Report and Recommendations of the Nonpoint Source Evaluation Panel

December 1990

December 18,1990

Mr. William K. Reilly
Chairman, Chesapeake Executive Council
c/o Environmental Protection Agency
401 M Street, SW
Washington, D.C. 20460

Dear Mr. Reilly,

The members of the Nonpoint Source Evaluation Panel are pleased to transmit to you and the Chesapeake Executive Council our final report. We presented the report to the Nonpoint Source Committee on December 14 after eight months of research, review and deliberation.

When you created this panel last March, you asked us to evaluate the adequacy of current nonpoint source programs and provide you with our judgement of the likelihood that these programs will achieve the 40% nutrient reduction goal set for the year 2000. We took this charge seriously, and our report summarizes our findings on the issue and recommends a number of program enhancements and modifications.

We sincerely congratulate program managers for having initiated a large and complex nonpoint effort in a very short period of time. However, we were not persuaded that the present array of programs, if implemented as presently designed and at the current resource levels, is sufficient to guarantee success. Achievement of the 40% nutrient reduction goal will demand, we believe, greater effort in a number of areas. We want to leave you with several key ideas:

* The efficiency of nonpoint pollution control efforts needs to be improved through targeting and through better management of resources, so that maximum pollution reduction is achieved per unit of program resources expended.

* A wider, more complex array of tools and techniques to achieve pollution reduction needs to be aggressively employed by program managers.

* Nutrient management to achieve a net reduction of nitrogen and phosphorus migrating into the atmosphere, surface water and groundwater needs to be the principle which drives program and funding decisions.

Our report elaborates on these points and provides our ideas on how they might be achieved.

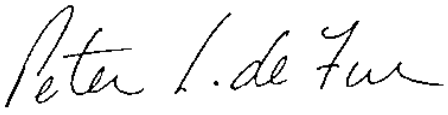
We genuinely appreciate the opportunity to offer our insights to the Chesapeake Bay Program. The program's unflagging willingness to listen to advice and to make adjustments and modifications based on experience and on new knowledge distinguishes it and encourages us about the prospects for its ultimate success.

Frances H. Flanigan, Chairperson

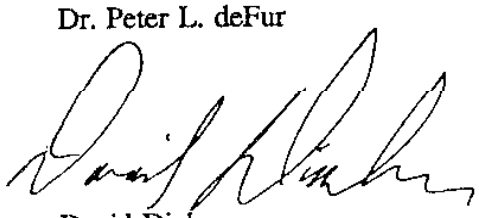
Dr. John C. Barber

Dr. Sandra S. Batie

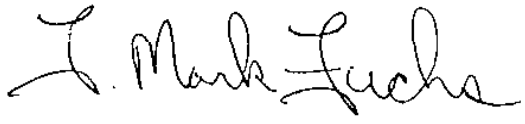
Mel Davis



Dr. Peter L. deFur

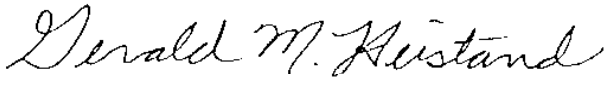


David Dickson

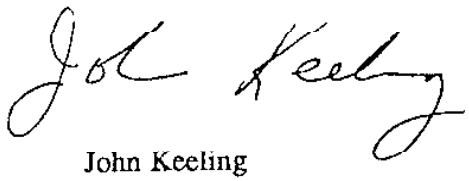


Mark Fuchs

Patrick Gardner

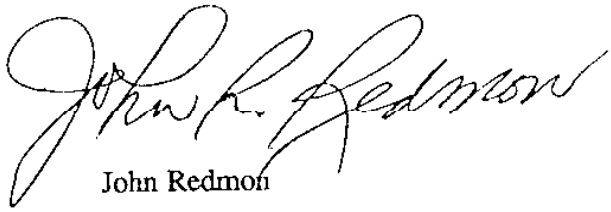


Gerald Heistand

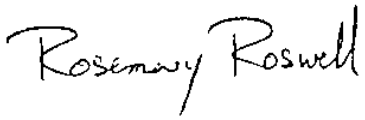


John Keeling

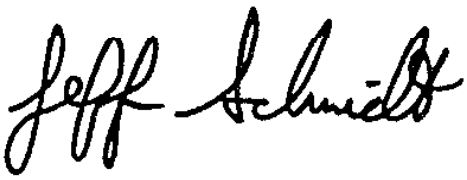
Mary Nightlinger



John Redmon



Rosemary Roswell



Jeff Schmidt

Senator Noah W. Wenger

December 1990

REPORT

CHESAPEAKE BAY NONPOINT SOURCE PROGRAM EVALUATION PANEL

INTRODUCTION

In March 1990, the Administrator of the U.S. Environmental Protection Agency (EPA), acting on behalf of the Executive Council of the Chesapeake Bay Program, convened this Panel to assess the effectiveness of current efforts to reduce nonpoint source loadings of nutrients entering the Bay system. Our task was to provide an independent assessment of the likelihood that the current array of programs is sufficient to achieve the Baywide 40 percent nutrient reduction goal established by the 1987 Chesapeake Bay Agreement. This panel's members represent a wide range of interests concerned with and affected by Bay programs in Maryland, Virginia, Pennsylvania, and the District of Columbia.

Over the course of eight months, we reviewed programs related to agriculture, forestry and urban nonpoint source pollution. We focused on evaluating the effectiveness of programs that encourage voluntary adoption of measures for controlling nutrient loadings from nonpoint sources. However, we examined these efforts within the context of the full spectrum of regulatory and nonregulatory options for achieving nutrient load reductions. We considered the basic nature of the nutrient enrichment problem, the contribution of various point and nonpoint sources, including some presently considered to be beyond the control of the States in the Bay program, and likely trends in the relative contribution of these sources. We examined how nonpoint source control programs are designed, we looked at program implementation, we reviewed program budgets, and we assessed research efforts.

Overall, we are impressed with the progress being made within the Chesapeake Bay Basin in identifying and reducing nonpoint sources of nutrients. The Chesapeake Bay Program is, we believe, an unprecedented and unparalleled achievement. The multi-State, multi-agency attack on nonpoint sources of pollution has raised the level of public awareness of the problem, substantially reduced nutrient and sediment losses from the land, pushed the frontiers of science and engineering, and become a model for the Nation. The professionalism, expertise and dedication of program administrators and staff have brought nonpoint pollution from an obscure problem into the mainstream of environmental policy.

FINDINGS

While we recognize the progress being made, we are not convinced that nonpoint source control programs, as currently designed and implemented, are sufficient to ensure meeting the year 2000 goal. We believe that current programs must be improved and supplemented, if the States are to make certain that their efforts will be successful. We recognize that strengthening programs will require the allocation of additional resources to nonpoint source control, as well as re-allocation of current resources. We believe the costs should be shared by government and the private sector.

We concluded that current programs are inadequate to ensure meeting the year 2000 goal for a number of reasons. We found that the limited information available on the rates of voluntary adoption of nonpoint source control measures suggests too slow a pace to ensure meeting the 40 percent goal. We found low participation by Basin farmers in the major Federal agricultural programs designed to promote conservation. Finally we were unable to discover data showing perceptible water quality improvements resulting from increased conservation efforts. Based on our investigation, we concluded that even after the conservation provisions of the 1985 and 1990 Food Security Acts are adopted, implementation of best management practices (BMPs) will not be sufficient to achieve the year 2000 goal.

Our conclusion in this regard was reinforced when our review determined that estimates of nutrient load reductions are probably optimistic. Because little empirical data exists, reliance on estimating techniques has formed the foundation of the year 2000 projections. The most commonly

used estimation techniques, which are based on the universal soil loss equation and assume certain relationships between soil loss and nutrient loadings, result in load reduction values that are much higher than estimates made using techniques based upon measured nutrient loads lost from typical farm fields. Estimates of the effectiveness of some structural BMPs in reducing nutrient loads appear to be inflated. The discrepancy seems to arise primarily from double counting when multiple BMPs are installed in a field, and because of failure to consider the movement of soluble nutrients through groundwater and the assumption that structural BMPs always function at their design capabilities.

In reviewing available information, we found it is presently impossible to accurately account for nutrients entering, moving through and leaving the Bay system. This lack of information is a great handicap to management efforts. The Panel believes that a mass balance approach should be developed for nutrient management. The mass balance system would require developing statistical data bases for all sources of nutrients including, for example; animal wastes, chemical fertilizers, municipal sludges and atmospheric deposition; for products that use nutrients, such as crops harvested, and for exports of nutrients, such as processed wastes transported outside of the basin, losses to ground and surface water and volatilization to the atmosphere. We believe that this approach should be a long-term program goal. It is described in more detail at the end of this report.

We further found that continuing rapid urbanization in the basin means the nonpoint source problem is intensifying and changing in character. Urban and suburban land uses contribute much higher nutrient loads, on a per acre basis, than other land uses. Moreover, development can involve the conversion of forest land and wetlands, which now provide positive water quality benefits. We believe that in spite of efforts to manage and anticipate development and urbanization, more needs to be done to encourage counties, communities, and private landowners to protect environmentally beneficial land uses and land cover types. Individuals also need to be convinced to make changes in the consumptive life-styles that generally characterize the United States today.

In reviewing current nonpoint source control efforts, we found there is no systematic planning framework that captures all aspects of the nutrient management problem, including the wide range of nutrient sources and the variety of regulatory and nonregulatory mechanisms for controlling

loadings. In some cases, individual nutrient sources are addressed by several regulatory and nonregulatory programs. For example, nutrient discharges from some types of animal feedlot operations may be subject to water quality permit requirements, and may also be the focus of cost-share programs for the construction of manure storage facilities. There is no evidence that the disparate parts of nonpoint control strategies are well coordinated. The jurisdictions, individually and collectively, must establish ways to initiate and maintain stronger functional relationships among program components.

In the course of our deliberations, we also identified a number of specific areas where the design or implementation of current programs should be modified to increase program efficiency. Government efforts to encourage the adoption of nonpoint source control measures must be more sharply focused on the major sources of nutrient loadings. Increased emphasis should be placed on nutrient management, within a mass balance framework that takes in the full range of nutrient sources and pathways. The jurisdictions should be particularly aggressive in dealing with the problem of animal wastes, and should supplement voluntary programs with regulatory requirements. In addition, the partners in the nutrient reduction strategy must do a better job in developing and managing the information that is necessary to guide their programs toward success.

When we examined possible ways that the participants in the Baywide nutrient reduction strategy could further reduce nonpoint source nutrient loads, we considered a range of available tools, including: regulatory requirements; requirements with public funding and/or technical assistance supplied; partial public funding as cost share; voluntary adoption by landowners without financial assistance and technical assistance; and quasi-regulatory programs where important benefits are withheld if conservation measures are not adopted. We concluded that all these approaches must be exploited to achieve reduction goals, because none alone is capable of obtaining the water quality goals of the Chesapeake Bay Program.

The States should continually assess their programs to ensure that they incorporate the most cost-effective mix of education, technical assistance, financial assistance, research and demonstration projects, and regulation. Incentives that encourage voluntary adoption of nonpoint source measures at relatively low cost to the government should be encouraged. In addition, we envision more active

participation by the private sector, especially in the area of education and outreach within the agricultural community.

The Panel's specific recommendations are described in detail in the sections that follow.

RECOMMENDATIONS

1. TARGETING PROGRAMS

Improvements in program targeting offer the best immediate opportunities for further reducing nonpoint source nutrient loads within the Bay system.

The Panel recommends that the jurisdictions continue to refine their identification of specific geographic areas and activities that are the most important contributors of nutrients to the Bay system, and develop and improve targeting strategies accordingly. Identification of individual farms, woodlots, and development sites for priority action is essential.

Better targeting requires better information. The jurisdictions must develop more detailed information that includes farming, forestry, and development practices being employed, proximity of operations to surface waters or vulnerable groundwater, and the potential leaching or runoff for given practices, soil types, and topography. Targeting strategies need to focus on smaller land areas, rather than whole counties or watersheds. Valuable forest and wetland areas that provide buffering capabilities should be identified and targeted for protection. The Panel believes that sophisticated information management tools, such as Geographic Information Systems, can be extremely useful in improving targeting capabilities.

We recommend that the States adopt a tiered targeting structure, with levels of program support directly related to established priorities, based on explicit cost-effectiveness considerations.

Targeting systems need to incorporate cost-effectiveness considerations which will help guide programs. For example, if focusing on a specific land use or activity would result in greater nutrient load reductions per program dollar expended, then the program should establish criteria for making resource allocation and targeting decisions that address these land uses or activities. These criteria could include establishing size thresholds for animal production facilities, targeting all expanding animal facilities or selecting certain land areas for mandatory nutrient management planning.

Targeting strategies need to consider the economic and sociological characteristics that influence decision making. Different crops and livestock operations face different economic realities and pollution potential. Predominant farm type (eg. livestock, hay, grains, truck crops etc.) heavily influences conservation options as well as pollution potential. Absentee landowners, farmers with limited resources, and persons holding land for future development do not necessarily respond to the same incentives or educational efforts as owners/ operators or farm lessees.

Targeting should provide land users with choices that have the highest potential of reducing nonpoint pollution. For agriculture, these choices should include such actions as participation in the Conservation Reserve Program. To the extent possible, the landowner should be provided an analysis of the impacts of his choices on both nonpoint pollution and income.

We recognize that increasing the selectivity of targeting means that some individuals seeking support will go unsatisfied. But we believe that a tiered targeting structure will enhance the probability that the jurisdictions will achieve the 40 percent nutrient reduction goal. A farmer whose operation does not meet requirements for top priority consideration might be ineligible for financial assistance but could be eligible for technical assistance. Individuals or organizations ranking low in priority might not have available to them on-site individual technical assistance but could be involved in group training, workshops and educational programs.

The Panel believes that assuring effective implementation of well-designed targeting strategies is critical. Where local entities are responsible for making or implementing targeting decisions (such as establishing criteria for projects eligible for government cost-share), the States

and federal agencies should establish targeting guidelines and require local entities to adhere to them. Where specific land areas or activities have been identified as high priorities for program action, jurisdictions should determine if the focus on these areas or activities has actually resulted in the corresponding adoption of effective nonpoint source nutrient control. That is, monitoring and evaluation should be better integrated into the program. For example: has the education activity targeted to a certain group resulted in a higher rate of implementation by that group than by others? Has the technical assistance targeted to a specific watershed segment increased participation in that watershed as compared to others? The answers to these questions should be used to refine targeting programs. Targeting evaluation must be followed up with timely program modifications that reflect the management lessons learned.

State water quality management agencies should ensure that water quality standards, water quality criteria, and monitoring of water quality are adequate to measure the need for and effectiveness of nonpoint source controls. Hence, improved coordination between water quality agencies and agencies involved in nonpoint source programs is essential.

2. PROGRAM DESIGN: VOLUNTARY VS. REGULATORY

The Panel examined the question of whether a largely voluntary nonpoint source program will suffice, or whether more regulatory programs will be necessary to meet the year 2000 goal.

The Panel recommends that the States and the federal government augment voluntary programs with increased use of regulatory authority for the reduction of nutrient loadings To minimize financial burdens, regulatory requirements should be accompanted by technical and, where appropriate, financial assistance. The development of any regulatory requirements should include ample opportunity for public participation.

The Panel recommends that the wide spectrum of programs and policies

that fall between voluntary and regulatory be fully explored and utilized.

We concluded that the jurisdictions need to more aggressively implement the wide range of options, from voluntary to regulatory, that presently exist. While additional regulations will be necessary to meet the nutrient reduction goal, other options that fall between voluntary and regulatory are largely unexplored territory and offer the Chesapeake Bay Program the greatest opportunity to attack nonpoint source problems in the coming decade.

Where particular water quality problems are identified, either through complaint or inspection, States should have both the authority and the resources to compel corrective actions. The imposition of mandatory controls or practices could be based on the use of "trigger" mechanisms. For example, stricter controls on the application of nutrients or the management of animal wastes could be imposed when a certain action level of nitrogen contamination in surface or groundwater is reached. Other triggers might involve water quality criteria being exceeded or beneficial uses not being met in receiving waters by a certain date. Any time-limited triggers should allow for an ample period to implement requirements and reduce loadings prior to the year 2000 reduction target date. Reliable data will obviously be necessary to make a trigger approach work.

In addition, regulatory requirements could also be phased in. For example, in the next section the Panel recommends that nutrient management planning be required for lands that are targeted as sources of nutrient loading to the Bay. Once nutrient management capability is in place in these areas, and when the agencies have the institutional capability to provide technical assistance, nutrient management could be required for all agricultural operations within the basin.

Examples of programs or policies that lie between voluntarism and regulation include those that tie government benefits to recipient obligations. The principal case where this *quid pro quo* approach has been used is Food Security Act programs including sodbuster, conservation compliance, and swampbuster. In each case, while farmers are not required to protect fragile lands, they stand to lose their eligibility for a broad array of farm programs if they farm environmentally fragile lands and fail to take certain conservation measures. There are as many opportunities to build on this approach as there are farm programs. Accordingly, Bay Program managers should inventory all

existing benefit programs and assess their potential to increase farmer and landowner incentives to participate in the Bay clean-up by coupling water quality responsibilities to existing farm programs.

Another policy option that lies between mandatory and voluntary, referred to as "point and pay," embodies the idea that improved targeting of remedial resources increases pollution reduction efficiency and brings program savings. As such, government ought to be willing to pay a proportionately higher cost-share in return for more efficient targeting. One way to implement this concept would be to pay the full cost of BMP implementation in return for having the authority to mandate which farmers would install them. The marginal cost increase to government is small because cost-shares for installing BMPs already are between 75 and 87.5 percent. The increase in efficiency could be substantial because the program would eliminate the reluctant participant problem that presently exists under voluntary programs, since identifying a polluter is no guarantee of his participation in Chesapeake Bay water quality programs.

One last example of a new approach to reducing nonpoint source pollution incorporates economic incentives. This approach reflects the idea that many incentives exist to change human behavior, and one of the most powerful is the profit motive. If non-polluting technology can be made cheaper than the alternative, then government regulation can be avoided.

A real world example of this can be found in conservation tillage. The Mid-Atlantic states have one of the highest conservation tillage adoption rates in the country. And while conservation tillage has salutary environmental benefits through reduced soil erosion, area farmers adopted this technology primarily because it saves time and money. Integrated pest management and fast developing alternative agriculture technologies offer additional proof that economics can work in favor of water quality.

In summary, there are numerous incentives that can motivate farmers to participate in water quality programs to control nutrient losses to the Bay system. These incentives include voluntary land stewardship, government benefit programs, economic opportunities, and regulation. No single incentive will do the job; rather, managers must rely on a reasonable mix selected from the entire spectrum of purely voluntary to exclusively regulatory.

3. NUTRIENT MANAGEMENT

Programs and practices that were originally intended to control erosion and soil loss have provided a foundation for our current strategy for controlling nonpoint sources of nutrient loadings. BMPs for reducing soil loss offer the additional benefit of controlling the nutrients and pesticide residues attached to soil particles. Accordingly, water quality program managers have adopted BMPs as the basic component of a multiple objectives conservation strategy.

If, however, our water quality program is limited to the use of conservation BMPs that have been designed primarily for erosion control, nutrient control will not be adequately addressed. For example, many BMPs are ineffective in controlling the soluble nutrient fractions. In fact, several recent studies show that some BMPs (e.g., contour farming, terracing, and no-till, when implemented without nutrient management planning) can increase loadings of dissolved forms of nutrients. In such cases, BMP implementation may only be altering the pathway for nutrients leaving land areas.

The Panel urges the Chesapeake Bay jurisdictions to develop a uniform and clearly stated approach to management of nutrient-rich materials, including animal wastes, chemical fertilizers, and municipal sludges, stored on or applied to land. These sources, whether agricultural or urban, must be considered collectively in developing regional and watershed nonpoint source management strategies based on a mass balance concept. To achieve the desired water quality objective, we believe it is necessary to move beyond the traditional BMP approach.

The Panel recommends that the term Best Management System, which would go beyond traditional soil loss concepts, be adopted by Chesapeake Bay jurisdictions and Federal agencies. Use of this term will show common support of a comprehensive nutrient reduction strategy. It should also improve communication which has been confused by the varying uses of the established term "BMP."

A Best Management System is defined as a combination of conservation practices or

management measures, which, when applied, will achieve nonpoint source pollution control through reduced transport of sediment, nutrients and chemicals into surface and groundwater. This term applies to agricultural, forestry, and urban nonpoint source control measures.

The Best Management System concept is based on the need to promote combinations of practices that most effectively protect or improve water quality. The Panel recognizes that in some instances, traditional soil erosion control BMPs cannot themselves reduce nutrient loadings, and may actually increase nutrient loadings. Nutrient management techniques, such as storage of animal waste and application of fertilizer according to a nutrient management plan, may also be insufficient if soil erosion is not controlled. Best Management Systems take into account the effect of soil erosion control, management of animal wastes, synthetic fertilizers and municipal sludges, application of chemicals, biological uptake of nutrients, establishment of vegetative buffers and other management measures. They can include structural and management practices.

Program managers also should selectively encourage the adoption of traditional BMPs that are proven to be effective both in reducing erosion and in controlling nutrient loadings. Where erosion control practices are likely to be ineffective in controlling nutrient loadings, nonpoint source program managers must encourage the adoption of a nutrient management plan for the same acreage. Adoption of plans would promote the accomplishment of multiple environmental quality objectives.

The Panel believes there should be greater emphasis on nutrient management plans. Nutrient management plans should be applied to private and commercial lawn and turf, as well as agricultural lands. These plans would establish appropriate nutrient budgets, based upon manure or sludge testing, soil tests, and nutrient application rates and timing. The goal is to have no excess nutrients lost into the ecosystem. Nutrient management plans can be expected to provide cost savings to the landowner, which makes the concept attractive and enhances the potential for voluntary adoption.

The Panel recommends that nutrient management plans be required and implemented for lands that are targeted as sources of nutrient loading to the Bay.

Criteria for deciding which land areas must have nutrient management plans should be kept

consistent with the guidelines described in the preceding targeting section. Nutrient management plans for individual properties should be based on the mass balance concept, and be incorporated into the Best Management System approach described above.

Chesapeake Bay Program funds allocated for nonpoint source controls should be used only to support those practices and combinations of practices included in a Best Management System. In making funding decisions, Bay Program managers should strongly emphasize their support of nutrient management efforts.

4. ANIMAL WASTES

We expect that animal numbers, as well as density of animal units per acre in the Bay basin will continue to increase and that total cropland acres will decline in the future. As a result, manure will become an even more important source of nutrient loads originating in the agricultural sector. The States will not achieve a 40 percent nutrient reduction in the agricultural sector without significantly improving the management and use of manure.

We recommend that the Bay States be more aggressive in ensuring the effective management of animal wastes. Specifically, we recommend that the States target animal operations according to the impact that they may have on the resource. Larger or more intensive operations should be a priority. Further, we recommend that the States set mandatory animal unit thresholds above which they will require farmers to develop and implement best management systems for animal facilities. Farms in close proximity to surface water or vulnerable groundwater, as well as operations that are planning to expand, should be specially targeted for program participation.

The authority is available at the federal and state level to regulate significant numbers of livestock operations within the watershed. At present, reliance on this authority is sparse, notwithstanding the mandatory nature of the Federal law. In cases where the States have invoked

existing authority the results have been strongly positive. Accordingly, the States should utilize the regulatory authority provided under the Clean Water Act and as provided by State law to ensure that affected livestock operations participate in the States' animal waste control programs. The federal guidelines should be revised to include nutrient management as a permit condition and to lower the threshold limits.

The Bay States also should examine and track regional trends in the distribution and characteristics of livestock operations. These data should provide useful information for targeting program resources and setting priorities in the future. In addition, the States need to devote new resources to research on management techniques for animal waste. The present heavy reliance on manure storage as the centerpiece of the States' animal waste programs is very expensive and storage without proper manure management does not itself reduce nutrients. Cheaper and more practical solutions need to be developed so that all farmers, not just government assisted farmers, will be able to incorporate improved nutrient management into their livestock operations.

The Bay States should encourage the development of markets for animal wastes, as well as municipal sludges and other organic wastes. As part of this effort, the Bay jurisdictions need to evaluate existing laws and ordinances prohibiting intercounty or interstate transfer of animal wastes, municipal sludges, and composting bulking agents, and, where prudent, eliminate such barriers to the development of markets.

5. LAND USE, GROWTH, AND URBANIZATION

About 10 percent of the total area of the Chesapeake Bay Basin is urbanized, which is more than the area in pastures and approximately half the total area in cropland within the Basin. We noted that total nonpoint source nutrient loadings from urbanized land exceed those from forest and pasture land, and are comparable to those from cropland.

Urbanization of the basin is continuing at a rapid rate, with an anticipated 20 percent increase in population over the next 30 years. A recent Maryland study shows that from 1970 to 1980 the percentage increase in developed acreage was twice that of population growth.

Development is intensifying urban runoff problems and increasing loadings of nutrients to wastewater treatment facilities.

The population growth that has occurred in the Bay area in the last 30 years has come in the form of suburban sprawl. This development pattern is extremely detrimental to the waters of the region including the Chesapeake Bay. It results in large scale displacement of environmentally beneficial land uses such as forest cover, wetlands and natural floodplains and introduces large areas of impervious surface. It is characterized by heavy use of low-occupancy vehicles which generate large pollutant loads and demand major conversion of natural areas to impervious surfaces in the form of roads and parking lots.

The Report of the Year 2020 Panel and other studies have concluded that, if anticipated growth in the region continues in the present pattern, the Chesapeake Bay will not survive. Future growth must be accommodated by channeling it into density centers, usually preexisting, where it can be served by more efficient transportation modes and other public facilities and where it will occupy a smaller footprint on the natural land surface. Those natural areas and uses that are especially beneficial to maintaining water quality need to be protected.

The environmental benefits of concentrated development centers have an ally in fiscal necessities. The local jurisdictions which have experienced the heaviest development have found that the demands for transportation and other public facilities generated by inefficiently sited development have overwhelmed their fiscal resources. However, political and legal obstacles to changes in land use policies are formidable. Overcoming these obstacles will require that the urgency of the issue and strategies for addressing it be brought to the forefront of public attention.

We recommend that the States, universities, and local and regional agencies greatly increase their efforts to devise land use management systems that accommodate growth in patterns that minimize environmental damage and can be affordably served, devise methods to better distribute costs and profits of development, and promote understanding and acceptance of these policies.

We also recommend that States provide the authority to localities to implement plans that guide growth while protecting environmentally sensitive areas. Local planning needs to occur within the framework of statewide growth management programs.

We recognize that the States are undertaking initiatives to address specific problems related to urban and suburban nonpoint sources. These initiatives include efforts related to the inspection and maintenance of BMPs, stormwater management, erosion and sedimentation controls, and septic systems.

We recommend that the Bay jurisdictions continue to increase their emphasis on controlling urban sources of nutrients, such as stormwater discharges, runoff from paved areas and construction sites, suburban lawns, and the nutrient-enriched groundwater sometimes associated with concentrated septic tanks. The States should closely oversee local programs that include inspection, maintenance, and monitoring efforts.

The Panel recognizes that this increased emphasis will require additional resources. The Bay jurisdictions should consider a full range of alternatives for funding enhanced program activities, including fee-based options, such as stormwater utility fees.

We recommend that the Bay jurisdictions intensify their efforts to protect those land uses and land cover types that provide positive water quality benefits. In particular, we recommend that additional efforts be made to encourage the maintenance of forests, wetlands, and agricultural lands, most of which are held in private ownership.

The Bay jurisdictions and relevant Federal agencies should develop a coordinated, comprehensive inventory of forest and wetland areas within the Basin. Consideration should be

given to incorporating, and augmenting as necessary, existing inventories within a unified GIS. The inventory should be designed to facilitate updating and tracking of changes, perhaps making use of remote sensing technology.

Each State should develop forest conservation policies and strategies aimed at preventing urbanization from causing net losses of forests. The strategy should incorporate appropriate land use planning guidelines as well as public and private land conservation programs and practices. It should provide adequate incentives to induce owners of forest lands to protect these resources so they may continue to provide the pollution control benefits that accrue to the general public.

The States should review their wetlands protection strategies for consistency with the Bay goal of achieving no net loss of wetlands over the short term and a net gain over the long term. In particular, the States should evaluate pressures for continuing conversions and alterations of wetlands as the Basin develops. If necessary, the States should take action to increase the effectiveness of their wetland protection programs, using the full range of regulatory and nonregulatory tools available.

We urge acceleration of efforts to preserve farmland. Properly managed agricultural land tends to produce lower nutrient loadings on a per acre basis than urbanized land. The Bay States should develop economic incentive programs for agricultural landowners to retain their lands in current use. Participation in such programs should require that property owners adequately address nutrient loading problems.

6. EDUCATION AND OUTREACH

The Panel found that little information is available on the effectiveness of education and outreach efforts in encouraging the adoption of conservation measures for nonpoint source pollution control. However, the few studies we reviewed strongly indicate that education and outreach offers very high payoff per unit of investment. Overall, we agree that effective, targeted, persuasive education and outreach is vital to changing the behavior of many individuals who collectively

contribute to nonpoint source pollution.

We recommend that enhanced educational efforts be given high priority as a means of achieving nutrient reduction goals. Specifically, we recommend that the Bay States refocus and restructure the educational components of their programs to more effectively market nonpoint source control to targeted audiences. Specific goals and measures of ultimate success in terms of both the rate of adoption of nonpoint source control practices and ultimate improvements in water quality must be established and adhered to.

Program managers should set marketing goals and should provide training, professional incentives, and rewards for excellent performance. Similarly, incentives and rewards should be made available to encourage the targeted audience to participate in nonpoint source control efforts. Public image, peer group (or user group) influence and social responsibility should all be used in structuring approaches for encouraging participation. Better information must be assembled and made available on who is participating in voluntary programs, why they are involved, and where they get their information.

The nonpoint source pollution issue involves a wide array of individuals, groups and organizations, including but not limited to homeowners, farmers, loggers, developers, and landowners. Therefore, the educational and outreach components of nonpoint source programs must be designed for varied but specific audiences. We noted that some key audience segments do not seem to be receiving educational and outreach services at all. Others may have been contacted, but in a way that has failed to achieve desired results.

The agricultural community is served by several USDA agencies, state departments of agriculture and forestry, extension services, industry representatives, cooperatives and farmers associations. We found that there is not much systematic cooperation among these groups and concluded that closer cooperation would enhance the success of nonpoint source control efforts. For example, county level representatives have been particularly important contacts, and the training and

use of extension agents to meet outreach and education goals must continue at a high level. At a time of budgetary and financial cutbacks, the role of these agencies in pollution prevention and control is essential, not peripheral. Attention to these water quality responsibilities should have first call on the educational portion of these agencies' budgets.

The state forestry organizations provide leadership in contacts with landowners, loggers, and the forest industry. Within the forestry sector, mechanisms should be put in place to inform landowners of their responsibilities for protecting water quality, and to ensure that landowners have contact with either agency or consulting foresters in advance of entering into contracts to sell their timber. This advance contact would provide landowners with better information about Best Management Systems upon which to base their contracts to ensure that proper BMPs are planned and implemented. State forestry personnel should be provided the resources to monitor harvesting and regeneration and to follow up on logging operations to advise the landowner of whether the BMP component of his or her contract has been adhered to.

It is critical that all personnel involved in education and outreach efforts remain informed regarding technical and programmatic developments. We found existing mechanisms inefficient for ensuring the maintenance of an adequate knowledge base and skill level for staff working in nonpoint source control programs. Effective staff training and continuing education programs must be developed and adhered to.

We also believe that cooperative and collaborative arrangements between government programs and other groups offer significant opportunities in education and outreach. In particular, we believe that agribusiness has been significantly under-utilized with regard to education and training of landowners. The potential for outreach within this segment is enormous and if properly tapped, could greatly augment government's efforts. A stronger cooperative approach between government and the agribusiness industry would expedite the achievement of many of the goals of nonpoint source control programs. For example, we have noted that local representatives for the fertilizer industry have established an excellent rapport with Basin farmers. Such rapport can be the foundation for educational programs on nutrient management.

We recommend that Federal agencies and the Bay States take advantage of private sector expertise and establish public/private partnerships to further common education objectives. We recommend that the Bay States undertake a special initiative to offer more extensive training to representatives of industry, the academic community, and environmental groups so that they can effectively promote good nutrient management practices.

Private industry appears to be playing an increasingly important role in nutrient and pesticide management within the Basin. This development is largely driven by reduced costs resulting from improved farm management, but the net result can be improved water quality. Crop Management Associations and similar groups and companies lie at the cutting edge of the farm information and management revolution. Every effort should be made to aid these private entrepreneurs to market and deliver an environmentally sound service by providing training and establishing a licensing or certification program.

Universities offer another opportunity for education and outreach. One example of the role academia can play in outreach is illustrated by university-sponsored or affiliated demonstration farms. Government program staff and university staff should collaborate to a greater extent. For example, they should work together to develop courses that include current information on nonpoint source control strategies and practices. Such collaborative efforts can result in achieving multiple objectives, such as: ensuring that courses are available to meet the needs of the program managers by educating current or future employees; allowing for direct communication of the results of university research to those who are developing or promoting programs in the field; identifying program managers' information needs and channeling research efforts to meet these needs. Research programs within universities offer a source of expertise in gathering and analyzing data. This expertise needs to be better tapped by increasing the involvement of the scientific community in management programs.

Public interest organizations have played a vital role in public education and policy development. For example, citizen stream monitoring programs have encouraged local involvement

in erosion and sediment control programs and provided valuable water quality information. Field trips to local farms, publications on pesticides, lawn care and soil conservation, and other educational activities have been invaluable. Several groups also conduct on-farm conservation demonstrations and water quality research. Finally this community of groups and individuals plays a key oversight and input role in the goal-setting and policy-making process relating to the nonpoint source component of the Chesapeake Bay program. In this period of fiscal austerity, at a time when more is demanded of the government and less resources are available, the support of the public interest community is essential. Not only can this community continue to provide information and education directly to the public in the area of nonpoint source pollution, it can help build and solidify the political base of nonpoint source programs. Toward that end, Bay program managers and public interest organizations should cooperate in every aspect of the Chesapeake Bay cleanup.

7. INADEQUATELY ADDRESSED NUTRIENT SOURCES

Under the current Baywide nutrient control strategy, the Bay States have sought to achieve the 40 percent nutrient reduction goal by addressing sources considered to be relatively "controllable." Consequently, a number of known and suspected sources of nutrients entering the Bay system were initially excluded from the strategy and the water quality models that support the nutrient reduction effort. We concluded that some of these sources, particularly the atmosphere and groundwater, are associated with significant loadings. Thus, by specifically addressing them, the participants in the nutrient reduction strategy will increase their chances of reducing nutrient loads sufficiently to achieve the desired water quality improvements.

We recommend that the Bay States and the federal government undertake more aggressive efforts to address nutrient loadings associated with atmospheric deposition, groundwater, septic systems, and shoreline and streambank erosion, and that these sources be included in the nutrient reduction strategy.

Studies have indicated that between 25-35 percent of nitrogen loadings to the Bay come from atmospheric sources, making the atmosphere a major contributor to the nutrient problem. Sources include volatilization from sludge, animal waste, chemical fertilizers, and automotive and

industrial emissions. The Panel urges that these sources be incorporated into the 1991 reevaluation studies and explicitly included in the reduction strategy. Also, expected increases in power generating capacity within the watershed may increase nitrate deposition and tend to negate nutrient reductions from other sources. Nitrate deposition must be addressed in the nutrient reduction programs, necessitating State Air Boards' involvement in the process. The Bay program needs to take advantage of the newly passed Clean Air Act to address these issues.

The Bay States should continue to develop and implement strategies for controlling nutrients entering groundwater. Where they have not done so already, the States should initiate efforts to protect groundwater from degradation by nutrients and to identify any areas where degradation has already occurred. The States should target efforts to areas where groundwater and the Bay system are closely connected hydrologically. Full integration of groundwater into State water quality programs will necessitate additional training for technical assistance specialists.

The hundreds of thousands of septic systems located within the Basin are an important source of the nutrients entering the Bay system. Septic systems are not specifically designed to remove nutrients and even when operating properly, can be a source of nutrient pollution to the water resources in the basin. We recognize that the Bay States are increasing the stringency of their standards for septic tank design, installation, and maintenance. We support these efforts and urge that the States and localities use land use planning and other appropriate mechanisms to prohibit the installation of additional septic systems in areas where seepage to Chesapeake Bay waters is likely. Further, the States should encourage the availability of sewage treatment to small communities and subdivisions, as an alternative to concentrated septic tanks. Further, the land application of effluent from such treatment systems should be encouraged. Where sewage treatment systems are not feasible, efforts should be made to provide a broader range of alternatives.

Where they have not done so, the Bay States should limit development and other activities that aggravate shoreline and streambank erosion, and should undertake revegetation and other bank stabilization efforts in areas subject to high erosion rates. The States should require developers to maintain forested or other types of buffer strips when development projects are proposed in areas subject to shoreline erosion. Managing boat traffic and reducing speed limits would help reduce

shoreline erosion and attendant nutrient loadings.

Each of these sources or conduits of nutrients affects water quality and uncontrolled has the potential to impede achievement of the water quality goals. Because of their large contribution, atmospheric and groundwater considerations are Bay concerns. However, these sources are also quite difficult to contain. The Panel recognizes that cost-effectiveness considerations are important in developing programs for inadequately addressed sources of nutrients. Therefore, efforts and resources should be focused where there is the greatest likelihood of controlling the source.

In some cases, nutrient loadings originate from areas outside the jurisdiction of the States participating in the Baywide strategy. In such cases, efforts should be made to bring other responsible jurisdictions into the nutrient reduction process. The Bay Program should adopt a total basin planning concept that includes an evaluation of nutrient loadings originating in New York, West Virginia, and Delaware. Opportunities to encourage nutrient reduction strategies in these jurisdictions should be actively pursued.

8. INFORMATION AND RESEARCH NEEDS

As the Bay nutrient reduction strategies progress, improvements in the existing information base and changes in how participating agencies manage technical information will be needed. It is understandable that detailed information and data are not available for all aspects of the program now, but acquisition of better information needs to be a priority in the future. This information needs to be computerized for easy retrieval and analysis.

We recommend that a greater effort be made by all participants in the Bay program to ensure that information requested and gathered be planned to strengthen and guide policy and program decisions, and that the Bay States cooperate in developing a more consistent information management framework.

We recommend that the Bay Program fund research studies and monitoring programs to generate the data, information, and knowledge needed to refine and

perfect nutrient management efforts.

Water quality information relating to nonpoint sources is lacking in many areas of the basin. Therefore, EPA, in cooperation with the Bay States, should evaluate current monitoring programs to determine the adequacy of data to support nonpoint source policy making efforts and assess program effectiveness. The States should identify data gaps in the parameters studied and the watersheds monitored, as well as opportunities to cooperate with other monitoring programs or to modify existing monitoring programs in order to expand their value for nonpoint source problem assessment and program management.

The Panel is concerned about the limitations of the data and information available regarding the water quality changes that result from the installation of BMPs in the basin. In order to improve this data base, the Federal government and the States should expand their research efforts on the water quality effectiveness of all BMPs. Most of the information available for BMP effectiveness came from small plots. We believe that effectiveness studies should be conducted in phased steps, moving from small plots to actual field scale demonstrations. This approach allows for design modifications to be made between steps and provides program managers with the data from field scale studies, which meets their needs for "real world" information. While we found information lacking for all BMPs, particular emphasis should be placed on determining the effectiveness of urban and forestry BMPs within the Chesapeake Bay basin. In addition, research and monitoring on the effectiveness of combinations of practices and nutrient management approaches -- what we call Best Management Systems-- needs to be undertaken.

It is clear to the Panel that nutrient management represents the best option for agriculture to meet the water quality goals for the Bay. We believe that the U.S. Department of Agriculture (USDA), EPA, the state nonpoint source programs, and the state universities should integrate and expand their research programs on sustainable agricultural and the management practices that reduce nutrient loadings from agricultural lands. Managers need a better understanding of the biological uptake of nutrients, as well as the relationship between changes in nutrient inputs and changes in loadings.

Current research activities should be expanded to determine the effectiveness of buffer strips to uptake nutrients from surface and subsurface flows. Studies should be conducted to identify relative values of plant species for use in buffer strips including trees, shrubs, grass, and natural vegetation, and evaluate the management techniques that will maximize nutrient uptake of the most promising species. Additional studies should be done to identify which buffer characteristics are most effective considering differing topography, soils, and adjacent land use.

Overall, it is clear that targeting is likely to become more complex and more information intensive. Accordingly, we believe that improved information management tools, such as GIS will be essential for effective and systematic targeting. Pioneering efforts suggest that GIS technology, which allows more complex and sensitive analyses of detailed sets of data, holds great promise as a tool for effective allocation of resources. Such systems could be used in many other ways by local administrators, and system costs could be shared. Still, we recognize that GIS frameworks can be costly to develop, and we have not examined the cost-effectiveness of using such systems. Bay jurisdictions should undertake a formal assessment of the costs and benefits of using GIS technology for targeting nonpoint source program resources. If cost effective, consideration should be given to developing a basinwide system based upon or compatible with the VirGIS system used in Virginia.

We believe the Bay States and the state universities should undertake research and training programs for on-lot septic systems to ensure proper design, installation and maintenance for long-term nutrient management effectiveness. Studies should be conducted that will evaluate various options for resolving home sewage problems in areas where septic systems are failing or where conditions will not allow their installation. Options should include the use of small-scale sewage treatment facilities, regional collection and treatment systems, and systems that utilize gray water for beneficial use.

We urge that studies be undertaken to quantify the impacts of land use changes on water quality. Data should be collected on the cumulative effects of land use changes (e.g., conversion of forests to agriculture or urban uses and the conversion of agriculture to urban uses) in order to assess the sediment and nutrient loading effects of these changes. These studies should estimate the amount of land that would be consumed per unit of population growth for varying population densities.

These data would be used to predict land use changes and the resultant changes in nutrient and sediment loadings. The objective should be to provide the nonpoint source management agencies with information necessary to control and mitigate the loss of beneficial land use cover in each sub-watershed throughout the basin.

After reviewing modeling efforts for the Chesapeake Bay, which support Bay programs, we recommend that model developers and users ensure that modeling results always specify assumptions, confidence intervals for specific estimated values, and limitations of the model output for use in policy making. It is very important that the users of model output clearly understand these limitations as they make program and policy decisions regarding the future direction of the nonpoint source programs within the Chesapeake.

9. PROGRAM ADMINISTRATION

The Panel identified a number of issues and problems related to administrative aspects of the multi-state, multi-agency, nutrient reduction strategy. Our concerns had to do with lack of consistent information upon which program comparisons could be made, incompatible program reporting formats, difficulties in tracking program expenditures, and several additional administrative issues mentioned earlier in our report. While these issues lack the political and public appeal of many of the others raised here, the Panel views them as extremely important to the overall program and potentially capable of seriously undermining it. We believe that improvements in program planning, data management, financial management, reporting, and accountability are necessary to ensure ultimate success in meeting the nutrient reduction target.

We recommend that program managers clearly identify their annual action plans for accomplishing nutrient load reduction goals. Specific measurable objectives need to be identified and progress in meeting those objectives evaluated regularly. The results of program evaluations should be documented and made available to the general public.

The Bay jurisdictions need to do a better job in selecting and tracking meaningful indicators

of program progress. For example, the States should track whether progress is made in correcting the high priority nonpoint source problems identified through targeting efforts. In addition, the States should collect and maintain information on the numbers of farmers receiving technical assistance and the rate of adoption of all BMPs, not just those that are supported by cost-share programs. The Bay States should conduct surveys to determine the effectiveness of education efforts and to help reveal factors that encourage or discourage the adoption of conservation practices.

We recommend that EPA require and the Bay jurisdictions use compatible reporting formats and data management systems for nonpoint source monitoring and modeling data and information.

Compatible reporting formats would help provide a more coherent picture of conditions within the basin and would allow more meaningful comparisons of progress and approaches being implemented in each jurisdiction. State water quality monitoring programs provide a good example of the use of compatible data gathering, analysis, and reporting formats.

We recommend that each Bay State establish a centralized accounting system for funding and labor resources allocated to nonpoint source control programs.

This centralized approach should identify funding amounts and the number of full-time equivalent (FTE) employees allocated to each nonpoint source program component (e.g., cost-share, technical assistance, education). The approach should also identify resource allocations among specific projects and areas within each broad program component. As in the case of technical information, the States should use similar tracking procedures to enable comparisons of program approaches among jurisdictions. The Panel recognizes the enormity of the task of managing such a complex and multi-faceted program, but we also recognize the importance of sound management. Public confidence will be eroded if difficulties that have been encountered in overseeing the expenditure of cost-share funds and reporting on administrative and fiscal issues are not quickly addressed. We believe that program success is dependent on the establishment of a more effective

program management framework.

A NEW APPROACH TO NUTRIENT CONTROL

The preceding recommendations, if fully implemented, will result in short-term improvements to the nonpoint source programs of all the jurisdictions. The Panel believes, however, that a fundamental change in the approach to management of nutrients is necessary if the Bay region is to achieve its ultimate goal.

The Panel recommends that the Bay jurisdictions and the federal agencies develop a mass balance accounting system, where nutrient loadings are balanced by the nutrients removed from the system plus those which are introduced and stored.

This mass balance approach would involve collecting statistics on each of the principal components of nitrogen and phosphorus sources and uses. Sources would include animal waste, commercial fertilizers, and municipal sludge. Uses would include crops harvested and waste composted, incinerated or transported outside the watershed. This approach is based on the idea that a 40 percent reduction in nutrients must be reflected in significant relative changes in these sources or uses. Either the sources must decline or the uses must increase by a combined total of 40 percent if we are to meet our nutrient reduction goal.

The mass balance accounting technique should not replace existing measures. Indeed, several steps need to be taken by the jurisdictions before a reliable mass balance equation could be estimated. Fertilizer statistics must be collected and reported in a more reliable fashion. Animal numbers and concentrations also need to be counted or estimated more accurately. In addition, crop statistics will need to be more complete and detailed in order to generate accurate yield and nutrient uptake data. Finally, gaps in the mass balance equation will need to be identified and filled in.

It will take time to improve data collection and analysis to the point where confidence that a mass balance measure truly reflects changes in nutrient loadings can be assured. Even rough

estimates, however, should prove quite useful in allowing assessment of progress under the Chesapeake Bay Agreement. Although it may take several years to establish a high level of confidence in the mass balance approach, this procedure, in conjunction with existing techniques, is certain to prove more determinate than the current approach alone.

In pursuing the development of a framework based on the mass balance concept, the States should undertake additional efforts to understand the processes by which excess nutrients are removed from the ecosystem by biological uptake. Greater understanding of this process has application for all areas, including farms, urban areas, and aquatic systems, and may prove to be the most cost effective way to address many problems. Winter cover crops, green manure, composting, and biological uptake in wet ponds, wetlands, and forests, are examples of specific processes that should be understood in greater depth. The Panel believes that the development of a mass balance approach is essential to a long range nutrient management strategy.

CONCLUSION

This Panel has reached consensus on this report through free and open discussion, and examination of the information available to it. We commend the States, federal and local agencies, and the private organizations, businesses and citizens for their recognition of the importance of nonpoint source pollution, and their efforts to deal with those problems. Our intent is to provide constructive recommendations and suggestions that, when implemented, will increase the accomplishments of the Chesapeake Bay Program and move the Bay region closer to the goal of a healthy and productive ecosystem.

MEMBERS OF THE NONPOINT SOURCE EVALUATION PANEL

Frances H. Flanigan, Chairperson
Alliance for the Chesapeake Bay, Inc.
Baltimore, MD

Dr. John C. Barber
U.S. Forest Service (Retired)
Warsaw, VA

Dr. S[illegible]ia S. Batie
VPI and SU
Blacksburg, VA

Mel Davis
U.S. Soil Conservation Service (Retired)
Mechanicsburg, PA

Dr. Peter L. deFur
Environmental Defense Fund
Richmond, VA

David Dickson
Izaak Walton League of America
Arlington, VA

Mark Fuchs
Delaware Maryland Agribusiness Association
Ridgely, MD

Patrick Gardner
Chesapeake Bay Foundation
Annapolis, MD

Gerald Heistand
Lancaster Conservation District
Lancaster, PA

John Keeling
American Farm Bureau Federation
Washington, D.C.

Mary Nightlinger
League of Women Voters
Fairfax, VA

John Redmon
Department of Consumer
and Regulatory Affairs (Retired)
Washington, D.C.

Rosemary Roswell
Maryland Department of Agriculture
Annapolis, MD

Jeff Schmidt
Sierra Club
Harrisburg, PA

Senator Noah W. Wenger
Chesapeake Bay Commission
Harrisburg, PA