ISSUES AND ASSOCIATED RECOMMENDATIONS

This chapter is a condensed summary of the major issues and recommendations that are detailed in Chapter 2. They have been organized into three main categories: Nutrient Management, Sensitive Resources, and Non-Nutrient Contaminants. Within these main categories, specific issues have been grouped into high, medium, and low-priority concerns. For each of these concerns there is a brief discussion of the issue followed by the Chesapeake team's related recommendations. The recommendations have been slotted into two groups: Type I – Those over which the Department has direct control, and Type II – Those beyond the Department's jurisdiction. This chapter's structure allows the reader to identify the Chesapeake Basin's most pressing issues, understand them better, and see what can be done to start addressing them.

CONTENTS

3.1 NUTRIENT MANAGEMENT ISSUES

According to the *1998 (305(b)) Watershed Assessment Report,* nutrients pose a serious threat to water quality, aquatic life, and human health. The enrichment of lakes, ponds, bays, and estuaries by nitrogen and phosphorus from surface runoff and ground-water discharge is known to be a contributing factor to eutrophication. Agricultural runoff, urban runoff, and municipal and industrial point source discharges are the primary sources of nutrients. In many watersheds of the Chesapeake Basin, agriculture is the major land use. Poultry production is a major industry in Delaware. Intense animal livestock production tends to create an imbalance of nutrient input to export resulting in an accumulation of nutrients that lead to leaching, erosion, and runoff of excess nutrients to ground and surface waters.

Nitrogen can be transported from organic waste-amended soils into ground waters by leaching and to surface waters by erosion or runoff. Nitrate leaching is a major concern in humid regions with excessively well-drained soils that overlay shallow water tables. These conditions are common throughout Delaware. If nitrate enters ground-water supplies, two major environmental problems can occur. The consumption by humans or animals of drinking water with high nitrate levels has been associated with several health problems, the most serious being methemoglobinemia (O_2 deficiency in blood) in infants. Additionally, ground waters with high nitrate levels that discharge into sensitive surface waters can contribute to the long-term eutrophication of these water bodies. Erosion and surface runoff can transport soluble inorganic nitrogen and organic nitrogen to surface water. Most of the nitrogen lost in this manner is sediment-bound organic nitrogen. Although the solubility of nitrate favors its loss in runoff as opposed to sediment transport, total nitrogen losses from most watershed studies are usually several fold greater than soluble nitrogen.

In the Chesapeake Basin, phosphorus is the major nutrient that is most frequently found to limit plant growth in freshwater streams. Phosphorus contributes to eutrophication by its movement into surface waters through erosion, runoff, and subsurface flow in artificial drainage and ground-water discharge. Accumulation of soil phosphorus to excessive levels must be minimized to reduce the transport of soluble or sediment-bound phosphorus to sensitive water bodies. Because crop production systems are forced to continually use manure as fertilizer, due to the lack of

economically viable alternatives for manure disposal, the systems almost always build soil phosphorus levels well beyond the ranges considered optimum for most agronomic crops. The unfavorable N:P ratio in most manures also results in over-application of manure phosphorus relative to crop needs; to meet crop needs for nitrogen, phosphorus must be over-applied.

3.1.1 TOTAL MAXIMUM DAILY LOADS AND POLLUTION CONTROL STRATEGIES

A Total Maximum Daily Load (TMDL) sets a limit on the amount of a pollutant that can be discharged into a water body and still protect water quality. The Nanticoke River and Broad Creek have been identified as streams with water-quality concerns. As such, they were targeted for TMDL development by December 15, 1998. The major environmental problems in these waters are nutrient over enrichment and low dissolved oxygen levels. These problems are caused by both point and nonpoint sources.

By Secretary's Order No. 98-W-0045, the Department has adopted the TMDL Regulations for nitrogen and for phosphorus for the Nanticoke River and Broad Creek. The effective date of the final regulations was December 10, 1998. These regulations require a 30 percent reduction in the loading of both nitrogen and phosphorus to these water bodies.

The next step is the development and implementation of Pollution Control Strategies to achieve these TMDLs. Pollution Control Strategies for nutrient management can vary from point discharge elimination to Best Management Practices (BMPs) for agriculture. The remainder of this section details the Chesapeake Basin Team's recommendations that could be used as part of the overall Pollution Control Strategies from the Nanticoke River, the Broad Creek, and the rest of the Basin.

3.1.1.1 Riparian Areas

The land immediately adjacent to streams, rivers, or other water bodies is referred to as the riparian corridor. These riparian areas are very important for enhancing both ecological and water-quality values because they maintain unbroken wildlife corridors to the floodplain area, and reduce sediment and nutrient loading downstream. Riparian areas can act as effective nutrient and sediment buffers for their streams by improving the quality of water moving through these areas. Most of the water entering the streams in the Basin initially passes through these riparian buffers. Therefore, protecting these riparian areas can aid in safeguarding the ecological integrity of the larger downstream floodplain systems.

Recommendations — Riparian Areas

High Priority — Riparian Areas:

Type I

- Develop Best Management Practices and an accompanying manual that promotes riparian buffers to help trap nutrients and improve water quality in both channelized and natural streams. (2.6.11 #9, 2.3.5.1; #5)

Type II

- Promote the establishment of forested wetlands and upland forest to supplement and/or restore natural riparian buffers. (2.6.11 #10, 2.8.11 #15, 2.8.11 #11, 2.7.7 #5, 2.3.5.1; #5)

3.1.1.2 Channelization

Approximately 2,000 miles of tax ditches have been reconstructed in Delaware since 1951. In general, many of these drainage-ditch systems involved channelizing the headwaters of existing natural streams, then constructing ditches out and back from headwater channelization. In past decades, natural streams and wetlands were a lower priority than arable land for farming and development. In addition, water-quality impacts and possible habitat losses associated with the "way" drainage ditches were constructed or maintained were not really considered. Drainage systems were constructed as efficiently as possible.

Drainage construction and maintenance efforts do impact water quality and wildlife habitat. Research indicates that drainage systems play an important role in the release and transport of nutrients and bacteria. They also disrupt habitat. In many areas, natural riparian vegetation is removed, affecting upland and transitional habitat for many animal and bird species. Lack of canopy affects in-stream temperature and dissolved oxygen parameters, which in turn disrupts biological integrity and diversity.

In light of accumulated information, the state's drainage program has developed and is implementing a number of management practices to address these concerns. A need has been expressed to review these existing practices, define a process that allows consistent use, and track implementation.

The Conservation Reserve Enhancement Program (CREP) is providing increased incentives for landowners to implement certain Best Management Practices (BMPs) to improve water quality and enhance wildlife habitat. CREP is focusing efforts on implementing riparian buffers and grass filter strips, increase wildlife habitat acres, and restore wetlands in targeted water quality and wildlife habitat degraded areas. It is expected that implementation of this program will advance Delaware's goal of meeting water-quality standards.

Recommendations — Channelization

High Priority — Channelization:

Type I

- Implement the channelization BMP manual that promotes riparian buffers to help trap nutrients and excessive land runoff. Alternative maintenance techniques should be considered, including saving trees, mowing along one side of ditch, use of herbicides for those landowners who refuse to establish woody vegetation, or not mowing at all. (2.6.11 #11, 2.3.5.1; #6 & 7)
- Promote ways (utilizing brochures) for landowners affected by ditching to easily obtain monies from Conservation Districts for ditch improvement projects and riparian buffers. (2.7.7 #17)
- Educate the agricultural community and other people affected by ditching that drainage and wetlands habitat can coexist if managed properly. (2.6.11 #12)
- Require the use of existing and new BMPs for channel construction activities. (2.6.11 #13, 2.7.7 #5)
- Finalize products of the Department's Comprehensive Tax Ditch Committee. (2.6.11 #14)

3.1.1.3 Pond Management

Many of the ponds and lakes within the Chesapeake Basin can be classified as eutrophic due to heavy infestations of algae and aquatic weeds. Although the natural aging process tends to fill a pond in over time, the rate has been greatly accelerated by land-use practices adjacent to and upstream from the ponds. Development, farmland runoff, storm events, and heavy use of fertilizers have served to increase the nutrient and silt loads to high levels. This has resulted in excess growth of aquatic weeds and algae, which can impede water-based recreation, adversely affect fish populations, degrade adjacent streams, and cause displeasing odors.

The present "solution" of weed harvesting and herbicide application is similar to mowing the lawn. While they serve as a temporary solution, the nutrients are still available in the substrate and the water column in excess levels. Concurrently, nutrient inputs continue to be high. A long-term solution relies in responsible management of the lands surrounding and affecting these water bodies. Private and public landowners who reside on or manage these lands need to alter land-use practices to reduce nutrient inputs.

Recommendations — Pond Management

High Priority — Pond Management:

Type I

- Recommend that the Department develop BMPs for pond maintenance and remediation. (2.6.11; #2)
- Examine current pond management approaches and develop a more effective, broad-based management approach. Educate pond managers and concerned public to the problems confronting the eutrophication problem in ponds. (2.6.11 #5, 2.7.7 #8)

3.1.1.4 Department Policy and Future Direction

A reduction in the amount of nitrogen and phosphorus reaching the water bodies of the Chesapeake Basin is necessary to reverse the undesirable effects. These nutrients enter the water bodies from several sources including point sources, nonpoint sources, and from the atmosphere. Point sources of nutrients are end-of-pipe discharges coming from municipal and industrial wastewater treatment plants and other industrial uses. Nonpoint sources of nutrients include runoff from agricultural and urban areas, seepage from septic drainfields, and ground-water discharges. Atmospheric deposition comes from both local and regional sources, such as motor vehicle exhaust and emissions from power plants burning fossil fuel.

On December 10, 1998, the Department adopted nutrient Total Maximum Daily Loads (TMDLs) for the Nanticoke River and Broad Creek. These regulations call for 30 percent reduction in nitrogen and phosphorus loads from point and nonpoint sources.

The attainment of TMDLs for the Nanticoke River and Broad Creek watersheds within the state will be achieved through development and implementation of Watershed Restoration Action Strategies (WRASs), which will consist of many Pollution Control Strategies (PCSs). The WRASs will be developed by the Department in concert with the Department's ongoing Whole Basin Management Program, Tributary Advisory Teams, and the affected public.

The purpose of WRAS is to initiate actions that will reduce the nutrient loads to impaired water bodies that do not meet Delaware's water-quality standards. The proposed WRAS will be accomplished by optimizing Best Management Practices (BMPs) for nutrient removal at existing to point sources facilities and by developing and implementing pollution control strategies for nonpoint sources. To effectively implement the WRAS, there must be extensive effort to educate the citizens of Delaware about the process and impacts of that process on their living, working, and playing. Consequently, a myriad of opportunities exists to educate both the public and private sector on the effects of the PCSs on their daily lives.

TMDLs required for the Chesapeake Basin are as follows:

Nanticoke River and Broad Creek Main Stems	1998
Nanticoke River and Broad Creek Ponds and Tributaries	2000
Choptank, Chester, Marshyhope, and Pocomoke Listed waters	2005

Recommendations — Policy

High Priority — Policy:

Type I

- Continue to promote and financially support conservation planning in the Chesapeake Basin and use COMPAS GIS technology to document implementation of Best Management Practices (2.3.5.1; #1)
- Recommend use of septic mapping data in the development of Pollution Control Strategies (2.3.5.1; #14)
- Provide cost-sharing on poultry litter movement from areas of high concentration to areas where it can be utilized to meet crop needs as demonstrated in a comprehensive nutrient management plan. (2.3.5.1; #2)
- Offer low-interest loans to poultry companies to retrofit feed mills for nutrient reduction in poultry litter. (2.3.5.1; #12h)
- Advocate cover-crop program. (2.3.5.1; #4)
- State that P/N nutrient management system is needed. (2.3.5.1 #9)
- Finalize and Adopt updated P Index. (2.3.5.1 #8 & #10)
- Recommend that state develop Animal Feeding Operations strategy (permits, BMPs, etc.). (2.3.5.1 #15)
- Focus nutrient management plans for intensive animal-based agriculture on farm-scale nutrient balance rather than exclusively on field-scale crop response to nutrients applied in animal wastes. (2.3.5.1 #11)
- Develop economically viable alternative uses of manure; encourage expedited demonstrations into composting, post-composting processing, and market potential of composted products. (2.3.5.1 #12d)
- Support implementation of phytase feed lines by all integrators on the shore by year 2003. (2.3.5.1 #12g)
- Identify the areas where a significant amount of ground water is being consumed and the Department has little or no water-quality data. (2.3.5.1 #16)
- Develop and implement pollution control strategies to meet established TMDLs for Nanticoke and Broad Creek. (2.3.5.1 #17)
- Develop and implement storm-water monitoring plan. (2.3.5.1 #19)
- Begin development of TMDLs for remainder of Basin. (2.3.5.1 #18)
- Eliminate all Combined Sewer Overflows in Basin. (2.3.5.1 #20)
- Synchronize NPDES permits in watersheds/basins. (2.3.5.1 #21)
- Review septic regulations considering TMDL/PCS issues. (2.3.5.1 #22)
- Implement the Conservation Reserve Enhancement Program (CREP) in the Chesapeake Basin on 2,000 to 3,000 acres by the year 2002 for the following Best Management Practices: filter strips, riparian buffers, wildlife habitat restoration, and shallow wildlife areas. (2.3.5.1 #5)
- Develop depth to ground-water maps for the entire state that highlight areas with an extremely shallow water table (2.1.5 #2, 2.5.4 #10)
- Review irrigation well-water quality for nutrient loading. Incorporate in Management Plans. (2.5.4 #11)
- The Department should closely monitor Maryland's *Pfiesteria* Action Plan as it contains proposed land-based solutions to the overall nutrient-loading problem. (2.3.5.1 #12)

Type II

- Rather than control economic growth, town zoning codes, which were conceived in the 1960s, prevent it. Traditional Neighborhood Districts, Village Overlays, Transit Oriented Overlays, and updating of town comprehensive plans partially or completely, etc., should direct growth to areas where infrastructure already exists. (2.8.11 #16)
- Intergovernmental coordination zones should be designated in growth areas and areas likely to be annexed to provide the latest and best data to decision-makers. (2.8.11 #17)
- The Department should encourage the three counties to have a (two- or three-year) sunset time of rezoned and subdivided land in the non-urban growth areas of this Basin. Land in urban growth areas should have a longer time span for initiating new construction on rezoned land. (2.8.11 #1)
- Work with counties and local governments to coordinate septic regulations for greater (average) open space for unsewered areas. (2.3.5.1; #23)

Medium Priority — Policy:

Type I

- Targeted ground-water monitoring should be incorporated more frequently into BMP implementation projects. If possible, monitoring plans should be developed to discern short-term effects and predict long-term trends to provide a better indication of implementation impact. (2.3.5.1; #3)
- Amend the septic regulation to provide for more appropriately located large community septic systems. (2.3.5.1; #24)

- Review analytical site data from all site types for any available nutrient information. (2.3.5.1; #31)
- Recommend that the Department deny the placement of new (non-replacement) alternative septic systems outside of investment areas and restrict their placement in investment areas to reduce impacts to wetlands and important habitats. (2.3.5.1; #25)
- Assess septic system failure rate for the Chesapeake Basin through remote sensing and verification by grounding survey. (2.3.5.1; #26)
- Determine ground-water system lag time in various sites throughout the state. This could be very helpful in establishing timetables to see results of Pollution Control Strategies. (2.5.4 #13)
- Develop a combined strategy to coordinate ground-water sampling and share analytical data. (2.5.4 #1)

Type II

- Encourage update of town plans. The Department, in conjunction with the Office of State Planning Coordination and the Sussex County Planning Department, should encourage the towns of Greenwood, Bridgeville, Seaford, Blades, Laurel, and Delmar to develop comprehensive plans. The plans would, among other things, prioritize the areas in and around the towns for sewer and water service, annexation procedures, requiring procedures, etc. The plans should include a transportation element, conservation element, and economic development element. The Office of State Planning Coordination should grant funds for this. (2.8.11 #19)
- Corridor preservation for reducing air pollution and runoff, and reducing sewer construction should be supported by the Department along U.S. 301 and other major corridors. (2.8.11 #4)
- When and where construction is needed, encourage infill to existing developed areas rather than development of "green" spaces. Continue to work with communities to encourage the protection of stream corridors. (2.7.7 #6)

Low Priority — Policy:

Type I

- Support and develop certification for (required) inspection of septic during property transfer. (2.3.5.1 #27)
- Obtain grants to repair, or replace, malfunctioning septic systems in environmentally sensitive areas. Incorporate innovative technologies where appropriate. (2.3.5.1 #28)
- Continue to research and demonstrate alternative systems, such as gray-water separation, or the placement of sawdust under tile drainage fields. (2.3.5.1 #29)
- Refine regional ground-water flow data with information from all possible sites. (2.5.4 #12)
- Determine more accurate base-flow loading for impacted streams; Compare ground-water and surface-water data for interactions. (2.5.4 #5)
- Analyze up-gradient well data from monitored sites to see if there are any regional trends in ground-water quality. (2.5.4 #4)

Type II

- A study should be undertaken to determine the maximum density an urban growth area must attain before additional undeveloped land is added to an urban growth area. This may have serious implications for infrastructure expansion issues. (2.8.11 #18)
- The Department should support a new county sewer district in the greater Summit area north of Middletown to reduce the potential for contamination of the water-table aquifer. (2.8.11 #3)

3.1.1.5 Implemented Projects and Pollution Control Strategies

Although action is needed on all of these recommendations in order to better manage nutrients throughout the Basin and the state, the following recommendations were acted upon and are currently in varying stages of implementation. The first two recommendations-turned-projects were conceptualized, planned, and funded as a direct result of the Chesapeake Basin Assessment. The atmospheric deposition study was identified by the Chesapeake Team, but was implemented and funded by the Inland Bays/Atlantic Ocean Team and its associates because it provided a vital piece of information for that basin's TMDL effort. The wetlands loss project was started outside of the Whole Basin process, but Chesapeake Basin team members provided support.

As the state moves to implement TMDLs and Pollution Control Strategies, it is very important that the lands the government owns or controls be managed properly. Therefore, all agricultural lands owned by state and federal governments must be assessed and have comprehensive conservation plans developed for them. These plans should then be incorporated into the land lease agreements and daily management practices. (2.3.5.1; #30)

With the widespread nutrient inputs throughout the Basin, it is important to locate all of the various sources accurately so that local action can be taken. In particular, as population increases in rural areas, septic systems are installed to dispose of the waste. The regional density of these systems and their proximity to sensitive resources are important pieces of the nutrient management puzzle. Therefore, all septic systems in basins (state) should be mapped using aerial

photography. This information, when placed in GIS format, should the be used to answer more specific questions about system placement and density. (2.3.5.1; #13)

Atmospheric deposition is proving to be a major contributor to acidification, nitrogen loading, and toxification of waterways. There is currently little or no specific information on the impact of atmospheric deposition to the Chesapeake and other Delaware basins. It is recommended that options be explored for acquiring the necessary resources to conduct computer modeling and other research to quantify the impact of atmospheric deposition on the Chesapeake and other basins. (2.4.4 #5)

Also, there is a strong need to develop baseline wetland losses in the Chesapeake Basin and identify areas that are losing wetlands due to urbanization and/or agriculture. (2.6.11 #1)

3.2 SENSITIVE RESOURCES

The Chesapeake Basin team has identified a number of very diverse resources in the Basin as being "sensitive." These sensitive resources can include living resources such as endangered species or fragile habitat, but also include items as diverse as open space, drinking-water supply areas, or even scenic rivers. The Chesapeake Basin contains some of the state's most picturesque areas. From the Cypress Swamp to the Nanticoke River, much of the natural beauty of this Basin has been preserved. However, habitat loss and degradation due to land-use practices is impacting many of the species that reside in this Basin. Rare and declining species are vulnerable to environmental change and alteration of habitat. Many species exist only in the protected portions of the watershed or rely on certain critical areas for reproduction. This includes both rare and endangered species as well as those considered to be commercially and recreationally important. The locations of some of these critical habitats have not been identified and may be lost before protective measures can be imposed. Therefore, it is not only important to provide protection to known critical areas, but to those areas that have a high potential as well.

3.2.1 RESOURCE PROTECTION

Some of the state's most valuable natural lands are located in this Basin. Many of these are still intact because most growth has occurred in other areas of the state. In a continuing effort to protect these resources, the Department and other non-profit organizations regularly evaluate these areas and rank them for acquisition or protection. In most cases, these rankings are based on existing data and are grouped with those from throughout the state. The Chesapeake Team feels that, because of its relatively undisturbed nature, much of this Basin should be evaluated more critically to protect pristine areas before they are lost.

3.2.1.1 Surface Water, Ground Water, and Wetlands

Many of the rivers and streams in the Basin are considered to be of exceptional recreational and ecological value. These water bodies have a great impact on the character of this Basin. In fact, much of the recreation and almost all of the Basin's truly natural areas surround these streams. Not only should these streams be protected, but some effort most be made to protect the ground water that provides much of their water. Ground water is the primary source of drinking water in the Basin and can account for almost 80 percent of the stream flow. Many factors can help improve both surface- and ground-water quality, one of which is the preservation of natural wetlands. These wetlands act as buffers and filters for many of the activities and contaminants that would otherwise enter the ground water/surface water system. In addition, these wetlands provide vital habitat for many of the Basin's endangered and threatened species. As one can see, this is a complex system that needs to be addressed comprehensively in order to protect many of the Basin's sensitive resources.

Recommendations — Surface Water, Ground Water, and Wetlands

High Priority — Surface Water, Ground Water, and Wetlands:

Type I

- Promote the acquisition and protection of wetlands and natural heritage sites. (2.6.11 #3)
- Adopt department-wide comprehensive wetland plan. (2.6.11 #4)
- Examine current pond management approaches and develop a more effective, broad-based management approach. Educate pond managers and concerned public to the problems confronting the eutrophication problem in ponds. (2.6.11 #5, 2.7.7 #8)
- Delineation of all source-water protection areas, such as wellhead areas and excellent recharge potential area. (2.5.4 #6)

Type II

- Adopt statewide wetland mitigation policy. Include the concept of "Land Banking." (2.6.11 #7)
- Prohibit dredging in the Nanticoke upstream of Rte. 13 in Seaford. Siltation and mechanical removal of benthic sediments would disrupt SAV beds, freshwater fish, wetland plants, shoreline vegetation, and benthic invertebrates. (2.7.7 #14)
- Establish wellhead protection ordinances, Best Management Practices, and/or regulations. (2.5.4 #7)

Medium Priority — Surface Water, Ground Water, and Wetlands:

Type I

- Better characterization of metals, pesticides and PCBs in Nanticoke watershed. (2.3.5.2 #2,#5,#10,#15)
- Identify intensive ground water extractive use in areas that may have water availability issues. (2.5.4 #8)
- The location of all facilities with water allocations should be updated and a coverage created in the Department GIS similar to that created for public supply wells. (2.5.4 #2,#3)

Low Priority — Surface Water, Ground Water, and Wetlands:

Type I

- Accurately define all sub-cropping aquifer areas to help protect the deeper portions of these aquifers. (2.5.4 #9)
- Better mapping accuracy for surface-water intakes including all irrigational uses. (2.5.4 #2,#3,#14)

3.2.1.2 Riparian

Riparian vegetation not only harbors rare species, but also acts as a buffer for adjacent aquatic habitat. Plant roots stabilize banks and impede or filter nutrient-laden runoff from entering directly into the surface water. When this habitat is destroyed or altered, there is a loss of plant and animal species and degradation of water quality. The excess siltation resulting from improper bank management can smother fish egg masses, freshwater mussels, and aquatic vegetation. For some species, this habitat is critical to their continued survival.

Current and existing land developments are often constructed without considering the protection of riparian habitat in the planning process. Many shore residents have installed bulkheads or other hard structures to retard bank erosion, a problem that could have been prevented if riparian buffers hadn't been destroyed. As riparian habitats continue to be destroyed and degraded, responsible management is lacking and protection of this habitat type is inadequate.

Recommendations — Riparian

High Priority — Riparian:

Type I

- Preservation and restoration of riparian buffers for both natural streams and tax ditches should include new, environmentally friendly techniques for tax ditch maintenance, inter-agency coordination, and public/governmental education. (2.8.11 #11)
- Develop model zoning ordinance favoring riparian protection. (2.8.11 #12)
- Promote activities that eliminate unnaturally high sedimentation and erosion rates, and unnaturally high nutrient inputs. Assess effect of direct stream irrigation on aquatic and riparian systems. (2.7.7 #5)
- Recommend, whenever practical, the use of non-structural alternatives for erosion control, or a combination of rip-rap with natural vegetation should be emphasized where shoreline erosion is a problem for property owners. (2.8.11 #13)

Type II

- Work with county and municipal governments to adopt zoning ordinance favoring riparian protection. (2.8.11 #12)

Medium Priority — Riparian:

Type I

- Encourage stream and pond management that incorporates wide buffers of natural vegetation, including stands of woody species when possible. (2.7.7 #7)

3.2.1.3 Living Resources

An undeniable fact within the Chesapeake Basin is that the species composition of the remaining natural areas has permanently changed. The 18th-century direct habitat conversion of natural areas to agricultural use has altered a functioning natural landscape into a sprinkling of isolated islands and ribbons of natural areas in a sea of agricultural fields. Add to this the introduction of alien species, pollution, excessive sedimentation, altering of natural waterways, etc., and each natural area is further eroded. Therefore, it is imperative that efforts are made to protect the sensitive resources that still exist within this Basin and also throughout the state.

Recommendations — Living Resources

High Priority — Living Resources:

Type I

- The Statewide Wetland Mapping Project data should be compared with the Natural Heritage Inventory to identify areas where additional research and/or protection are needed. (2.6.11 #8)
- Institute mandatory reporting requirements for commercial American eel harvests to determine the status of the fishery. (2.7.7 #11)
- Implement American shad restoration and protection projects including the construction of fish passage facilities (e.g. Records and Concord Ponds), development of a hatchery program, and limiting existing harvests. (2.7.7 #12)

Type II

- Identify restoration possibilities to increase connectivity between available habitats (include cooperative opportunities with Maryland). (2.7.7 #19)

Medium Priority — Living Resources:

Type I

- Discourage planting invasive exotic plants in Delaware. Encourage the use of native and non-aggressive exotic plant species. Train management personnel to recognize invasives and to develop management strategies. (2.7.7 #9)
- Maintain or establish "no wake" zones where needed. The use of non-structural alternatives for erosion control or a combination of rip-rap with natural vegetation should be emphasized where shoreline erosion is a problem for property owners. (2.7.7 #13)

- Develop a plan to prevent zebra mussels from becoming established in Delaware (educating anglers, boaters, etc.) (2.7.7 #16)

Type II

- Discourage planting invasive exotic plants in Delaware. Encourage the use of native and non-aggressive exotic plant species. Train management personnel to recognize invasives and to develop management strategies. (2.7.7 #9)

3.2.1.4 Department Policy and Future Direction

Protecting the sensitive resources in the Chesapeake Basin requires a coordinated effort between numerous parties. In some instances, this coordination occurs smoothly, while in other instances there are many obstacles. The Department needs to evaluate many of its policies with regard to protecting these resources and initiate the appropriate actions within and outside the agency.

Recommendations — Policy

High Priority — Policy:

Type I

- Establish a methodology for discouraging development in Sensitive Areas. (2.6.11 #6)

Type II

- The Department should more actively seek agreement with the Office of State Planning on the definition of what is "more than local concern" and therefore trigger reviews under LUPA to protect open space. (2.8.11 #2)
- Development of lands within State Resource Areas, Natural Heritage Sites, Natural Areas Inventory, and Old Growth Forests should be discouraged. (2.8.11 #7)
- Critical Areas should be accorded special status and given special attention when a development is proposed on or adjacent to such an area. It is recommended that state and local governments care for these areas. Their actions and decisions should reflect a major commitment toward protecting and conserving these resources. (2.8.11 #8)
- Implement requirements for buffer zones along streams to protect prehistoric and early historic period archaeological sites. (2.8.11 #9)
- Establish historic review boards, such as the one in New Castle County, which will result in proactive measures to preserve historic buildings, and undertake efforts to record important features of those that cannot be preserved. (2.8.11 #10)

Medium Priority — Policy:

Type I

- Develop model open space ordinances. (2.8.11 #14)

Type II

- Comprehensive plans that are relevant today may become obsolete tomorrow. Most planning and zoning relationships must be reassessed on a continuing basis to guarantee that important land functions continue to operate while the land is used, no matter what the use. (2.8.11 #5)
- The Department should encourage the development of recreation facilities in and around population centers; encourage the inclusion of usable open space in the subdivision process; and work with local communities throughout the Basin to help them meet the recreation needs of their residents. (2.8.11 #6)
- Intergovernmental coordination zones should be designated in growth areas and areas likely to be annexed to provide the latest and best data to decision-makers. (2.8.11 #17)
- Work with county and municipal governments to adopt open space ordinances. (2.8.11 #14)
- A dedicated effort to improve and enforce County Comprehensive plans must be made in the future to prevent further degradation of natural resources in the state. (2.7.7 #3)
- When and where construction is needed, encourage infill to existing developed areas rather than development of "green" spaces. Continue to work with communities to encourage the protection of stream corridors. (2.7.7 #6)

3.2.2 RESOURCE CHARACTERIZATION

Although there are some highly developed areas in the Chesapeake Basin, much of this Basin is still relatively "natural." This rural and undeveloped landscape often leads to a scarcity of data about the natural areas that currently exist. As population increases and development pressures expand into the Basin, many of these sensitive resources may become threatened. Therefore, it is vital to adequately characterize these resources prior to this development pressure so that well-informed decisions can be made to implement appropriate and comprehensive protection strategies.

3.2.2.1 Surface Water, Ground Water, and Wetlands

The Chesapeake Basin team defines the sensitive resources in this Basin as including not only the traditional endangered species, but also certain natural features and properties. For instance, ground water, which is the Basin's primary source of water for both drinking and irrigation purposes, is deemed sensitive because of the potential for severe degradation from many human activities. Additionally, many rivers, streams, and wetlands, which serve as

crucial environmental buffers and habitats, are also appreciated for their aesthetic value and are therefore categorized as sensitive resources.

Recommendations — Surface Water, Ground Water, and Wetlands

High Priority — Surface Water, Ground Water, and Wetlands:

Type I

- Complete recharge-potential mapping for the rest of the state. This mapping shows areas where water and/or contaminants can rapidly enter the ground water. (2.1.5 #1)
- Develop depth to ground-water maps for the entire state that highlight areas with an extremely shallow water table. (2.1.5 #2)
- Support additional funding for statewide soil survey mapping update. (2.1.5 #3)

Medium Priority — Surface Water, Ground Water, and Wetlands:

Type I

- Better characterization of metals, pesticides, and PCBs in Nanticoke watershed. (2.3.5.2 #2,#5,#10,#15)
- Identify intensive ground-water extractive use in areas that may have water availability issues. (2.5.4 #8)
- The location of all facilities with water allocations should be updated and a coverage created in the Department GIS similar to that created for public supply wells. (2.5.4 #2,#3)

Low Priority — Surface Water, Ground Water, and Wetlands:

Type I

- Accurately define all sub-cropping aquifer areas to help protect the deeper portions of these aquifers. (2.5.4 #9)
- Better mapping accuracy for surface-water intakes including all irrigational uses. (2.5.4 #2,#3,#14)

3.2.2.2 Living Resources

In many ways, our living resources reveal more about the state of our environment than any other factor. Our native species are generally the first indicators of change or disruption. They experience first-hand the direct impact of habitat loss, degraded air and water quality, and competition from exotic species. In particular, studies of rare and declining species can play special roles as environmental indicators. These are often the species most sensitive to environmental change and habitat degradation, and hence can bring the first hints of environmental impact. With development pressure increasing, it becomes more urgent that these sensitive living resources be accurately characterized throughout the Basin.

Recommendations — Living Resources

High Priority — Living Resources:

Type I

- A survey of the Chesapeake Basin should be conducted as soon as possible to identify remaining upland forests and to evaluate the quality of these areas using such factors as biodiversity, size, age, and exotic infestation. Appropriate actions should then follow such as natural area designation for qualifying tracts, legal protection, and/or restoration. (2.7.7 #1)
- A survey of rare habitats should be conducted and summarized. Appropriate actions should be taken to protect these areas, including natural area designation for qualifying tracts, legal protection, and/or restoration. (2.7.7 #2)
- Critical spawning habitat in the Nanticoke River should be identified through subaqueous mapping and available fish sampling data. Once identified, these areas should be afforded protection from excess siltation, dredging, and water-quality degradation. (2.7.7 #14)
- Once high-quality freshwater mussel sites have been identified, they should be afforded protection from habitat degradation. (2.7.7 #15)
- Work cooperatively with adjacent states to identify the status of the American eel fishery. (2.7.7 #11)
- Incorporate Delaware Natural Heritage Program databases with other planning databases, including those in Maryland, so that rare species are identified prior to development. (2.7.7 #18)

Medium Priority — Living Resources:

Type I

- Little information is known about the status of many native fishes (mostly non-game species). More data need to be collected on the presence and population levels of these native species. (2.7.7 #20)
- Data on spawning locations, spawning success, population structure, and population levels for yellow perch need to be collected. (2.7.7 #21)

Low Priority — Living Resources:

Type I

- Delaware should contact the Army Corps of Engineers and ask them to summarize the nature and extent of shipping activity on the Nanticoke. (2.3.5.2 #6)

Type II

- A test-scale controlled burn should be conducted on fire-dependent plant communities to re-establish the link between fire and the natural diversity and adaptability of the extant species in Delaware's modern forests and marshes. (2.7.7 #10)
- Acquired the resources necessary to study and quantify the level of ozone-induced crop damage and its associated impacts. (2.4.4 #4)

3.3 NON-NUTRIENT CONTAMINANTS

Chemical contamination from "classic" industrial sources and the potential threat of this contamination is not widespread in the Chesapeake Basin. The highest concentration of these sites occurs within, and immediately surrounding, the towns located in Sussex County. Leaking underground storage tanks (LUSTs) make up a majority of the sites with known contamination. Petroleum hydrocarbons are the chemical contaminants that most often are associated with these LUST sites. Contamination of nearby drinking wells is the most common concern regarding this type of contamination. Besides the LUST sites, there are a number of contaminated sites located throughout the Basin that are managed by other programs within the Department. For instance, the Site Investigation and Restoration Branch oversees the abandoned Sussex county landfills, while the Ground Water Discharges Section monitors community septic systems.

Chemical contamination from the use of agricultural pesticides and herbicides has not been fully characterized in the Chesapeake Basin. Also, there may be some legacy issues surrounding contaminated sediments of the Basin's waterways; however, these are not adequately characterized either. While chemical contamination is of much less concern than the nutrient contamination that affects the Chesapeake Basin, existing data gaps inhibit the Department's ability to definitively characterize the issue of Basin-wide chemical contamination at this time.

3.3.1 RESEARCH AND INVESTIGATION

3.3.1.1 Department Policy and Future Direction

Recommendations — Policy

High Priority — Policy:

Type I

- The extent to which metals contamination of the sediment is also a problem in the water column is not well characterized. Historical water column metals data should be compiled and assessed in conjunction with the Preliminary Assessment Report. (2.3.5.2 #10)
- The results of the Chesapeake Bay Fall Line Toxics Monitoring Program for the Bridgeville USGS gauge location suggest existence of sources for pesticides and metals entering the Nanticoke River above the Bridgeville gauge. The Chesapeake Whole Basin Team should review and map out available pollutant source data for that area of the watershed above the Bridgeville gauge. The relative importance of these sources in comparison to sources in the Seaford area should be considered within an overall mass balance context. (2.3.5.2 #4)

Type II

- Due to the regional nature of the ozone problem, it is essential that we continue to participate with other states, regional and federal agencies on data sharing efforts. Delaware currently works with, and should continue to work with, other states, regional agencies and EPA to communicate ozone data between the various states and agencies. (2.4.4 #2)
- The Department should coordinate with the U.S. EPA and the City of Seaford in the review of influent and effluent data generated in conjunction with the city's Industrial Pretreatment Program for its wastewater treatment plant. The effluent data should be used to estimate mass loadings of toxics to the Nanticoke River from the treatment plant. (2.3.5.2 #1)

Medium Priority — Policy:

Type I

- A sediment "Triad" study should be conducted in the reach of the Nanticoke River below Seaford to confirm or refute whether the sediments are actually toxic to benthic organisms. (2.3.5.2 #14)
- Deep (e.g. 3 to 5 feet) sediment cores should be obtained and analyzed at discrete depth intervals in an effort to determine the historical input and sedimentation rate of PCBs and heavy metals in the Nanticoke below Seaford. (2.3.5.2 #15)
- Educate the public regarding the proper disposal of motor oil and household chemicals. Continue to support the efforts of the Delaware Solid Waste Authority in its household hazardous waste collection program. (2.3.5.2 #8)
- Adequate information currently exists to evaluate status and trends for the criteria pollutants: volatile organic compounds, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead. Data collection and evaluation should continue unchanged. (2.4.4 #1)
- The periodic ozone precursor emission inventories for VOCs, NO_x, and CO are compiled every three years. The inventories are comprehensive and cover all emission source categories. Emission inventories for SO_2, PM_{10}, TSP, lead, and toxics are performed annually but only for large point sources. More comprehensive inventories of these pollutants with the addition of $PM_{2.5}$ are recommended in order to gain

additional information on impacts to the Chesapeake and other basins. Impacts of emissions on the Chesapeake and other basins could also be improved by developing methods to enable aerial, mobile, and biogenic emissions to be illustrated in graphical form, such as on a Geographic Information System (GIS) map. (2.4.4 #4)

- Explore options for acquiring the needed support to produce comprehensive periodic inventories of SO_2, PM_{10}, TSP, lead, and toxics. (2.4.4 #4a)
- Explore options for acquiring the needed support to produce comprehensive periodic inventories of greenhouse gases. (2.3.5.2; #17)
- Develop a method to allocate area, mobile and biogenic emissions to geographic basins, and graphically portray those emissions. (2.4.4 #4b)
- The Department should evaluate the extent to which Best Management Practices are being implemented for bulk chemical transfer and storage along the Seaford waterfront. (2.3.5.2 #7)
- Adequate information currently exists to evaluate the status and trends for $PM_{10.}$ New particulate matter standards for $PM_{2.5}$ have been enacted by EPA and require the development of baseline data from which future reductions may be calculated. (2.4.4 #3)
- Develop a combined strategy to coordinate groundwater sampling and share analytical data. (2.5.4 #1)

3.3.2 EDUCATION AND PROTECTION

3.3.2.1 Department Policy and Future Direction

Recommendations — Policy

High Priority — Policy:

Type I

- Place EPCRA Tier II facilities on the chemical contaminants map and also populate the Site Index Database with these sites. (2.3.5.2 #9)
- Provide technical assistance to the City of Seaford for the installation of "urban BMPs" such as sand filters and other passive storm-water pollutant reduction devices. (2.3.5.2 #11)
- Aboveground storage tanks are currently unregulated; develop regulations for operation, spill/overfill protection, leak detection, tank testing requirements, and corrosion protection. (2.3.5.2 #13)

Type II

- The Department should continue to work with the City of Seaford to ensure that the city's Combined Sewer Overflows (CSOs) are eliminated in a timely manner. (2.3.5.2 #3)

Medium Priority — Policy:

Type I

- Develop education process for owners of exempt Underground Storage Tanks about proper maintenance and leak detection to avoid become a regulated LUST. (2.3.5.2 #16)

3.3.2.2 Implemented Projects and Pollution Control Strategies

The Chesapeake Team recognized the need for increased public awareness about Basin-wide environmental issues. The idea for placing street signs stating that you are entering the Basin was brought forward along with a Basin-wide storm-drain stenciling project. The Inland Bays/Atlantic Ocean team moved forward on the Basin project with the idea that the other basins will follow. The Chesapeake team help provide the information necessary to incorporate the storm-drain stenciling into the state's middle school Watershed Education Curriculum.

Recommendations — Implemented

High Priority — Implemented:

Type I

- Implement a storm-drain stenciling program to raise the awareness of the public concerning the relationship between storm-water runoff and river quality. (2.3.5.2 #12)