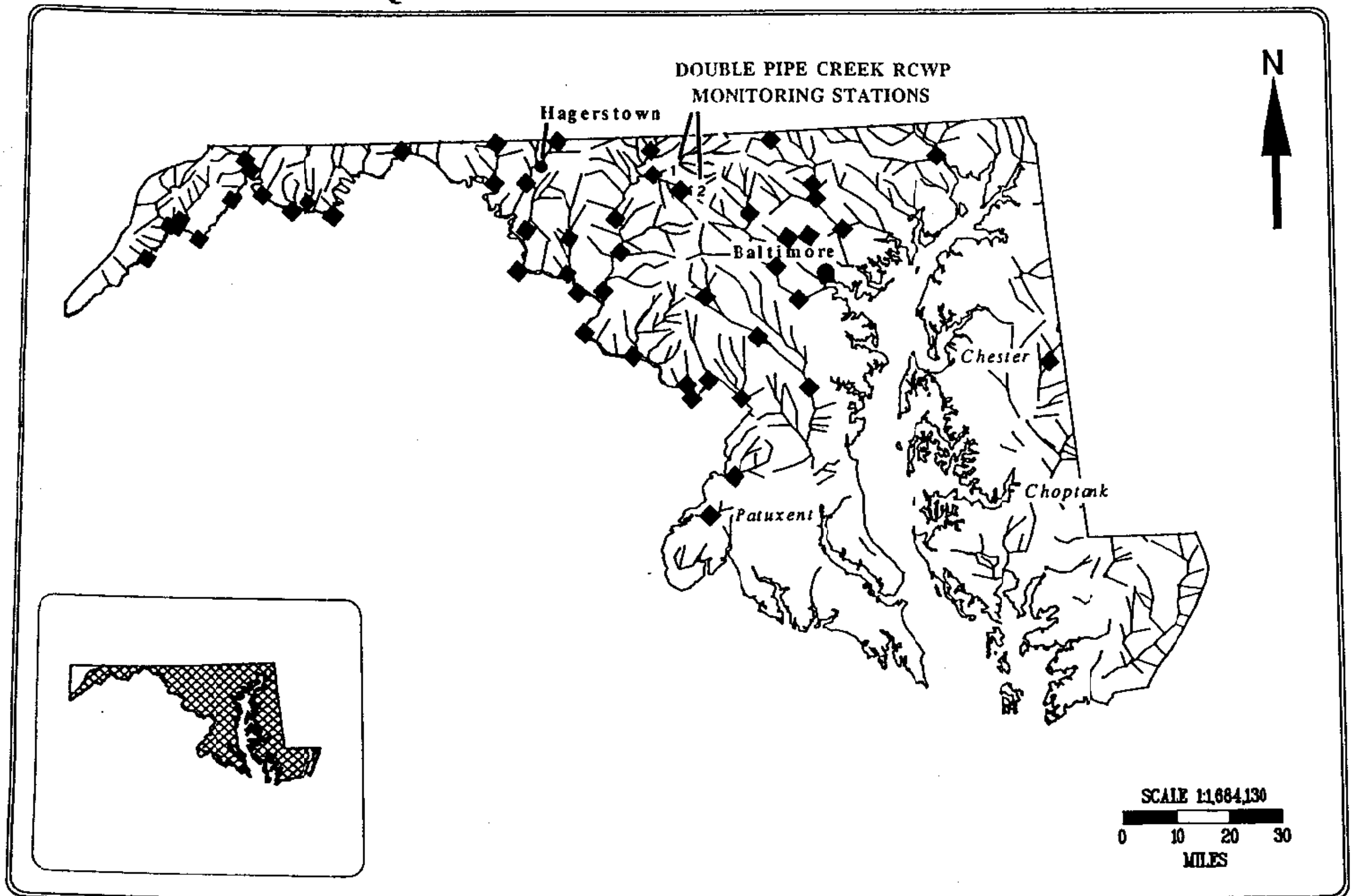
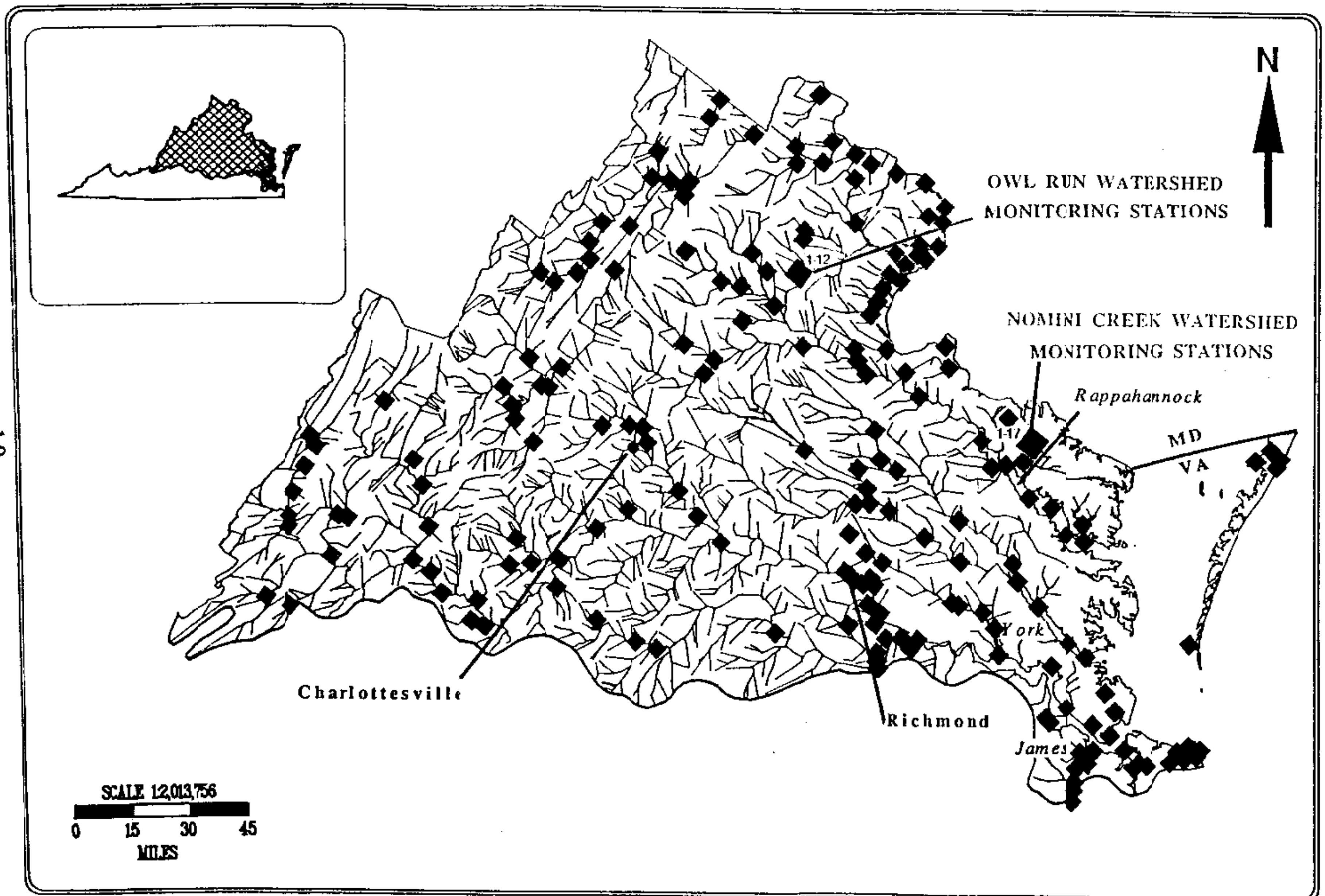


Figure 8

VIRGINIA AMBIENT WATER QUALITY MONITORING STATIONS



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