WATERSHED PLAN

Little Assawoman Bay Watershed

Prepared by:
Delaware NPS Program
2011

The contents of the Little Assawoman Bay Watershed Plan are intended to fulfill the elements of a Watershed Plan in compliance with the a) through i) criteria as established by EPA.

Version I

Complete: February 25, 2011

Submitted: March 5, 2012

By: Mark Hogan

Executive Summary

The contents of the Little Assawoman Bay Watershed Plan are intended to fulfill the elements of a Watershed Plan in compliance with the a) through i) criteria established by EPA. The Little Assawoman Bay Watershed Plan addresses the following criteria:

- Causes and Sources of Impairment
- Expected Load Reductions
- Proposed Management Measure
- Technical/Financial Needs
- Information, Education and Public Participation Component
- Schedule and Milestones
- Load Reduction and WQ Evaluation
- Monitoring Strategy

Nutrient over-enrichment has long been a concern in Delaware's Inland Bays, specifically in the Indian River, Indian River Bay, Rehoboth Bay and Little Assawoman Bay and their tributaries. Many plans have been made in order to correct these problems, but few were as contentious as the Total Maximum Daily Load (TMDL) regulations promulgated by the Delaware Department of Natural Resources and Environmental Control (Department). They were established for the Indian River, Indian River Bay and Rehoboth Bay in December, 1998 and for the Little Assawoman Bay in January 2005. These TMDLs called for the systematic elimination of all point sources of nutrient loading to those water bodies along with a 40-65% reduction in nonpoint phosphorus loading and a 40-85% reduction in nonpoint nitrogen loading see Appendix B. The TMDL also calls for a 20% reduction in atmospheric deposition of nitrogen through implementation of the Clean Air Act. An implementation plan, or a Pollution Control Strategy (Strategy), was to be developed by a Tributary Action Team, a diverse group of citizens and government agency personnel and presented to the Department for promulgation. This document reflects those recommendations made by the Inland Bays Tributary Action Team (Team) based on a consensus-seeking process.

The process used to generate the strategy, "Public Talk-Real Choices," places importance on putting the public first in policy making (Appendix C). The Tributary Action Team, through consultation with the general public, recommended a Pollution Control Strategy, a set of actions for achieving the TMDL, to the Department. This Strategy is based on general principles developed by the public during seven public forums held within the TMDL watersheds. These principles, or common ground, are the foundation that the Team used in building their Strategy.

While this Watershed Plan is based directly on the Inland Bays Pollution Control Strategy, it is drafted in a manner to specifically address the Little Assawoman Bay watershed.

Scientific literature and experts in the pertinent fields were consulted and assisted the Department in estimating the nutrient reductions that would be achieved through the promulgation of this Watershed Plan. These estimates are shown throughout this document and in addition, the Watershed Plan reviews the various costs associated with the recommended actions. The Plan also recommends

funding mechanisms and implementation schedules where appropriate as well as identifies responsible parties. Finally, the Plan reviews the agencies and programs that are charged with implementing elements of the recommended actions.

Introduction

Intensive water quality monitoring performed by the State of Delaware, the federal government, various university and private researchers, and citizen monitoring groups has shown that surface waters of the Inland Bays Watershed including the Little Assawoman Bay are highly enriched with the nutrients nitrogen and phosphorous. Although nutrients are essential elements for plants and animals, their presence in excessive amounts causes undesirable conditions. Symptoms of nutrient enrichment in the Little Assawoman Bay have included excessive macro algae growth (sea lettuce and other species), phytoplankton blooms (some potentially toxic), large daily swings in dissolved oxygen levels, loss of Submerged Aquatic Vegetation (SAV), and fish kills. These symptoms threaten the future of the Little Assawoman Bay - very significant natural, ecological, and recreational resources of the State - and may result in adverse impacts to the local and State economies through reduced tourism, a decline in property values, and lost revenues. Hence, excessive nutrients pose a significant threat to the health and well being of people, other animals, and plants living within the watershed.

A reduction in the amount of nitrogen and phosphorous reaching the Little Assawoman Bay is necessary to reverse the undesirable effects. These nutrients enter the Bays and its tributaries and ponds 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 tanks, and ground water discharges. Atmospheric deposition comes from both local and regional sources, such as motor vehicle exhausts and emissions from power plants that burn fossil fuels.

Section 303(d) of the Federal Clean Water Act (CWA) requires States to develop a list (303(d) List) of water bodies for which existing pollution control activities are not sufficient to attain applicable water quality standards and to develop Total Maximum Daily Loads (TMDLs) for pollutants or stressors causing the impacts. A TMDL sets a limit on the amount of a pollutant that can be discharged into a water body and still protect water quality. TMDLs are composed of three components, including Waste Load Allocations (WLAs) for point source discharges, Load Allocations (LAs) for nonpoint sources, and a Margin of Safety (MOS).

The Delaware Department of Natural Resources and Environmental Control (DNREC) listed the Little Assawoman Bay and several tributaries and ponds of the Inland Bays on the State's 303(d) Lists and proposes the following Total Maximum Daily Loads regulation for nitrogen and phosphorous:

A. The nonpoint source nitrogen load in the Little Assawoman Bay Watershed shall be reduced by 40 percent. For the 3-year period of 1998 through 2000, this would result in reduction of total nitrogen load in the Watershed from 594 pounds per day to 357 pounds per day.

B. The nonpoint source phosphorous load in the Little Assawoman Bay Watershed shall be reduced by 40 percent. For the 3-year period of 1998 through 2000, this would result in reduction of total phosphorous load in the Watershed from 49 pounds per day to 30 pounds per day.

C. The Implementation of this TMDL Regulation shall be achieved through development and implementation of a Pollution Control Strategy. The Strategy will be developed by DNREC in concert with the Inland Bays Tributary Action Team, other stakeholders, and the public.

Information, Education and Public Participation

The DNREC has determined that the water quality of the Little Assawoman Bay and its tributaries are impaired by elevated nutrient levels and low dissolved oxygen concentrations. These impairments cause macro algae and phytoplankton blooms, large daily swings in dissolved oxygen, habitat loss, reduced populations of aquatic life, and fish kills. These symptoms threaten the future of the Inland Bays and their significant natural, ecological, and recreational resources.

The environmental degradation and habitat loss may result in adverse impacts to our local and state economies through reduced tourism, a decline in property values, lost revenues and a diminished quality of life. Excessive nutrient levels pose a significant threat to the health and wellbeing of people, animals, and plants living within the watershed.

A Total Maximum Daily Load (TMDL), or the maximum amount of a pollutant that can enter surface waters from point and nonpoint sources and still meet water quality standards, must be determined for each impaired water body. Point Sources include any facility with a National Pollutant Discharge Elimination System (NPDES) permit. Nonpoint Sources are spread across the landscape and are most often associated with agriculture and the wastewater and stormwater from developed lands. DNREC established TMDLs for nitrogen and phosphorus in the Little Assawoman Bay and tributaries in 2005. The TMDLs call for the systematic elimination of all point sources of nutrient loading, a 40-65% reduction in nonpoint phosphorus loading, and a 40-85% reduction of nonpoint nitrogen loading. The nonpoint source reductions required in the Inland Bays Watershed, which includes the Little Assawoman Bay, a dynamic home to agriculture, development, and tourism, are the highest in the State. The TMDLs also call for implementation through a publically developed Pollution Control Strategy.

To identify nutrient reducing actions that could be implemented in the Inland Bays Watershed,as a whole, DNREC worked with a diverse group of stakeholders, called a Tributary Action Team, for several years. Beginning in 1998, the Team developed a set of recommendations, including voluntary and regulatory actions, to reduce nutrients entering the streams, ponds, and bays of the watershed. The resulting Pollution Control Strategy (PCS) focuses on pollution caused by the activities of people and is based on the premise that since we all contribute to the sources of pollution,

we all need to act to improve water quality. The PCS actions focus on four main areas of pollution: agriculture, urban land use, stormwater, and wastewater.

The draft of the Inland Bays PCS, including draft regulations, was initially presented at a public information workshop in February 2005 and then again at several other public feedback events over a three year period. Although changes have been made to address public comments received between 2005 and 2008, the PCS is based upon the recommendations offered by the Inland Bays Tributary Action Team. During the summer of 2008, DNREC formally proposed a regulation that includes provisions requiring riparian buffers, improved stormwater management, and additional standards and measures for onsite wastewater treatment and disposal systems (septic) in the Inland Bays Watershed. These regulations, which are designed to reduce nonpoint source pollution with certainty, are the first of their kind!

The regulations were proposed in the June 1, 2008 Delaware Register of Regulations, opening a month-long public comment period. A public hearing, attended by more than 400 interested individuals, was held on June 23, 2008 at the CHEER Center in Georgetown. A wide range of comments were received, with some in opposition to the proposed regulations, some in support of the regulations as written, and some requesting additional regulatory actions. The majority of comments focused on the proposed buffer and onsite wastewater treatment and disposal system provisions. The hearing officer reviewed all comments received on the proposed regulation, and the Department's response to comments and reported to the Secretary, who then signed an order to adopt the regulation.

The adopted regulation was published in the Delaware Register of Regulations on November 1, 2008. Currently, DNREC is undergoing extensive education and outreach activities to further public participation in the PCS implementation process.

Causes and Sources of Impairment

Causes

Excessive nutrients, i.e., nitrogen and phosphorus, are pollutants of concern for the Little Assawoman Bay and cause violations of water quality standards. Removing these pollutants is the goal of this Watershed Plan and Pollution Control Strategies. The sources of nutrient loading to the Little Assawomen Bay are nonpoint sources which include surface runoff from agricultural, urban, and other land use activities in the sub-basin, ground water discharge, atmospheric deposition, and contributions from nutrient-rich coastal waters (Cerci et al., 1993).

Sources

NONPOINT SOURCES

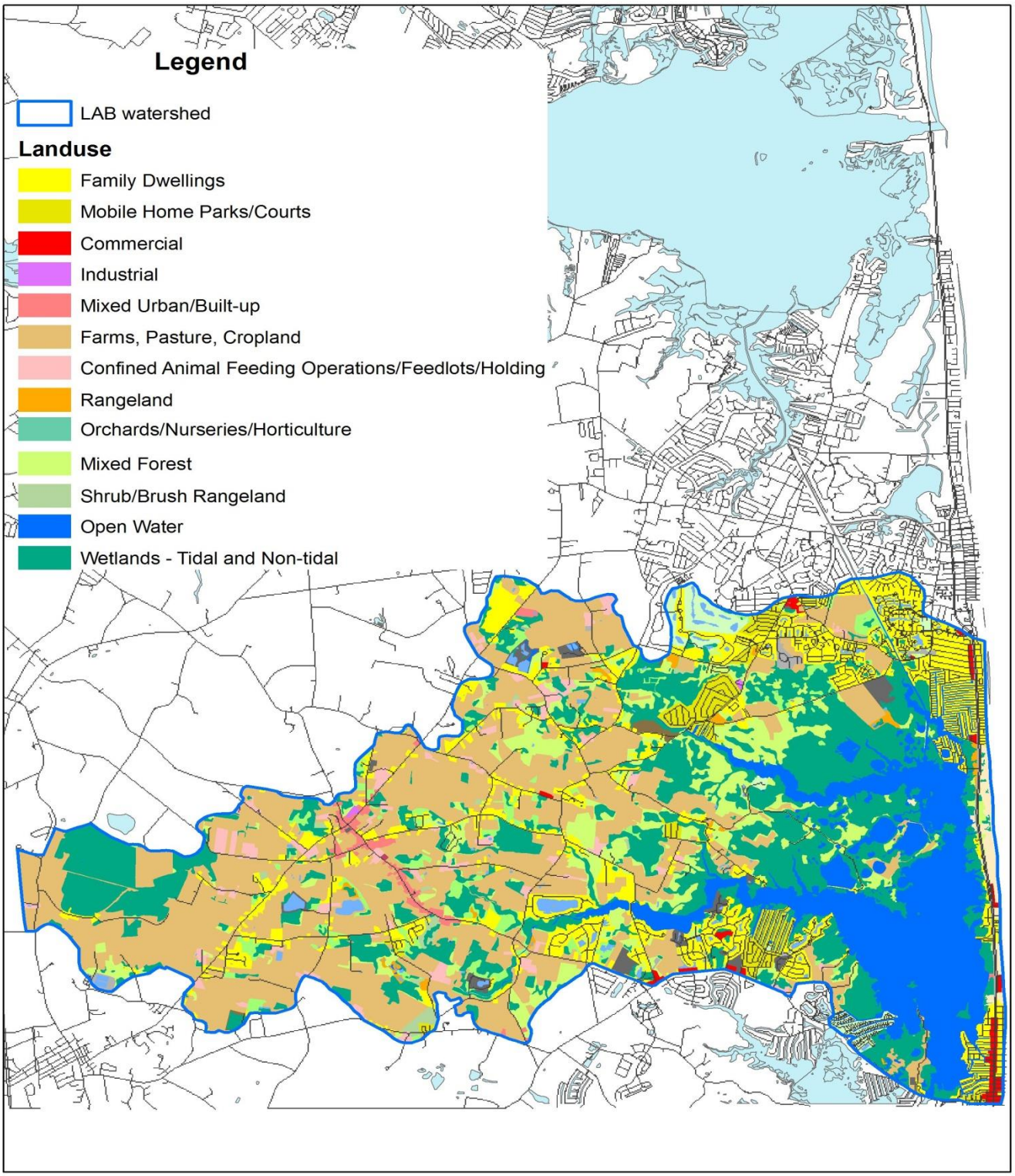
Pollutant loads not associated with discrete discharges are categorized as nonpoint sources. In contrast to continuous discharge from treatment plants, loading from nonpoint sources is typically intermittent, diffuse and difficult to track back to specific sources. Depending on the type of land use and physiographic characteristics of a watershed, nonpoint source pollution may account for a

significant portion of the total load within the watershed (Cech, 2002), as it is in this case. Nonpoint sources of pollution can come from most land uses through overland flow. However, nonpoint source pollution can also leach into the ground water and subsequently enter surface water. Since 80 percent of the freshwater entering the Bays and their tributaries comes from ground water (Johnston, 1976; Andres, 1992), we need to curb all types of nonpoint source pollution. For the purposes of this Strategy, the following types of nonpoint sources will be addressed:

- agriculture,
- urban land use,
- wastewater, and
- stormwater.

When land is developed, nutrient loadings can come from multiple sources, such as yard maintenance, wastewater disposal, stormwater runoff and soil erosion, and increases in impervious cover (Herlihy et al., 1998). Given the growth, pressures from development, and tourism in this watershed, this Strategy must address these sources of nutrient loading. In addition, agricultural practices lead to nutrient pollution via their use of fertilizers and manures (Jordan et al., 1997). Upwards of 30 million chickens are produced annually in the watershed and their waste is primarily used as fertilizers on some of the 62,728 acres of agricultural lands. Thus, this Strategy addresses the existing Best Management Practices (BMPs) that can be employed to reduce the impacts from these activities. The Strategy can adapt to changes in technology and new BMPs as science and pilot programs prove their functionality and reliability in the field.

Figure:1 Land Use of Little Assawoman Bay



ATMOSPHERIC DEPOSITION

There are several forms of nitrogen to consider when estimating an atmospheric deposition rate: nitrate (NO3-), which comes from high temperature combustion sources like coal-fired power plants and motor vehicles; ammonium (NH4+) and ammonia (NH3) gas, which are largely produced by agricultural practices; and organic nitrogen (ON), whose sources have not been well quantified. The estimated atmospheric nitrogen load directly deposited to Delaware's Inland Bays is based on the findings reported in Scudlark and Church (1999) and Scudlark (2002), which produce a different atmospheric load than originally used in the 1998 TMDL analysis document. Both of these reports make use of the data generated at the long-term (20+ years) precipitation chemistry sampling site at Cape Henlopen State Park, Lewes, Delaware (NADP, 2003). The more recent study additionally examined the spatial gradient in NO_{3-} and NH_{4+} concentrations in precipitation and the dry deposition of NH_3 gas across the Inland Bays Watershed. The wet and dry deposition rates reported for these species produce a total nitrogen deposition rate ranging from 12.9-14.7 kg N/ha/yr when summed. The average deposition rate (12.3 lb/acre/yr) can be applied to the surface area of the bays (19,811 acres) to yield a nitrogen load of 243,408 lb N/year, or 667 lb N/day. This estimated load considers only direct atmospheric deposition to the bay surface waters and does not take into account deposition to the watershed. The contribution from this latter component will ultimately be reflected in surface and ground water loads. The 1998 TMDL calls for a 20 percent reduction in the atmospheric deposition of nitrogen, which will reduce the daily load to surface waters to 534 lb N/day. Since the sources of organic nitrogen are currently uncertain, strategies to reduce this component of atmospheric N deposition have not yet been developed.

Recommended Management Measure and Expected Load Reductions

This part of the plan details desired and expected load reductions. These reductions are estimated for each management measure.

Agriculture

General Action: **The agriculture sector should implement additional best management practices (BMPs) in order to achieve water quality standards. This Strategy will establish goals for implementation levels of various BMPs.**

Agriculture contributes significant amounts of nitrogen and phosphorous to the Inland Bays Watershed through field applications of manure, litter, and commercial fertilizers that are ultimately transported to the water. Agriculture is the largest land use in the watershed, accounting for 33 percent of the land. In 2005, more than 33 million chickens were raised in the watershed, generating more than 36,000 tons of manure and litter that are typically applied to the land. Most of the croplands are devoted to growing corn and soybeans. If nutrients are over-applied to agricultural

sites, the excess may be transported to surface waters. Implementation of comprehensive nutrient management plans and agriculture best management practices (BMPs) can significantly reduce nutrient losses from agricultural activities.

The Delaware Nutrient Management Act gives the authority to regulate the application and generation of nutrients in order to achieve water quality standards. However, since the technical analysis of existing agricultural BMPs and required nutrient management plans do not do enough to achieve the TMDL, this Strategy does address agricultural practices other than BMPs. In December 2003, the DNMC agreed to the concept of implementation goals for agriculture, as well as other sectors. Agriculture has already taken significant strides towards improving water quality.

Results: To date, agriculture significantly reduced nonpoint source nutrient loads in order to achieve the TMDL reductions—20 percent of the needed TN reduction and 32 percent of the needed TP reduction. This has been done at a relatively inexpensive cost of an average $4.74/lb of TN reduced and $297/lb TP reduced. Because of the diversity of cost-share programs available, the farmer or producer bares little to none of these costs. Under this Strategy, agriculture will be responsible for reducing 87 percent of the TN reductions and 60 percent of the TP reductions needed.

1. ***Management Measure:*** **Full compliance with the NMA; all agricultural acres should have a nutrient management plan.**

Implementation mechanism: The Delaware Nutrient Management Act and the Delaware Nutrient Management Commission.

Schedule: All agricultural operations (where nutrients are applied to 10 acres or more) are required to have Nutrient Management Plans as of January 1, 2007.

Milestones: Annual: The DNMC assesses compliance with requirements.

Monitoring: The DNMC has authority to oversee the implementation of the requirements of the Act.

Funding: Farmers and producers are responsible for having a certified nutrient planner design the plans. Cost-share funds are available from the DNMC and the Sussex Conservation District.

Responsible organizations: DNMC, farmers and producers.

Estimated load reductions: The Strategy workgroup determined that TN loading is reduced by 20.5 percent. Assuming that NMPs will be implemented on 53,827 acres (23,543 exist), a total of 635 lbs/day of TN 49 lbs/day of TP and will be reduced in the Inland Bays Watershed. The LAB has 7,343 acres available for NMP's. A total of 81 lbs/day of TN and 5.4 lbs/day of TP will be reduced in the LAB watershed.

Estimated cost: Farmers are eligible for cost share and the amount varies depending on the number of acres enrolled. An average cost share value is $4.35 per acre for a 3-year plan. This amounts to an annual cost of $78,049 or $0.34 per lb TN reduced.

2. ***Management Measure:*** **Annual goal of 3,550 acres in cover crops one week before the published date of the first killing frost, and not fertilized.**

Implementation mechanism: The Sussex Conservation District will provide cost share for this BMP. The Department will assist the DNMC and Conservation Districts to promote the use of cover crops and the cost-share program.

Schedule: 25% of the acres should be implemented by annually after 2010; an additional 25% by 2016 and the total amount by 2020.

Milestones: Annual Evaluation: Monitored and assessed by the Sussex Conservation District to determine compliance with suggested schedule.

Monitoring: The District will monitor farms involved in the cover crop cost-share program.

Funding: The Conservation District will provide cost-share funds. However, the EQIP program also has funds available.

Responsible organizations: Farmers, producers, NMC, and the District

Estimated load reductions: The Pollution Control Strategy workgroup (PCS workgroup) used a formula that recognized the differing efficiencies associated with different crop species. The group recommends 59 percent reduction in TN and a 4.9 percent reduction in TP. The total amount of cropland (approximately 7,101 acres) is available for cover crop. Based on crop rotation from year to year, if 50 percent of that is implemented in the LAB then there should be a reduction of 121 lbs TN/day. The total phosphorous reduction will 0.4 TP/day. Then 100% of available acres, based on crop rotation would be implemented.

Estimated cost: Cover crops cost about $35/acre or $2.81/lbs TN removed. However, farmers can receive $30-$40/acre for planting cover crops. Since some species that are more efficient at reducing nitrogen loading to the water can be planted at less than $35/acre, an opportunity exists for the farmer to benefit from this best management practice.

Comment: The Sussex Conservation District continues to add new incentives to their cover crop program in order to increase participation. In 2005, they offered bonuses for early planting. In 2006, they are piloted a "commodity" cover crop program, which allowed farmers to harvest the crops.

3. ***Management Measure:*** **Goal of 100% acres of riparian forested buffer along NHD streams. For buffer details, see Attachment G.**

Implementation mechanism: The Conservation District along with the DNMC and DNREC will promote this practice and the relevant cost-share programs.

Schedule: 25% should be installed by 2010, and additional 25% by 2016 and 100% by 2020. *Monitoring:* The Conservation District will monitor farms included in cost-share programs.

Milestones: Annual Evaluation: Monitored and assessed by the Sussex Conservation District to determine compliance with suggested schedule.

Funding: Cost-share funds will be available through the CRP, EQIP and CREP programs.

Responsible organizations: Farmers, producers, NMC, and the District

Estimated load reductions: The PCS workgroup recommended that forest buffer be assigned efficiencies of 62 percent reduction in both TN and TP. Each acre of buffer has nutrient reduction associated with a land use change for the actual area in the buffer and reductions for reducing runoff from two upland acres. The goal of a 60 foot forested buffer in the LAB for every acre of the 1675 acres available, 2 acres will be applied. See Appendix E. The total nutrient reduction for this goal is 196 TN/day and 6.4 TP/day.

Estimated cost: Cost-share programs such as CREP provide funding for planting, maintenance and land rental. Thus, the farmer bares no costs associated with this BMP. However, the annual cost of this action is $4.25/lb TN reduced.

4. ***Management Measure:*** **Goal of restoring wetlands in areas that were previously converted to cropland. For buffer details, see Appendix E.**

Implementation mechanism: The Conservation District along with the DNMC and the Department will promote this practice and the relevant cost-share programs.

Schedule: 25% should be installed by 2007, and additional 25% by 2008 and 100% by 2011.

Milestones: Annual Evaluation: Monitored and assessed by the Sussex Conservation District to determine compliance with suggested schedule.

Monitoring: The Conservation District will monitor farms included in cost-share programs.

Funding: Cost-share funds will be available through the CRP, EQIP, WRP and CREP programs.

Responsible organizations: Farmers, producers, NMC, and the Conservation District

Estimated load reductions: The PCS workgroup recommended that wetlands be assigned the same efficiencies as those used for forest buffers, 62 percent reduction in both TN and TP. Each acre of wetland has nutrient reduction associated with a land use change for the actual area in wetland and reductions for reducing runoff from two upland acres.

Estimated cost: Cost-share programs such as CREP provide funding for planting, maintenance and land rental. Thus the farmer bares no costs associated with this BMP. The annual costs are $6.80/lb TN reduced.

5. ***Management Measure:*** **Maintain the existing wildlife habitat, grassed waterways, and grassed filter strips. For buffer details, see Appendix G.**

Implementation mechanism: The Conservation District along with the DNMC and DNREC will promote this practice and the relevant cost-share programs.

Schedule: The goal has been achieved and will require maintenance.

Milestones: Annual Evaluation: Monitored and assessed by the Sussex Conservation District to determine compliance with suggested schedule.

Monitoring: The Conservation District will monitor farms included in cost-share programs.

Funding: Cost-share funds are available through the CRP, EQIP and CREP programs.

Responsible organizations: Farmers, producers, NMC, and the Conservation District

Estimated load reductions: The PCS workgroup recommended that wildlife habitat and grassed waterways be assigned nutrient reductions due to the change in land use, the change from cropland to grasslands. There is 1.5 acres of grass buffers are estimated to be responsible for 0.11 lbs/day of TN reductions and 0.13 lbs/day of TP reduction.

Estimated cost: Cost-share programs such as CREP provide funding for planting, maintenance and land rental. Thus, the farmer bares no costs associated with this BMP.

6. ***Management Measure: G*****rassed buffers. For buffer details, see Attachment E.**

Implementation mechanism: The Conservation District along with the DNMC and DNREC will promote this practice and the relevant cost-share programs.

Schedule: 25% of available acres should be installed by 2007, and additional 25% by 2008 and 100% by 2011.

Milestones: Annual Evaluation: Monitored and assessed by the Sussex Conservation District to determine compliance with suggested schedule.

Monitoring: The Conservation District will monitor farms included in cost-share programs.

Funding: Cost-share funds will be available through the CRP, EQIP, and CREP programs.

Responsible organizations: Farmers, producers, NMC, and the Conservation District.

Estimated load reductions: The PCS workgroup recommended that grass buffers be assigned efficiencies of 46 percent reduction in TN and 54 percent reduction in TP. Each acre of buffer has nutrient reduction associated with a land use change for the actual area in buffer and reductions for reducing runoff from two upland acres.

Estimated cost: Cost-share programs such as CREP provide funding for planting, maintenance and land rental. Thus the farmer bares no costs associated with this BMP. However, the annual costs are $6.05/lb TN reduced.

7. ***Management Measure:*** **Continue to use and support the construction of poultry manure storage sheds and composters.**

Implementation mechanism: Promotion by the Conservation Districts, DNMC and the Department.

Milestones: Annual Evaluation: Monitored and assessed by the Sussex Conservation District to determine compliance with suggested schedule.

Schedule: As soon as possible

Monitoring: The Conservation District monitors those structures where cost-share and low interest loans were received for their construction.

Funding: Cost-share is provided by the Conservation District through EQIP and by the Financial Assistance Branch of the Department through SRF.

Responsible organizations: Farmers and producers.

Estimated load reductions: The PCS workgroup was unable to assign specific load reductions to the manures sheds or poultry mortality composters. Thus, although these BMPs reduce nutrients, we will not specifically assign a nutrient load reduction to them. In the alternative, they will act as a "margin of safety" for achieving the TMDL.

Estimated cost: Cost-share programs provide partial funding for the construction of these structures. The total annual cost for these structures is $263,195, including funds expended through cost-share programs.

8. ***Management Measure:*** **Increase the annual quantity of manure relocated or put into an alternative use.**

Implementation mechanism: DNMC's cost-share program for manure relocation will provide outreach in order to gain more participants in the relocation program. The Perdue Agri-recycle facilities will continue to take excess manure for their plant as well.

Schedule: This relocation goal would be achieved on an annual basis. More intensive outreach has already begun.

Milestones: Annual Evaluation: Monitored and assessed by the DNMC to determine compliance with suggested schedule.

Monitoring: The DNMC tracks the manure that is relocated and reports that data such that progress towards the goal may be tracked.

Funding: Funds for the relocation program come from the General Assembly as well as the Nonpoint Source Program, if it is relocated off-peninsula.

Responsible organizations: Farmers, producers, DNMC

Estimated load reductions: The PCS workgroup assigned nutrient reductions from relocation (See Appendix E). Consequently, TN will be reduced by 321 lbs/day and TP by 34.1 lbs/day.

Estimated cost: The cost-share program is designed such that the producer will not have to bare any costs. Annually, this goal would cost $271,822 or $2.32/lb TN reduced.

9. ***Management Measure:*** **Continue the use of feed amendments, such as phytase, and to minimize calcium di-phosphate in poultry feed in order to reduce nutrients in poultry manure.**

Implementation mechanism: Poultry integrators must continue to attempt to balance feed additives with the nutritional needs of the birds. A Memorandum of Understanding between the integrators and the DNMC requires the use of feed additives. Poultry Companies shall research and incorporate, when appropriate, into their feed formulations the use of feed additives, feed ingredients or other nutritional strategies. These strategies shall be used in an effort to modify the ratio of phosphorus and nitrogen, or reduce or otherwise modify the nutrient levels within the feed without detrimental effects on bird health or growth. Progress on these initiatives and goals shall be part of the Company's annual report to the Nutrient Management Commission."

Schedule: Optimum utilization of this additive will occur as soon as possible, although, all integrators use phytase in their feeds now.

Milestones: Annual Evaluation: Monitored and assessed by the DNMC to determine compliance with suggested schedule.

Monitoring: Manure nutrient contents from a University of Delaware fact sheet were used to calculate nutrient reductions. Poultry integrators report annually to the DNMC on the use of amendments.

Funding: The integrators pay for the process of adding phytase to the feed.

Responsible organizations: Poultry integrators.

Estimated load reductions: If there are 2,563,200 chickens producing 2,819.52 tons of manure per year in the LAB then it is estimated that 1.44lbs/day of TP are removed through the use of phytase. See Appendix E page 18 for how this load reduction is calculated.

Estimated cost: Not available.

10. ***Management Measure:*** **Implement additional Water Control Structures and maintain the 480 acres currently treated by these structures.** The use of water control structures is a highly efficient BMP for nutrient reduction, with little to no loss of crop land. Properly managed, these structures can also be used to increase yields on dry land farm ground by retaining moisture in the soil during dry periods.

Implementation mechanism: The Sussex Conservation District will approach farmers in the areas where these additional structures will be most appropriate.

Schedule: Implement as soon as possible.

Milestones: Annual Evaluation: Monitored and assessed by the Sussex Conservation District to determine compliance with suggested schedule.

Monitoring: The Conservation District tracks BMPs that they cost-share.

Funding: Cost share is available through the Sussex Conservation District for 75% of the cost, not to exceed $5,000, and through EQUIP for 50% of the total cost. The average cost is $4,000-$5,000 per structure.

Responsible organizations: Farmers and land owners.

Estimated load reductions: The PCS workgroup devised a method to estimate nutrient reductions from this practice. When the goal is achieved, these BMPs will be responsible for approximately 37.6 lbs/day reductions of TN. Currently, there are 16 water control structures in the LAB watershed. Each structure drains 30 acres, resulting in 480 treated acres total.

21 (N loading rate) x 480 acres x 33% (efficiency) = 3,326.4 lb N/yr

Estimated cost: The Sussex Conservation District provides cost-share for this practice. Total annual costs will be $23,212 or $1.69/lb TN reduced.

Urban Land Use

General Action: **Decrease nutrient loading from urban nonpoint sources.**
Urban or residential land usage is increasing in the watershed. From 1992 to 2002, the acreage considered urban increased 35 percent. It is expected that this trend will continue. In fact, 2000 census figures show that coastal Sussex County is the fastest growing area in Delaware. Urban areas with high percentages of impervious surface contribute significant pollution loads in waterways.

Numerous urban sources of nutrients are transported to the Inland Bays through erosion, stormwater runoff and leaching from soils to the ground water. The sources include discharges from individual and community on-site septic systems as well as fertilizers applied to private and commercial landscapes, nutrient rich sediments from construction activities, exhaust emissions, and open burning.

For these reasons, urban land usage must be regulated in order to reduce nutrient loading from it—so that we may achieve the TMDL.

Results: This section of the Pollution Control Strategy will work to reduce nutrient loading by impacting how land is developed. Although most of the reductions are going to come from the agriculture sector, the watershed is developing quickly. Thus, as these agricultural lands convert to urban/residential/commercial use, the development must be accomplished such that nutrient loadings continue to be reduced through implementing all available Best Management Practices.

1. ***Management Measure:*** **Designation of the Inland Bays Watershed as a 'Critical Environmental Area.' The entire Inland Bays Watershed should be managed for nutrient reductions consistent with TMDL load reductions, or to the maximum extent possible.**

Implementation mechanism: All relevant programs should incorporate provisions that require permitted technologies and resource management needed to control nutrients. Nutrient reduction levels may be defined through the use of standards, performance measures and other techniques to ensure optimal nutrient removal.

Schedule: Programs will make changes upon the promulgation of this Strategy.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: The Inland Bays Tributary Action Team in partnership with the Department will monitor progress toward the implementation of this action.

Funding: No funding is required to implement this action item.

Responsible organizations: Department, the County, Municipalities, other State agencies

Estimated load reductions: Depend upon the practice implemented.

Estimated cost: NA

2. ***Management Measure: Encourage resource-based land use planning.*** The Preliminary land Use Service (PLUS) has improved coordination between federal, State and local government, yet measures must be taken to ensure that local zoning codes and ordinances provide adequate protection to the Inland Bays. The Strategies for State Policies and Spending (SSPS) is an important incentive tool in encouraging resource-based land use planning. **It is suggested that the SSPS and other incentive/disincentive tools shall be specifically tied to natural resource protection goals in the Inland Bays Watershed.**

Implementation mechanism: The Preliminary Land Use Service (PLUS) provides for early review of various projects, including County and municipal plans. This provides ample opportunities for developers to become aware of environmental requirements. In addition, the recent update of the

SSPS incorporated natural resource layers in an attempt to direct growth away from sensitive resources.

Schedule: County Comprehensive Plans must be updated every 5 years while municipal comprehensive plans are reviewed every 5 years and updated every 10.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: The Office of State Planning ensures that Comprehensive Plans are consistent with the SSPS.

Funding: NA

Responsible organizations: Office of State Planning Coordination, County, municipalities
Estimated load reductions: Although this action will lead to nutrient reductions, they are not quantifiable at this point.

Estimated cost: NA

3. ***Management Measure:*** **Establish buffers of 100 feet landward from State-regulated wetlands, or landward from the mean high water line of all tidal waters, whichever extends farther upland, and landward from the ordinary high water mark of all other primary water features. Establish buffers of 60 feet landward from the ordinary high water mark of all secondary water features.** These buffers shall be clearly demarcated, designated, and recorded on final site plans or final major subdivision plats and demarcated on the ground with signs or other kinds of markers. More details regarding buffer requirements can be found in the Regulations Governing the Pollution Control Strategy for the Indian River, Indian River Bay, Rehoboth Bay and Little Assawoman Bay Watersheds.

Implementation mechanism: Promulgation of the Regulations of the Pollution Control Strategy for the Inland Bays Watershed.

Schedule: Implementation will begin according to effective dates outlined in the Regulations of the PCS.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: Compliance will be monitored through issuance of related permits.

Funding: None required.

Responsible organizations: State, county, municipalities, property owners

Estimate load reductions: Reductions from the implementation of buffers in the urban setting would result from the conversion of land in the buffer and by assuming that each acre of buffer reduces nutrients from two upland acres of urban land.

Estimated costs: NA.

4. ***Management Measure:*** **Buffer widths may be reduced when combined with stormwater provisions and with the creation of a development-wide nutrient management plan created by a certified nutrient consultant and implemented by a certified nutrient handler.** More details regarding buffer and sediment and stormwater requirements can be found in the Regulations Governing the Pollution Control Strategy for the Indian River, Indian River Bay, Rehoboth Bay and Little Assawoman Bay Watersheds.

Implementation mechanism: Promulgation of the Regulations of the Pollution Control Strategy for the Inland Bays watershed.

Schedule: Implementation will begin according to effective dates outlined in the Regulations of the PCS.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: Compliance will be monitored through issuance of related permits.

Funding: The costs will be born by the developer.

Responsible organizations: Sediment and Stormwater Program, Division of Soil and Water Conservation, DNREC, Nutrient Management Program, Department of Agriculture, State, county, municipalities, property owners

Estimate load reductions: Reductions from the implementation of buffers in the urban setting would result from the conversion of land in the buffer and by assuming that each acre of buffer reduces nutrients from a portion of the upland urban land. In addition, nutrient reductions will occur as a result of any stormwater BMPs installed and the implementation of a nutrient management plan.

Estimated costs: NA.

5. ***Management Measure:*** **When development-wide nutrient management plans are required, the homeowners association must retain the plan on file, maintain records of nutrient applications, and submit a summary of nutrient application records to the Department of Agriculture, Nutrient Management Program on an annual basis.**

Implementation mechanism: Promulgation of the Regulations of the Pollution Control Strategy for the Inland Bays watershed.

Schedule: Implementation will begin according to effective dates outlined in the Regulations of the PCS.

Milestones: Annual Evaluation: Monitored and assessed by DNMC to determine compliance with suggested schedule.

Monitoring: Compliance will be monitored through issuance of related permits and annual submittal of nutrient application summary reports to the Nutrient Management Program.

Funding: The costs will be born by the homeowner's association.

Responsible organizations: homeowner's association, Nutrient Management Program, Department of Agriculture

Estimate load reductions: NA, nutrient management plans are very effective at reducing the over-application of nutrients in the agriculture sector and likely have similar impacts in the urban sector.

Estimated costs: NA.

6. ***Management Measure:*** **No landowner or their representative shall extend lot lines into buffers.**

Implementation mechanism: Promulgation of the Regulations of the Pollution Control Strategy for the Inland Bays watershed.

Schedule: Implementation will begin according to effective dates outlined in the Regulations the PCS.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: Through the Preliminary Land Use Service and other governmental permitting practices.

Funding: NA.

Responsible organizations: Department and local governments

Estimate load reductions: NA.

Estimated costs: NA.

7. ***Management Measure:*** **Encourage the planting of trees and other plants adjacent to all waters and wetlands.**

Implementation mechanism: Land owners are encouraged to plant buffers in trees, shrubs and grasses in order to maximize nutrient removal efficiencies of the buffers. In addition, turf grass abutting a

water or wetland should not be fertilized. The developer is encouraged to work with the tax ditch managers to develop an agreement which would allow some strategic planting of trees within the right-of-way. This may involve added maintenance responsibilities for the property owners which would be performed to the satisfaction of the tax ditch organization. This recommendation applies to both new and existing buffers.

Schedule: As this is strictly a voluntary action, implementation is encouraged as soon as possible.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: Through working with State agencies, we should be able to track the acreage of planted buffers.

Funding: The Delaware Forest Service, Delaware Coastal Program, Delaware Fish and Wildlife and Delaware Nonpoint Source Program have grants which may be available for planting of buffers.

Responsible organizations: State, municipalities, property owners

Estimate load reductions: NA, depends on acreage planted

Estimated costs: NA, depends on acreage planted and species and plant sizes used.

8. ***Management Measure:*** **Upon the improvement of a parcel, the Department will produce a nutrient budget. The nutrient budget will illustrate how the future land use will reduce or increase nutrient loading.** This budget, based on the best available data, will illustrate the current nutrient loading of that parcel to ground and surface water and the proposed nutrient loading from the new use. The Department will use a protocol for producing this budget. Copies of the protocol are available for use from the Watershed Assessment Section.

Implementation mechanism: The Watershed Assessment Section has already begun this process. Projects subject to the Preliminary Land Use Service (PLUS) are being reviewed.

Schedule: This provision is being implemented.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine continued compliance.

Monitoring: The Department will use the protocol results to help estimate changes in nutrient loading to waters in the Inland Bays Watershed.

Funding: The protocol tool will be available free of charge.

Responsible organizations: Watershed Assessment Section

Estimated load reductions: Difference in the land use loading rate for the previous land use and the developed land use with BMPs.

Estimated cost: NA

9. ***Management Measure:*** **The Delaware Nutrient Management Commission (DNMC) is the controlling authority for fertilizer application on parcels of land 10 acres in size or greater within the Inland Bays Watershed. Recognizing the significant contributions of nitrogen and phosphorus from land parcels less than 10 acres in size develop a program which addresses practices that may result in nutrient reductions. These should include, but are not limited to: establishing nutrient budgets for homeowners, technical support for small landowners, and education.**

Implementation mechanism: The DNMC has produced a brochure on proper lawn maintenance. These brochures have been placed in most retail outlets that sell fertilizer in the watershed. In addition, the Inland Bays Tributary Action Team has run an advertisement on a local television station reminding people about proper lawn nutrient application and urging people to get a soil test done prior to applying fertilizer.

Schedule: Efforts are already underway.

Milestones: Annual Evaluation: Monitored and assessed by DNMC and DNREC to determine compliance with suggested schedule.

Monitoring: It is impossible to monitor the fertilizer usage on everyone's lawn. However, it is hoped that through education, people can learn the proper techniques and share their knowledge with their friends, family, and neighbors.

Funding: Funds for the brochure and the ad has come from multiple sources including the Department, EPA, and the Center for the Inland Bays.

Responsible organizations: Property owners, Nutrient Management Commission, the Department

Estimated load reductions: Although we know that there will be some reduction from this action, we are currently unable to assign a nutrient load reduction to this activity.

Estimated cost: NA

10. ***Management Measure:*** **Land maintained as open space under County or municipal ordinances or codes should be managed to minimize nutrient loading.** If the land is fertilized in order to achieve its intended use, nutrients should be applied by a licensed nutrient applicator according to a nutrient management plan.

Implementation mechanism: Implementation will occur at various levels of government—State, county and municipal. Open space will be designed at the site plan stage. The developments will then deed the open space to the community for their management.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Schedule: This recommendation is already being made.

Monitoring: The Watershed Assessment Section will assist associations in finding the appropriate agency or program to advise communities about their nutrient management needs.

Funding: This recommendation should save land owners money since it calls for limiting the use of fertilizers on the lands.

Responsible organizations: Homeowner associations, NMC, Department, Sussex County, Delaware Department of Agriculture, Coastal Management Program's Community Open Space Management Program

Estimated load reductions: Nutrient load reduction may occur as the land converts from its previous use to a grassed or forested area.

Estimated cost: NA

Onsite Wastewater Treatment and Disposal Systems

***General Action:* Improve operation and maintenance of onsite wastewater disposal systems such that nutrient loadings from them are reduced. This will require the use of innovative and alternative removal systems as well as the conversion of some onsite systems to central sewer.**

Onsite wastewater treatment and disposal systems are widely used within the Delaware's rural watersheds and contribute nutrients to the ground and surface waters. Approximately 18,212 septic systems are permitted in the Inland Bays Watershed, discharging as much as 523 pounds of nitrogen and 44.5 pounds of phosphorus to the groundwater, daily assuming that the systems are functioning properly. Further data collection will be used to determine how many of these are locked with the Little Assawoman Bay Watershed.

Malfunctioning systems would discharge even more pollutants into the ground. Most of the nitrogen from septic tanks is converted to nitrate-nitrogen, which easily enters the ground water and ultimately, the bays or their tributaries. Many older homes near the bays are on small lots with sandy soils, and some still have substandard onsite wastewater disposal systems like cesspools or seepage pits. Approximately 50 percent of the septic systems in the Inland Bays Watershed may not meet current regulations for onsite wastewater disposal systems for a variety of reasons including inadequate lot sizes and system capacities. Thus, these sources will be regulated in order to protect

water quality. However, once in the groundwater, the phosphorus may not necessarily make it to the surface waters given the multiple manners in which phosphorus acts in that environment. The recommended actions work toward reducing the load from these sources.

Results: Combined, these recommendations will lead to a reduction of 377 lbs/day of TN and 7.79 lb/day of TP. The annual costs of these recommendations will be $13,437,696.

	Action	# Systems	Cost per system	Total cost
Holding Tanks	Pump-out – 12 / yr	153	$2,100/yr	$321,300/yr
Septic Systems	Conversion to Sewer	1,754*	$10,000	$ 17,540,000
Septic Systems	Pump-out – Once / 3 yrs	1,380	$125 / yr	$ 172,500
Septic Systems	Retrofit w/ BATs	1,380	$6,900-$12,900	$9,522,000-$17,802,000

1. ***Management Measure:*** **Permanent holding tanks shall not be permitted within the watershed. A permanent holding tank is a tank that will be in use for 4 years or more.**

According to GIS there are currently 153 active holding tanks in the LAB watershed. For active holding tanks, the Tributary Action Team recommendations are to pump these systems out 12 times per year. This action would result in a reduction of 352 lb N and 117 lb P per year. In accordance with this plan, the active holding tanks will be pumped out 12 times per year and DNREC will continue regular inspections of these facilities.

The PCS bans all new permanent holding tanks in all new sub-divisions in the watershed. In accordance with this plan and the PCS, no new permanent holding tanks will be permitted in the LAB watershed.

In accordance with the TAT recommendations and this plan, the following stipulations will occur in addition to the aforementioned actions.

A sunset clause will be applied to existing, single lots.

A system of record keeping will be employed that will demonstrate compliance by the permit holder.

Deeds will include a covenant that notifies property owner that they are served by a holding tank and full disclosure of the condition of the tank.

Implementation mechanism: Section 5.13015 of the Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems implement this action.

Schedule: This prohibition is in effect.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: The Ground Water Discharges Section, Division of Water Resources, DNREC oversees the permitting of these systems.

Funding: No additional funding will be needed.

Responsible organizations: Ground Water Discharges Section, Division of Water Resources, DNREC.

Estimated Load Reductions: This action will prohibit any future additional loading of nutrients into the system.

The nutrient load reductions resulting from 12 pump-outs per year are as follows:

Reduction= loading rate x # tanks

2.301 x 153 = 352.05 lb N
0.764 x 153 = 116.90 lb P

Estimated cost: NA

Management Measure: **Maintain the existing Holding Tank inspection program.**

There are currently an estimated 1,380 active septic systems in the LAB watershed. Regarding existing septic systems, the TAT recommends pumping these systems out once every three years. This action would result in a reduction of 3,788 lbs N and 1,526 lbs P per year. In accordance with this plan, the existing, active septic systems will be pumped out once every three years, and DNREC will continue regular inspections of these facilities.

The TAT also recommends that all existing systems are to be equipped with nutrient reduction utilizing Best Available Technologies (BAT) within 15 yrs of adoption of the Pollution Control Strategies. This action would result in a reduction of 11,333 lbs N and 393 lbs P per year. In accordance with this plan, all existing systems will be retrofitted with BAT nutrient reduction within fifteen years. Owners of non-failing systems will be urged to voluntarily upgrade prior to the fifteen-year deadline.

In accordance with the TAT recommendations and this plan, the following stipulations will be followed.

Regular inspections will be made, with no charge to owners within a reasonable period after a maintenance pump-out has occurred.

The transfer of a title will include a system of record keeping that demonstrates compliance by the owner; an inspection will also occur at the time of transfer with costs assumed in the agreement between the buyer and seller.

Of these systems, 80 are planned to be converted to sewer by 2008. However, the reductions stated for retrofitted systems and pump-outs include these 80 systems.

Implementation mechanism: The Ground Water Discharges Section, Division of Water Resources, DNREC currently implements a State-wide holding tank inspection program. This Strategy relies on the continuation of this program.

Schedule: The program is currently underway.

Funding: The program is funded with EPA monies. It is hoped that this program will eventually be funded by the General Assembly and through fees. House Bill 150 authorizes annual license fees for the monitoring and enforcement of this program which will offset some costs. Periodic funding is being provided through the 319 NPS Pollution Program.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: Ground Water Discharges Section, Division of Water Resources, DNREC

Responsible organizations: Ground Water Discharges Section, Division of Water Resources, DNREC

Estimated load reductions:

- Reduction resulting from pump-out once every three years:

  Reduction = loading rate x # systems

  Nitrogen
  = 2.745 x 1380 future systems
  = 3,788.1 lb N

  Phosphorus
  = 1.106 x 1380 future systems
  = 1,526.28 lb P

- Reduction resulting from upgraded/retrofitted system

Reduction = loading rate x # systems x efficiency

Nitrogen
= 10.95 x 1380 x .75
= 11,333.25 lb N

Phosphorus
= .475 x 1380 x .60
= 393.3 lb P

Estimated cost: Annually, the action will cost $641 /lb of TN reduced.

2. ***Management Measure:*** **No new drainfields on parcels recorded 30 calendar days or more after the publication of these final Regulations in the Delaware Register of Regulations may be present within 100 feet landward from State-regulated wetlands, or the mean high water line of all tidal waters, whichever extends farther upland, and from the ordinary high water mark of all other primary water features.** In accordance with the TAT recommendations and this plan, all new on-site, individual sewage disposal systems will achieve the nutrient reduction levels as addressed in the TMDL. If the technologies are unavailable to achieve these reductions, BATs will be utilized. All new systems will comply with the regular inspection and maintenance schedule as described for existing systems.

Implementation mechanism: Promulgation of the Regulations of the Pollution Control Strategy for the Inland Bays watershed.

Schedule: This requirement becomes effective 30 days from the date of publication of the final Regulations.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: The Ground Water Discharges Section, Division of Water Resources, DNREC oversees the permitting of these systems.

Funding: The developers or homebuilders will absorb the costs of these systems. Additionally, the funding for this schedule may be acquired through a dedicated county fee collection system.

Responsible organizations: Ground Water Discharges Section, Division of Water Resources, DNREC.

Estimated load reductions: This requirement will reduce the additional nutrient loading from these new developments over what it would be if drainfield placement is allowed closer to the protected water features.

3. ***Management Measure:*** **All properties utilizing an OWTDS that are sold or otherwise transferred to other ownership shall have their systems pumped out and inspected prior to the completion of the sale. If an inspection has occurred within the previous 36 months and the property owner can provide documentation of such pump out and inspection, then that paperwork will fulfill the requirements of this section.**

Implementation Mechanism: The Regulations for this Pollution Control Strategy implement this recommendation. Inspectors shall be licensed by the Department. The Ground Water Discharges Section, Division of Water Resources, DNREC will maintain a list of all permitted septage haulers and licensed inspectors, which will be available for review on the Department's website.

Schedule: This requirement becomes effective 180 days from the date of publication of the final Regulations.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: This program will be self-monitoring since the paperwork will be required to be shared at settlement before title transfer occurs.

Funding: The costs of the inspection will be covered through an agreement between the buyer and the seller.

Responsible organization: Real estate agents, attorneys, Ground Water Discharges Section, Division of Water Resources, DNREC.

Estimated Nutrient Reductions: Although this recommendation will lead to improved system performance and reduced nutrient loading, these reductions cannot be quantified at this time.

4. ***Management Measure:*** **All new and replacement onsite wastewater disposal systems must be designed to achieve performance standards as specified in the PCS regulation. These standards vary based on system size.**

Implementation mechanism: This requirement is made through the promulgation of this Strategy. The Ground Water Discharges Section and the Watershed Assessment Section, Division of Water Resources, DNREC contracted with an expert in North Carolina to develop and recommend performance standards all sizes of onsite systems. The Ground Water Discharges Section will maintain a list of approved technologies for small systems from which permit applicants choose. The Groundwater Discharges Section will maintain the updated requirements.

Schedule: This requirement becomes effective on different dates for different systems. See the Regulations of the Pollution Control Strategy for the Indian River, Indian River Bay, Rehoboth Bay and Little Assawoman Bay Watersheds for the specific requirements.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: The technologies listed will be tested technologies.

Funding: The costs of these systems will be paid by the land owner. Cost-share funds may be found to assist those of middle-income and below. Currently, SRF funds may be used to provide low interest loans to property owners replacing a failed system.

Responsible organizations: Ground Water Discharges Section, Watershed Assessment Section, and the Financial Assistance Branch, Division of Water Resources, DNREC.

Estimated load reductions: 273 lbs/day TN for the retrofitting of existing small (<2,500 gpd) systems, 16.0 lbs/day TN for 2,500-20,000 gpd systems, 15.3 lbs/day TN for >20,000 gpd systems. All new systems that are required to use enhanced-nutrient removing technologies will actually add nutrients to the system.

Estimated cost: Annually, this recommendation will cost $11,230,899 on average for the 15,853 small systems owners who are not currently scheduled to connect to sewer. For the individual system owner, this will cost $708/system/year. Per pound of TN reduced, the recommendation will cost an average of $112.67. Costs are not currently available for the retrofit of larger systems.

5. ***Management Measure:*** **Sussex County converts 483 individual onsite systems to central sewer within the LAB.**

Implementation mechanism: The County is in the process of providing central sewer to 2,359 residences that currently utilize individual onsite wastewater treatment and disposal systems. The LAB has connected 483 systems to a sewer district. These hookups have an estimated load reduction of 11.3 lbs/day TN and 0.8 lb/day TP. Annually this will cost $338,374. Within the sewer districts there are an additional 313 systems that need to be hooked up.

Schedule: These changes will be made within 5 years.

Funding: Funds for sewer expansion come from the County and State and Federal grants and loans, however, property owners will also have to pay for the connection.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: The County will report on their progress.

Responsible organizations: County and property owners

Estimated load reductions: 67.7 lbs/day TN and 5.76 lb/day TP

Estimated cost: Annually, these will cost $2,028,032 or $82.04/lb of TN reduced.

6. ***Management Measure:*** **Economic assistance for those in need will be available through the Financial Assistance Branch, Division of Water Resources.**

Implementation mechanism: The Financial Assistance Branch, Division of Water Resources, DNREC administers low interest loans for on-site wastewater systems for persons of low to moderately low incomes from the State Revolving Fund. In addition, the Department is working with the Environmental Finance Center from the University of Maryland to identify various potential sources of additional funding.

Schedule: The program is currently underway.

Funding: The funds come from the State Revolving Fund.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine continued compliance with suggested schedule.

Monitoring: Financial Assistance Branch, Division of Water Resources, DNREC

Responsible organizations: Financial Assistance Branch, Division of Water Resources, DNREC

Estimated load reductions: NA

Estimated cost: NA

Stormwater

General Action: **Stormwater runoff shall be managed for nutrient reduction when practicable.**

Stormwater is a major factor in loading of nutrients in the Inland Bays Watershed, specifically caused by the rapid urbanization and development of the area. As stormwater moves overland, it picks up and carries natural and human-made pollutants from lawns, streets, parking lots and industrial and commercial facilities, eventually depositing them into the waters of the Inland Bays. Reducing stormwater impacts within the Inland Bays will require action by all stakeholders and innovative management techniques.

Stormwater management is the primary way to control nonpoint source pollution from developed areas. A variety of methods can be used to control and treat runoff from lawns, homes, parking lots, roads, and commercial and industrial facilities. Some of these methods reduce nutrient loading from stormwater more than others. When possible, these methods should be preferred. However, there may be instances where the pollutant of most concern on the site would not be reduced sufficiently by the

most effective nutrient removal technique. In these cases, the method used should be the best at treating the removal of the pollutant of most concern.

Results: The implementation of recommendations requiring the retrofitting of commercial and residential areas with stormwater management where none previously existed will result in 131 lbs/day reduction in TN and 5.48 lbs/day reduction in TP.

The remainder of the actions in this section will ensure that properties developed in the future will include stormwater management techniques that will help to achieve water quality standards and the TMDLs.

1. ***Management Measure:*** **Where practicable, all permanent sediment and stormwater management plans shall be designed and implemented to include criteria to reduce nutrient contributions by the percentage required by the TMDL to the ground and surface waters or to the maximum extent practicable.** For the Little Assawoman Bay watershed, the required reductions are 40% for total phosphorus and 40% for total nitrogen. Maps of these areas are available at the Watershed Assessment Section. The percent reductions shall be based on a comparison between the post-developed condition with and without stormwater quality management best management practices. See Appendix M of the Regulations of the Pollution Control Strategy for the Indian River, Indian River Bay, Rehoboth Bay and Little Assawoman Bay Watersheds for guidance on achieving stormwater pollution control strategy reductions for water quality. This guidance includes several methods for achieving this requirement and includes options that allow for the preservation or establishment of natural features like forest stands or use of mathematical computations of pollutant reductions using other types of BMPs. When the option of preserving or establishing forest stands is chosen to achieve compliance with this requirement, Appendix L of the Regulations of the Pollution Control Strategy for the Indian River, Indian River Bay, Rehoboth Bay and Little Assawoman Bay Watersheds should be consulted. Innovative designs such as rain gardens, natural landscaping, and constructed wetlands are encouraged where appropriate.

Implementation mechanism: The Regulations for this Pollution Control Strategy.

Schedule: For projects within the County, the effective date for this action shall be the date of adoption of the regulation. For projects on lands located within municipalities as of the date of adoption of the regulation, the effective date of this action shall be one year from the date of adoption of the regulation.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: Intensive 305b monitoring of the tributaries to the Inland Bays will track general water quality trends.

Funding: The costs will be born by the developer.

Responsible organizations: Sediment and Stormwater Program, Division of Soil and Water Conservation, DNREC.

Estimated load reductions: Stormwater management implemented to date results in reductions of 17.5 lbs/day TN and 1.29 lbs/day TP.

Estimated cost: Annually, these existing systems cost $688,580. Or, these systems reduce TN at a rate of $89.52 to $276.83/lb (depending on the structure used).

2. ***Management Measure:*** **Develop a program to assist homeowners' associations in the creation of a stormwater maintenance plan as well as to assist in the establishment of a funding mechanism to meet financial obligations for related stormwater facility maintenance.**

Implementation mechanism: DNREC's Sediment and Stormwater program produced a handbook for homeowners associations that can be used to learn how to maintain their plan. DNREC as well as the Sussex Conservation District will work with homeowners in forwarding this concept.

Schedule: The handbook was completed September 2004. Workshops on maintenance were held throughout the watershed in 2004 and 2007. More are anticipated for the upcoming years.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: DNREC's Sediment and Stormwater program and its designated agencies have the authority to inspect sites. The Sussex Conservation District has hired an inspector. Thus, through inspection, these agencies can monitor the maintenance of these facilities.

Funding: The program will be funded as the budget permits. Currently, a 319 Nonpoint Source Program grant is being used to develop the handbook for homeowners association on stormwater management maintenance. EPA funds were used to support maintenance workshops geared towards homeowners throughout the watershed in October 2004.

Responsible organizations: Homeowner associations, the Sediment and Stormwater Program, Division of Soil and Water Conservation, DNREC and its delegated agencies. Failure by homeowners to properly maintain stormwater facilities will make it difficult to achieve the TMDL nutrient reductions established for the Inland Bays.

Estimated load reductions: This action will help to ensure that the reductions associated with the specific stormwater management techniques are achieved through proper maintenance.

Estimated cost: NA

3. ***Management Measure:*** **Encourage Sussex County to create a stormwater utility for the Inland Bays Watershed. This utility will collect fees for the construction of stormwater management structures where needed.**

Implementation mechanism: The Sediment and Stormwater regulations serve as an enabling structure for the local ordinances needed in order to set up the utility. The Sediment and Stormwater program has held workshops to generate interest in the formation of a utility. The County is in the best position to start the most effective utility.

Schedule: The Department will begin talks with the County regarding creating a utility. Two workshops were held in 2004 promoting the concept.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: The utility would have a monitoring component.

Funding: Stormwater utilities are designed to become a funding mechanism for stormwater retrofits, maintenance, and source reduction strategies.

Responsible organizations: Sussex Conservation District; Sussex County; DNREC; Delaware Department of Transportation; Municipalities

Estimated load reductions: Stormwater retrofit projects would increase the amount of nutrient load reduction in various quantities associated with the practices used.

Estimated cost: Costs will depend on the goals of the program instituted. In some areas of the country, the household cost is equivalent to a fast food hamburger per month.

4. ***Management Measure:*** **Create stormwater management facilities and source reduction strategies for urban and residential lands.**

Implementation mechanism: DNREC will work with the DELDOT, the Sussex Conservation District, and Sussex County to identify priority areas for stormwater retrofits and to find funds to pay for these upgrades.

Schedule: Work on this task will begin upon promulgation of the Strategy.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: When possible, water quality samples will be taken to evaluate the effectiveness of the action taken.

Funding: The responsible organizations will work together to locate funds.

Responsible organizations: DNREC, DELDOT, Sussex County, Sussex Conservation District

Estimated load reductions: The specific reduction will depend upon the stormwater management techniques used. Within the LAB there are 22 stormwater ponds. Assuming that the majority of the area will be treated by filtration devices with some ponds, the nutrient reductions achieved by this action will be:

1.15 lbs/day TN; 0.2 lbs/day TP.

Estimated cost: Annually, this recommendation will cost about $106.14-$151.56/lb of TN reduced.

5. ***Management Measure:*** **Institute tax incentives that encourage an increase in open space (green areas) in commercial developments, thus, reducing the percentage of impervious surface and reduce nutrient contributions.**

Implementation mechanisms: This program could be instituted at the State or County level.

Schedule: This recommendation could be implemented once guidelines were established and tax law is changed.

Milestones: Annual Evaluation: Monitored and assessed by DNREC to determine compliance with suggested schedule.

Monitoring: This program could be monitored and administered by the County or the entity administering the Sediment and Stormwater law.

Funding: Funds lost due to the incentive would need to be generated.

Responsible organizations: County or State

Estimated load reductions: This recommendation will help to reduce the nutrient loading from the parcel in question.

Estimated cost: NA

If the preceding management measures are followed, then the TMDL will be met for the Little Assawoman Bay. The following table briefly summarizes how the TMDL of 237 lbs TN/day and 19 lbs TP/day will be met for the LAB.

Management Measure	**Lbs TN/Day**	**Lbs TP/Day**
Cover Crops	121	0.4
CREP	0.11	0.13
Phytase	0	1.44

NMA	81	5.4
Forrested Buffers	196	6.4
Holding Tanks	0.96	0.32
Septic Pumpout	10.38	4.18
Septic Upgrade/Retrofit	31.05	1.08
Connecting OWTDS to sewer	11.3	0.8
Retention Ponds	1.15	0.2
TOTAL	452.95	20.35

Achievement and Cost

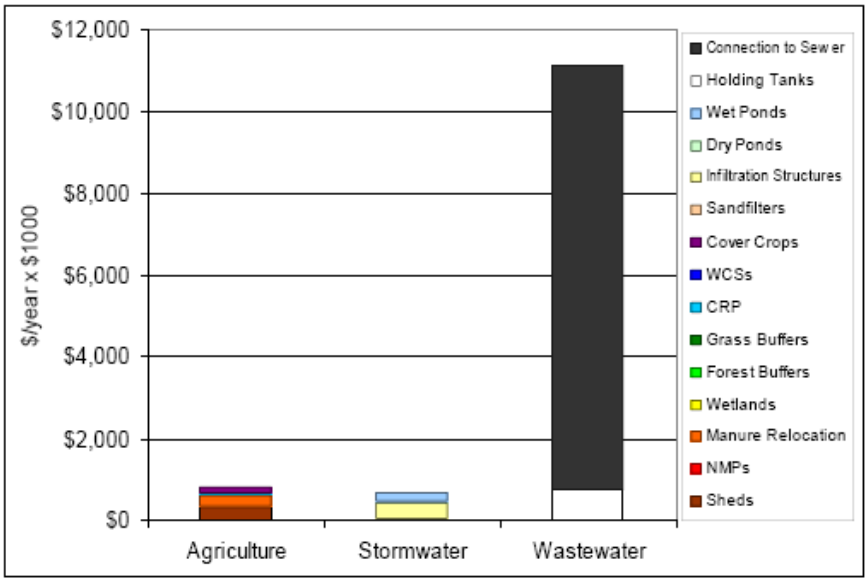
Details regarding technical and financial assistant needs are addressed within the contents of each action item. The action costs account for all planning and implementation costs where possible, cost for the management measure as well as identifying all potential funding sources and projected allocations (e.g. 319, NRCS, State Cost-share).

The contents of this section address the total achievement costs of implementation for this watershed plan. As proposed, the elements herein should lead to the achievement of the TMDLs for Total Nitrogen (TN) and Total Phosphorus (TP). Because of the lag time between seeing improvements in ground and surface water quality, estimated to be up to 30 years, improved water quality conditions will not be realized immediately.

Analysis using a basic land use loading rate model shows that, to date, nonpoint sources of TN and TP have been reduced by 31 percent and 62 percent, respectively. Thus, voluntary programs for installation of agricultural best management practices have been successful as well as the County's effort to expand central sewer and reduce the number of onsite wastewater treatment and disposal systems in use. Implementation of the Sediment and Stormwater law has also led to decreases in nutrient loading, however, the full impact is not shown here because many sediment and stormwater practices, known to be in place, are not yet captured in a database and therefore, not considered in these calculations.

Although agriculture and wastewater actions have made equivalent reductions in TP, the costs of achieving those reductions were vastly different. Figure 2 shows that the annualized cost of the wastewater actions are about 10 times greater than the costs of the agricultural best management practices. Thus, agricultural actions are far less expensive than those actions related to wastewater.

Figure:2 Annualized Cost of Best Management Practices Implemented to Date



Dollar per pound, agricultural BMPs are much less expensive than requiring additional wastewater or stormwater actions. But, care needs to be taken such that only a small amount of agricultural lands would be taken out of production and placed in BMPs such as buffers or wetlands. The agriculture industry would be impacted by losing to great a percentage of cropland, so the Plan only calls for a 14% reduction in lands used for production. A model was used to calculate the specific agricultural Best Management Practice implementation goals.

Figure 3: Dollar Per Pound TN Reduction

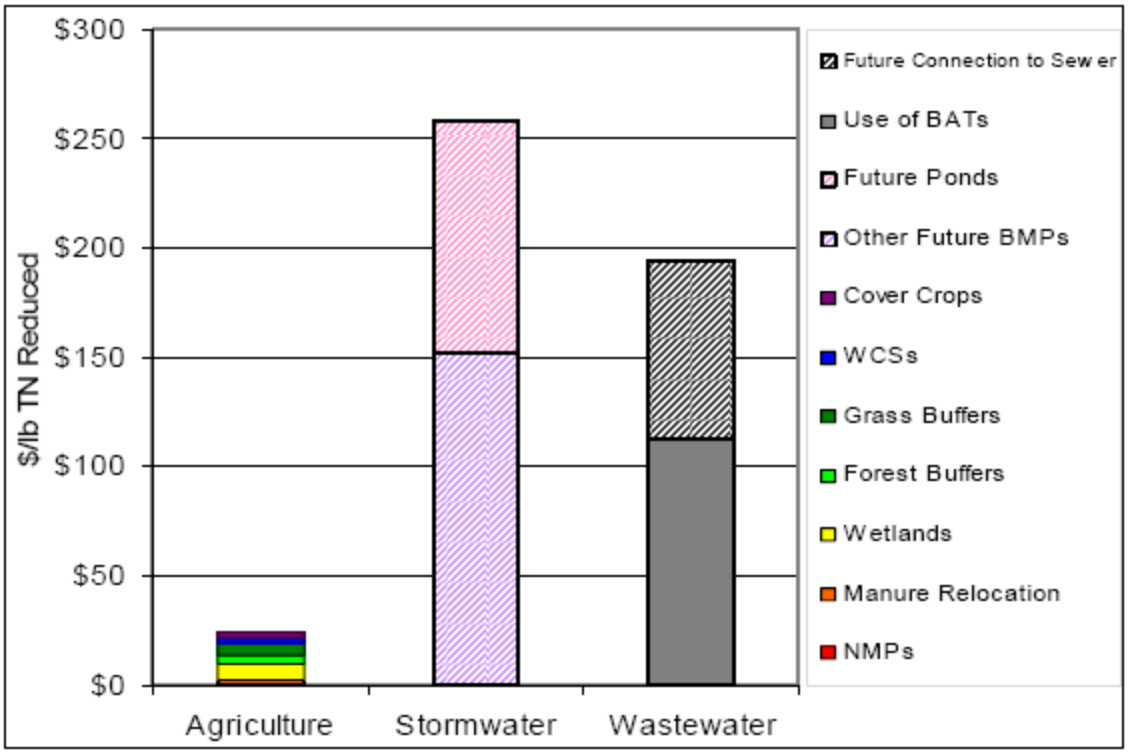
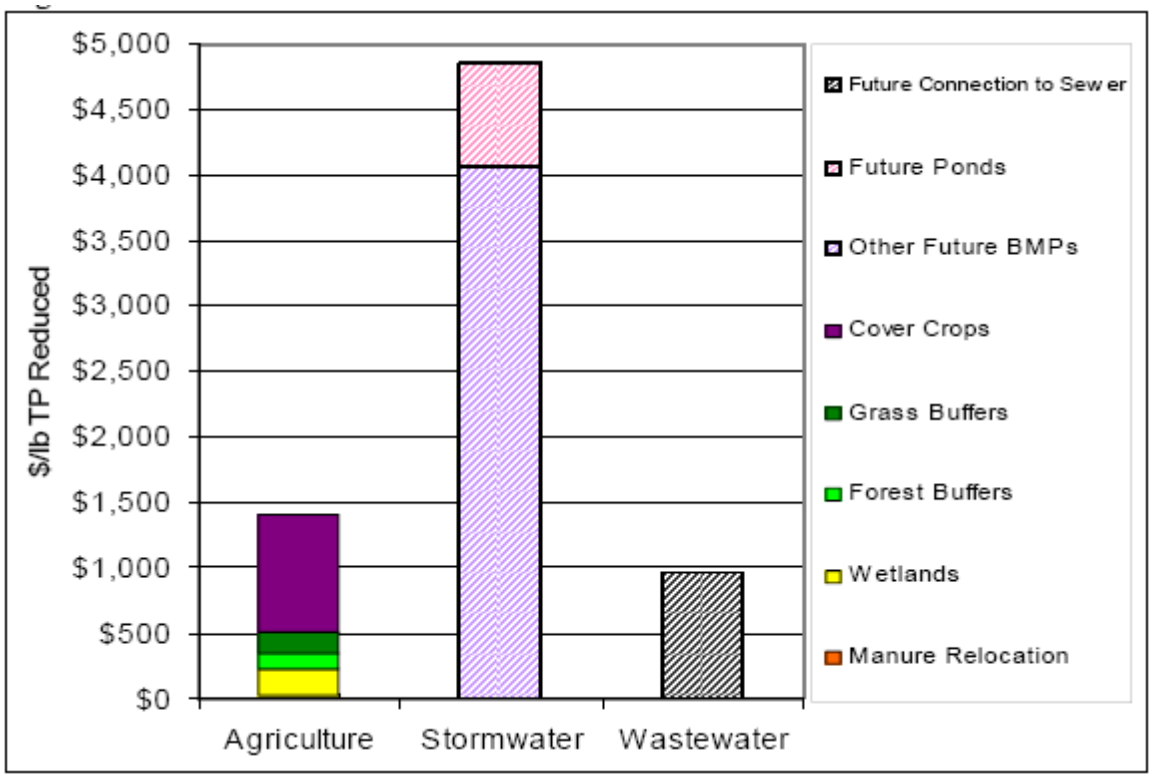


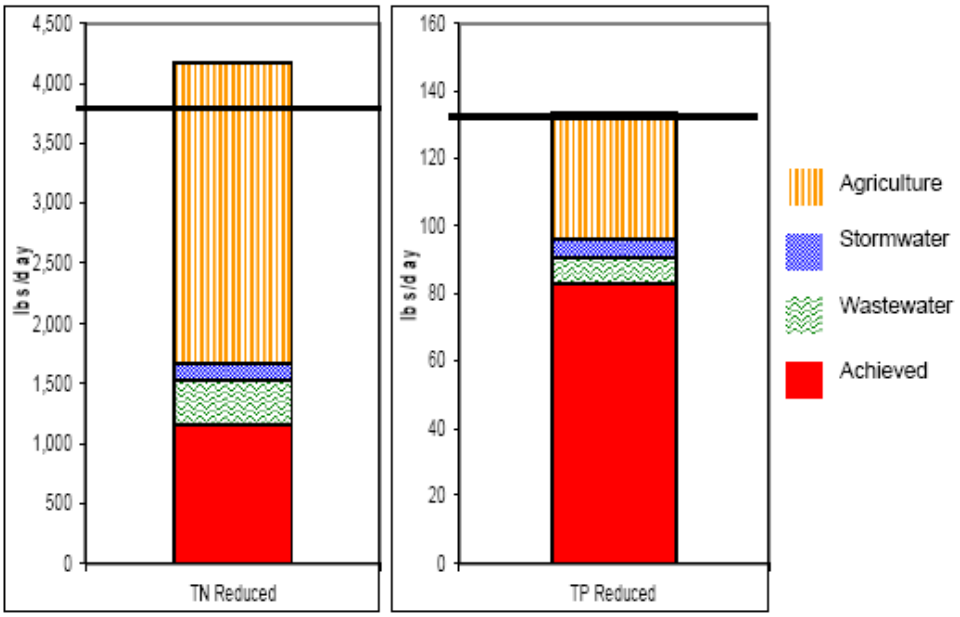
Figure:4 Dollar Per Pound TP Reduction



The Plan could not only be comprised of the actions within these three sectors with which we had nutrient load reduction efficiencies. Land values in the Little Assawoman Bay watershed continues to increase. Thus, the Plan needed a component that addressed how these former agricultural, forest and barren lands would be developed. The section on Urban Land Use sets out actions that will ensure that as these lands with agricultural BMPs are converted to other uses, that BMPs are required to be implemented, and ensuring achievement of the TMDL and water quality standards.

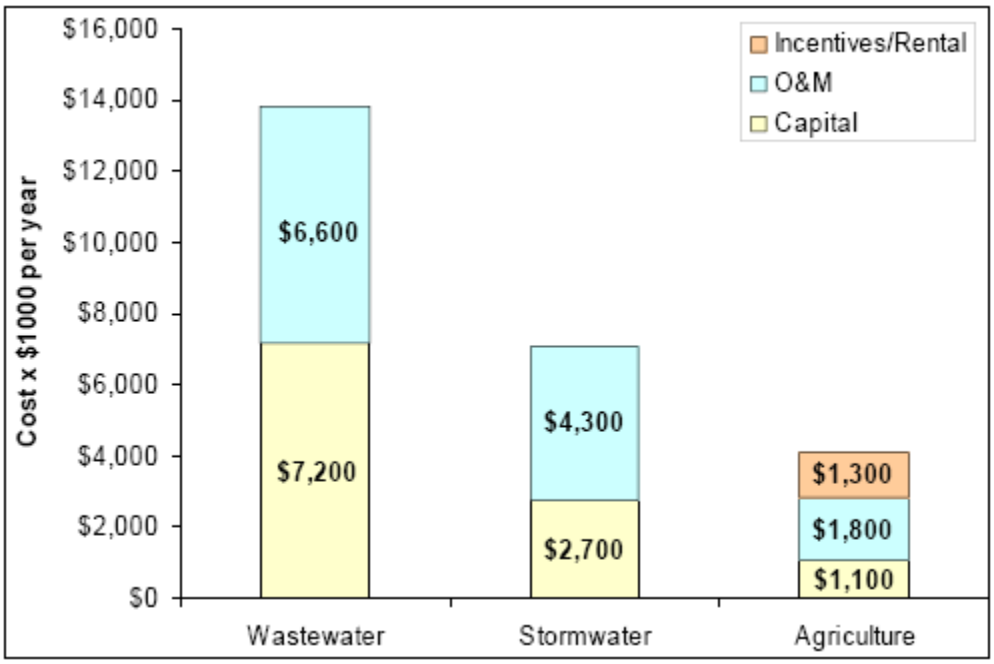
Overall, the Plan will likely achieve the TMDL, as depicted in Figure 5. Additionally, many of the actions in this Plan do not have nutrient loading reduction estimates associated with these actions (reduced home fertilizer usage, increases in open space). This provides an adequate margin of safety.

Figure 5: Watershed Plan's Progress Towards TMDL Implementation



Implementing this Watershed Plan could cost as much as twenty-five million dollars per year. This figure includes annualizing the over $169 million needed in capital expenditures plus annual operation and maintenance costs of various Best Management Practices. Figure 6 shows the annualized capital, annual operation and maintenance, and annual rental and incentives fees for each sector. Costs associated with wastewater strategies are the greatest in both the capital and operation and maintenance areas.

Figure 6: Annual Costs By Sector



Every effort has been made to make the Plan fair and equitable. It impacts everyone in the watershed given that all activities contribute to nutrient loading. And, it attempts to take cost into consideration through promoting the least expensive actions and cost share for those actions that are more expensive.

Water Quality Monitoring

The following section on water quality monitoring was largely taken from the "State of Delaware 2008 Combined Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs" DNREC,2008.

Water quality assessment for the State of Delaware is a requirement of Federal Clean Water Act of 1977 and the 1981 and 1987 amendments of the section 305(b). All of Delaware's water are designated for Primary Contact Recreation and for fish, Aquatic Life, and Wildlife purposes.

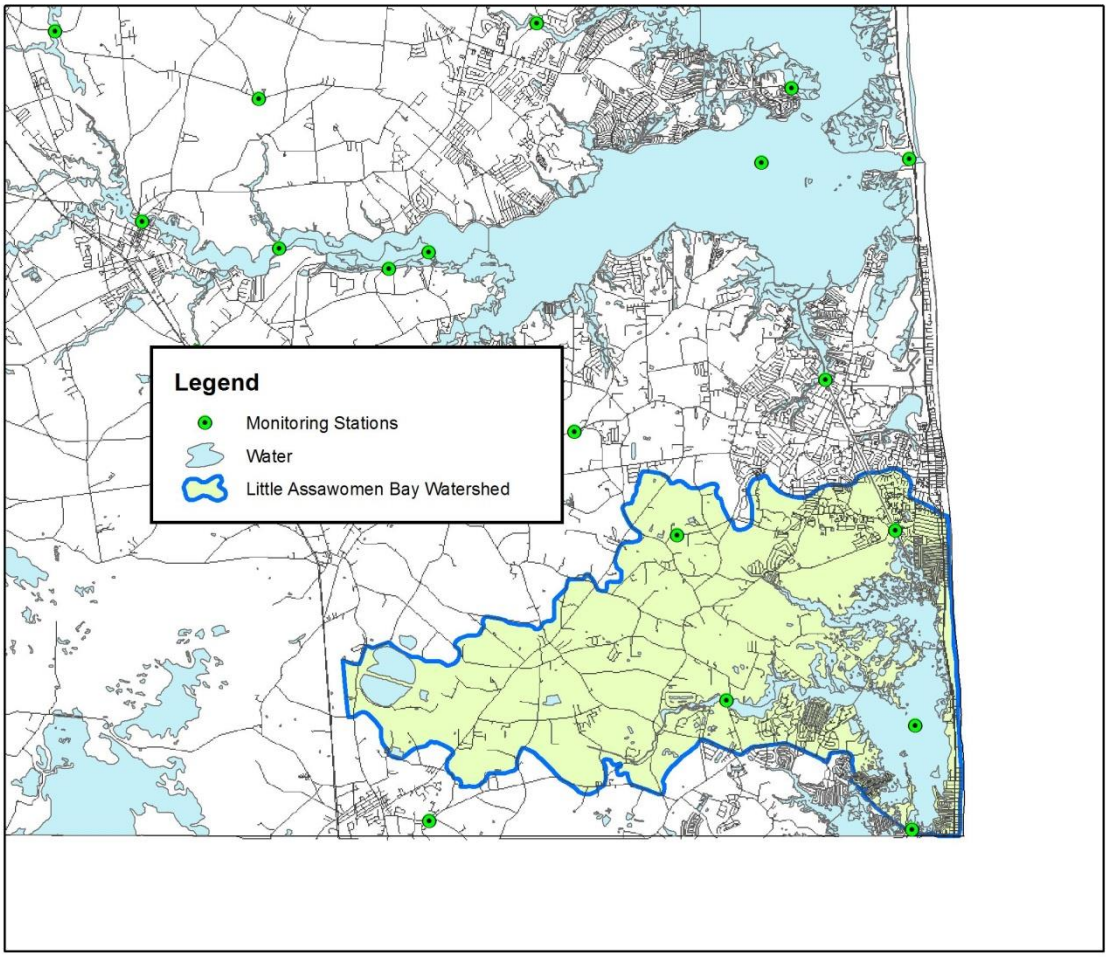
Water quality and biological data for Delaware's surface waters are collected under Delaware's Ambient Surface Water Quality Monitoring Program and Biological Monitoring Program within DNREC. Several active citizen monitoring programs have also been developed throughout Delaware that augment the data collected by DNREC. One program within the Inland Bays is discussed below.

The State's surface water monitoring program entails TMDL related monitoring, general assessments, Toxics both in biota and sediment, and Biological.

The General Assessment Monitoring Network (GAMN) provides for routine water quality monitoring of surface waters throughout Delaware. Each station is monitored for conventional parameters such

as nutrients, bacteria, dissolved oxygen, pH, alkalinity, hardness, and metals. The data from this monitoring is entered into the EPA's STORET database, is reviewed and then analyzed in assessing the water quality condition of each water body system. Figure 7 is a map of active STORET stations used for this report.

Figure 7: Monitoring Stations in the 2006 Combined 305(b)/303(d) Report and List



Dissolved Oxygen (DO) Aquatic Life Use Support (ALUS)

The following types of DO data are potentially available for analysis:
Field measurements taken by personnel using handheld DO probes; and Continuous monitoring data collected using multiparameter monitoring systems that are typically deployed for several days, weeks, or months. In order to get a more accurate picture of dissolved oxygen dynamics and other water quality parameters, the Department continues to increase its use of continuous monitoring systems.

To determine ALUS with regard to Dissolved Oxygen (DO), the following methodology will be used to compare measured DO concentrations to two different standards; the minimum at all times and

daily average concentrations. Average DO concentrations are considered to be met if the 10th percentile of available data is above the applicable criteria of 5.0 mg/l for marine waters and 5.5 mg/l for fresh waters. The statewide minimum DO concentration for surface waters is 4.0 mg/l at any time. Stations are judged to be in compliance with this criterion if the minimum is not violated by more than 1% of continuous monitoring data and no more than two field samples are below the minimum.

Assessment of Average DO Criteria Attainment:

If sampling events occurred on at least ten different days during the period September 1, 2002 through August 31, 2007 for each station, attainment of the DO average criteria will be assessed using the method that follows. Stations with fewer than ten different sampling days will be considered to have insufficient data and be placed in Category 3 for this parameter for this assessment cycle.

For purposes of DO compliance with the daily average criteria in a segment, continuous monitoring data, if available, will be averaged on a daily basis for each station. If no continuous data is available, then the field measurements (as available) will be considered to be representative of the daily average for that day. Any type of sample (continuous or field measurement) will be considered to be representative for that station at the time of collection. Once the daily average for each station (station daily average, SDA) has been determined, the SDAs for each station will be pooled and the upper confidence limit (UCL) of the nonparametric 10th percentile confidence interval will be determined. That UCL will be compared to the applicable standard. If the UCL is above the applicable average criteria for all stations in a segment, the segment will be considered to be fully supporting (Category 1) for the DO average portion of ALUS. If the UCL from any station in a segment is below the applicable average, the segment will be considered not fully supportive of the aquatic life use (Category 5)

Formally stated, the following hypotheses will be tested:

- H_0: at the 90% Confidence level, $X_{10} \geq$ Standard
- H_1: at the 90% Confidence level, $X_{10} <$ Standard
- Where X_{10}= Non parametric estimate of the 10th percentile of available data.

Assessment of Minimum DO Criteria Attainment:

Attainment of the minimum DO criteria will be assessed based on all available data (note that ten samples in 5 years are not needed for the comparison to the minimum). For stations for which no continuous DO monitoring data are available, two or more SDAs in five years below the applicable minimum will be sufficient evidence to show that the aquatic life use is not supported (Category 5).

For stations with continuous monitoring data, available continuous monitoring data will be pooled on an annual basis for each station. The UCL of the first percentile of the data will be calculated and

compared to the minimum criteria in the same manner as the average comparison above for each year of the applicable five previous years. One or more years in which the upper confidence limit of the first percentile is below the minimum will be sufficient to determine that aquatic life use is not fully supported in the segment (Category 5).

Excess nutrients cause algal blooms that block sunlight from reaching the bottom of the bays thereby decreasing of dissolved oxygen levels.

Nutrient Enrichment Assessment

From a state-wide perspective, nutrient over enrichment is one of the leading causes of water quality impairment in Delaware. While nutrients are essential to the health of aquatic ecosystems excessive nutrient loadings to surface waters can lead to an undesirable proliferation of aquatic weeds and algae, which in turn can result in oxygen depletion and associated impacts to fish and macro invertebrate populations. Excessive aquatic plant growth can also preclude or seriously curtail water dependent activities such as fishing and boating when plant densities become so great that uses are not physically possible.

For tidal portions of the Indian River, Rehoboth Bay and Little Assawoman Bay watersheds, the water quality criterion for dissolved inorganic nitrogen is a seasonal average of 0.14 mg/l as N, and for dissolved inorganic phosphorus a seasonal average of 0.01 mg/l. For those stations where sampling events occurred on at least ten different days during the period September 1, 2002 through August 31, 2007, the lower confidence limit (LCL) of the nonparametric estimate of the 90th percentile of the available data for each station will be compared to the above values to assess attainment of desired nutrient levels in these waters. Stations with fewer than ten different sampling days will be considered to have insufficient data and be placed in Category 3 for this assessment cycle. Segments with one or more stations whose LCL is above the criteria will be considered to be not fully supporting the aquatic life use (Category 5).

Categories of Nutrient Concentrations

Nutrient Range	Total Nitrogen (mg/l)	Total Phosphorus (mg/l)
Low	< 1.0	< 0.1
Moderate	1.0 - 3.0	0.1 - 0.20
High	> 3.0	> 0.20

Assessment of Waters of Exceptional Recreational or Ecological Significance

ERES is a special use designation in Delaware's Surface Water Quality Standards that applies to waters deemed to be of Exceptional Recreational or Ecological Significance. The short-term goal for ERES waters is to "hold the line" on pollution and the long-term goal is to restore ERES waters, to the maximum extent practicable, to their natural condition.

The ERES designated use will be assessed using data from the period January 1, 1995 through August 31, 2007 for total nitrogen and total phosphorous concentrations to assess trends for those parameters. Seasonality for each parameter at each station will be determined using the Kruskal-Wallis test at the 5% significance level. Parameters showing no seasonality will be assessed using Sen's slope estimator with an Alpha of .05. Parameters showing seasonality will be evaluated using seasonal Kendall slope estimations at the 95% confidence level. Segments with one or more stations that show statistically significant increases in total nitrogen or total phosphorus levels will be considered to not be in attainment of the ERES designated use.

Primary Contact Recreation Use Assessments

Generally, total enterococcus bacteria water quality samples are collected several times each year at each monitoring station. In addition, for all guarded beaches and many unguarded beaches, samples are collected much more frequently from mid-May through mid-September as part of beach monitoring activities. Assessment of the above two situations for primary contact recreation use support will be as follows. For segments with no beach monitoring, if sampling events occurred on at least ten different days during the five-year assessment period, the geometric mean of the available enterococcus (colonies/100 ml)data for each station will be compared to the geometric mean values shown in the table below. Stations with fewer than ten different sampling days will be considered to have insufficient data (Category 3) to make a determination if the geometric mean criterion is met. Segments with one or more station geometric means above the values in the table will be considered to not be in support of the Primary Contact Recreation designated use (Category 5).

Water Type	Geometric Mean (Enterococcus colonies/100 ml) Criteria for Primary Contact Use
Fresh	100
Marine	35

Segments with beaches that are closed as a result of poor bacterial water quality data two or more times in a single calendar year will be considered not to support the primary contact designated use (Category 5). Some beaches are routinely closed after rain events without using water quality data to make the decision. These rainfall-based management plans are developed by statistically analyzing the relationship between rainfall amounts and Enterococcus levels. Regression analyses are used to determine the amount of rainfall that will cause exceedances of criteria. However, since the existing

management plans are based upon outdated criteria, rainfall-based closures will not be considered for making designated use support decisions.

Inland Bays Citizen Monitoring Program

The Inland Bays Citizen Monitoring Program is managed by the University of Delaware Sea Grant Marine Advisory Service (SGMAS) through an MOU with DNREC, Division of Water Resources. The program was established in 1991. The goals of the Inland Bays Citizen Monitoring Program are: 1) to collect verifiable water quality data to be used to support public policy decisions with regard to the management of the Inland Bays and 2) to increase public awareness and support for the protection and management of these aquatic resources through public participation.

About 30 citizen monitors make observations at 25 sites encompassing the Inland Bays watershed, evaluating dissolved oxygen, surface water and air temperature, salinity, secchi depth and water depth. Additional site observations include weather, tides and the abundance of macro algae in near-shore waters. Volunteers collect samples on a weekly basis from mid-April to mid-October, and every two weeks otherwise, if weather permits. Rainfall data are collected daily at three designated locations in the watershed. Volunteers complete data collection sheets and send them to SGMAS for data entry. Volunteer data are reviewed for errors and entered by the field coordinator into a Microsoft Excel spreadsheet on a microcomputer.

Twice a month, volunteers collect water samples from 17 sites that are transferred to College of Marine Studies (CMS) laboratories for analysis of dissolved inorganic nitrogen (nitrate, nitrite and ammonium), dissolved inorganic phosphorous (orthophosphate), chlorophyll a, and total suspended solids using standard laboratory methods. Six times from April through October, volunteers collect water samples from six sites that are transferred to the DNREC Shellfish Program for analysis of fecal coliform bacteria.

The sampling methodology used in this program has been approved by the U.S. Environmental Protection Agency and has been published under the title Quality Assurance Project Plan for the Inland Bays Citizen Monitoring Project. Quality Assurance is maintained by holding group Quality Assurance/Quality Control (QA/QC) sessions at six month intervals. Sessions are conducted as needed for individual volunteers.

Rivers/Streams, Estuaries and Lakes Water Quality Assessments and List of Waters needing TMDLs

Presented on the following pages are three tables. Table 1 is a summary of data collected by the Department in the period from September 1, 2002 through August 31, 2007, by station. For each monitoring station, the segment number, segment description and location are shown with the summary statistics. Table 2 rolls up the stations into their segments and shows the current use attainment for each segment. Table 3 is the Final Determination for the State of Delaware Clean Water Act Section 303(d) List of Waters Needing TMDLs. Table 3 integrates current and past assessments into a list of waters
needing TMDLs.

Table 1 Delaware 2008 305(b)/303(d) IR Station Summary Statistics

Watershed	Segment	Station	Location Description	Avg. Salinity	Total Nitrogen Samples	LCL 90th Percentile Total N	Total N Category	DIP Growing Season Ave	DIP Category	DIN Growing Season Average	DIN Category	ERES Total Nitrogen Support	ERES Total Phosphorus Support
Little Assawoman Bay	DE 180-001	312041	Assawoman Canal, Rd. 361 Bridge	17.1	31	1.4	5	0.010	1	0.373	5	meets	meets
	DE 180-002	310101	Beaver Dam Ditch, Rd. 363, Miller Branch	6.8	32	4.9	5	0.021	5	1.799	5	meets	meets
		310121	Beaver Dam Ditch, Rd. 368	0.2	30	6.2	5	0.019	5	3.213	5	na	na
	DE 180-003	310031	Dirrickson Creek, RD. 381	8.5	32	4	5	0.059	5	1.162	5	meets	meets
	DE 180-E01	310011	Little Assawoman Bay Ditch at Rd. 58 Bridge	23.9	32	1.2	5	0.010	1	0.235	5	meets	meets
		310071	Little Assawoman Bay, Mid-Bay	21.8	31	1.6	5	0.011	5	0.448	5	meets	meets

Table 2 Delaware 2008 305(b)/303(d) Segment Use Attainment Summaries

Watershed	SegmentID	Segement Description	Use Support Category			
			Dissolved Oxygen	Enterococcus	Nitrogen (total or DIN)	Phosphorous (Total or DIP)
Little Assawoman Bay	DE 180-001	Little Assawoman Canal	5	5	5	1
Little Assawoman Bay	DE 180-002	Miller Creek	5	5	5	5
Little Assawoman Bay	DE 180-003	Dirickson Creek	5	5	5	5
Little Assawoman Bay	DE 180-E01	Little Assawoman Bay	1	1	5	1

Table 3 Final Determination For The State of Delaware 2008 Clean Water Act Section 303(d) List Of Waters Needing TMDLs

WATERBODY ID	WATERSHED NAME	SEGMENT	Overall CALM Code	DESCRIPTION	SIZE	POLLUTANT OR STRESSOR	PROBABLE SOURCES	YEAR LISTED	TARGET DATE FOR TMDL	TMDL DATE	Pollutant CALM Code	YR Changed from Category 5 per 305(b) Assessment and methodology	Notes
DE180-001	Little Assawoman Bay	Little Assawoman Canal	4a	Saline tidal waters from the confluence with White Creek to the confluence with little Assawoman Bay	3.1 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	4a	2006	
DE180-002	Little Assawoman Bay	Miller Creek	5	From the headwater of Miller Creek to the confluence with Little Assawoman bay	6.5 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	4a	2006	
				Beaver Dam Ditch-- from the confluence of Blackwater Creek to the confluence with the next larger stream order	2.31 miles	Habitat	NPS	1998	2013		5		
DE180-003	Little Assawoman Bay	Dirickson Creek	5	From the headwater of Dirickson Creek to the confluence with Little Assawoman bay	13.3 miles	Bacteria	NPS	1996	2006	2006	4a	2008	
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	4a	2006	
				Bearhole Ditch-- from the confluence of Headwaters to the confluence with Batson Branch	2.39 miles	Habitat	NPS	1998	2013		5		
				Agricultural Ditch-- from the confluence of the headwaters to the confluence with Dirickson Creek	2.39 miles	Habitat	NPS	1998	2013		5		
DE180-E01	Little Assawoman Bay	Little Assawoman Bay	4a	Estuary from the confluence with Assawoman Canal to the confluence with Assawoman Bay	3.0 sq miles	Bacteria	NPS	1996	2006	2006	1	2006	Bacteria, Listed 1996, delisted 2006
						Nutrients	NPS	1996	2003	2004	4a	2006	
						DO	NPS	1996	2003	2004	1	2008	DO, listed 1996, delisted 2008

Interim Water Quality Milestones

As a result of water quality protection programs that are in place in Delaware, surface water quality in general has remained fairly stable in spite of increasing development and population growth. Impacts to waters are generally the result of past practices or contamination events, activities that are not regulated nor otherwise managed, or changes that are occurring on a larger regional scale. For example, air pollutants from sources outside of Delaware contaminate Delaware's surface waters via rainfall.

Improvements in water quality have been documented in localized areas where a discharge was eliminated or better treatment installed. Basin-wide water quality improvements in waters that are being impacted by historical contamination and nonpoint pollution sources are very difficult to detect over a short period of time. Targeted monitoring over long time periods (years) is necessary in order to detect changes.

Although Delaware's surface water quality may not have changed significantly over the last several years, there have been many improvements made in watershed assessment approaches and methodologies. Additionally, many water quality criteria are stricter as a result of amendments to the State's Water Quality Standards. Therefore, we have become more proficient at identifying water quality problems and, at the same time, are calling for higher quality waters.

The stability of Delaware' s surface water quality is likely the result of increased efforts to control both point and nonpoint sources of pollution. In addition to the significant investments in wastewater treatment technologies previously mentioned, many private business interests are investing in practical and cost-effective nonpoint source pollution control practices (Best Management Practices) on farms, residential developments, and commercial and industrial sites. Likewise, public agencies such as the Delaware Department of Transportation are investing revenues in improved storm water management practices and wetlands creation to mitigate the impacts of maintenance and new highway construction activities.

Dissolved oxygen levels are related to eutrophication, nutrients and poor exchange of water. Because of the canal systems and low tidal fluctuations within the Bays, are a cause for poor dissolved oxygen. For the next 5-10 years Delaware wants to maintain consistent oxygen levels or a de-listing of a segment. Canal system dredging, aerators, and better BMP or stormwater controls can help DO numbers. One section of the LAB that was listed for DO in 2002 was de-listed for 2010.

The State of Delaware would like to see the bacteria results show improvements or a de-listing of a segment within the next 5-10 years. With more stringent laws, rules, and regulations put forth on new home building and developments these numbers should be better. Sewer hookups and the advancements made in the septic industry will also aid in reducing these numbers. A segment of the LAB was listed for bacteria in 1996 and de-listed in 2006. So efforts on the ground already may be showing some early indications of progress.

Interim water quality goals as related to this plan for nutrients and phosphorous are as follows:

- Full compliance with the NMA; all agricultural acres should have a nutrient management plan**.** The LAB has 7,343 acres available for NMP's. A total of 81 lbs/day of TN and 5.4 lbs/day of TP will be reduced in the LAB watershed.
- 25% of available land put into cover crop in the next 5-7 years. This would have a reduction of 60.5 lb TN/day and 0.2 lb TP/day.
- In the next 7-10 years from 2010 the watershed plan would like to attain a goal of 838 acres of 60 foot forested buffers. This would have a nutrient reduction of 98 lbs TN/day and 3.2 lbs TP/day.
- The feed additive phytase is already in use for 2010. This in turn would have an estimated reduction of 1.44 lb/day of TP.
- Within the next 3-5 years from 2010, Sussex county would convert 150 residences to central sewer. This would have an estimated load reduction of 4 lbs TN/day and 0.3 lbs TP/day.
- Septic pump out will continue to be an active program that will have 10.4 lb TN/day and 4 lbs TP/day of nutrient reduction.

For the next 5-10 years Delaware wants to hold the line on nutrients entering the Inland Bays. A study now underway from the Delaware Geological Survey is studying the flow of fresh groundwater into the Inland Bays. DGS will also age the water. This in turn will help scientists and policymakers understand when they should start seeing results from nutrient-reducing measures on land. The summer of 2010 showed significant decline in macro algae. This is an early environmental indicator showing reductions of nutrients to the Inland Bays.