Delaware Division of Watershed Stewardship – Nonpoint Source Program

2020 ANNUAL REPORT

Delaware Department of Natural Resources & Environmental Control
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Delaware Nonpoint Source Program administers a competitive grant made possible through Section 319 of the Clean Water Act (CWA). The grant provides funding for projects designed to reduce nonpoint source (NPS) pollution in Delaware. NPS pollution may be defined as any pollution that originates from a diffuse source (such as an open field or a road) and is transported to surface or ground waters through leaching or runoff. Reduction of NPS pollution may often be achieved through incorporation of specific best management practices (BMPs) into project workplans. Projects may target any source of NPS pollution, but most frequently involve agriculture, silviculture, construction, marinas, septic systems, and hydromodification activities.

In addition to funding projects that achieve reductions in NPS pollution, the Delaware NPS Program is committed to addressing these issues through educational programs, publications, and partnerships with other organizations working to reduce NPS pollution in Delaware.

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Preface

The 2020 Delaware NPS Annual Report is developed by the Delaware Department of Natural Resources and Environmental Control (DNREC) to meet a grant condition that appears in each annual 319(h) Grant award to the State of Delaware from the U.S. Environmental Protection Agency (EPA). This programmatic condition in the award states that the report shall contain the following:

- A brief summary of progress in meeting the schedule of milestones in the approved Delaware NPS Management Program;
- Reductions in nonpoint source pollutant loading and improvements in water quality that has resulted from implementation of the Management Program, and
- Descriptions of priority Watershed Based Plan accomplishments. Accomplishments should be based on the implementation milestone goals/objectives as identified in each priority plan. The goal information can be displayed in the form of a watershed goal/accomplishment chart showing percent achieved, supplemented by a short narrative that should give the reader a clear understanding of the actions being taken as well as the outputs and outcomes which are occurring from the actions. If monitoring was completed, a summary of that information should also be included. For example, how would the implementation of a 1,000 foot streambank stabilization best management practice (BMP) project compare to the needs identified in the watershed-based plan (i.e. what percent of streambank stabilization was completed compared to the overall needs as identified by the plan?). Similar comparisons should also be provided for each significant pollutant load reduction.

What is Nonpoint Source (NPS) Pollution?

NPS pollution is defined as polluted stormwater runoff associated with rainfall, snowmelt, or irrigation water moving over and through the ground. As this water travels, it can collect and carry pollutants such as sediments, nutrients, toxics, and pathogens. These pollutants eventually reach lakes, rivers, streams, wetlands, coastal waters, and ground waters of Delaware.

NPS pollution is associated with a variety of activities on the land, including farming, logging, urban/construction runoff, onsite sewage systems, streambank degradation, shore erosion, etc. For example, stormwater flowing off the land carries nutrient sources of nitrogen and phosphorus into local streams, rivers, and ponds. Under natural conditions, this is beneficial. However, if excessive nutrients enter these water bodies and cause nuisance algae blooms, then these nutrients are deemed pollutants.

The pollution contributed by nonpoint sources are the main reason why many of Delaware's waters are considered "impaired." Impaired waters are those waters that do not meet Water Quality Standards for designated uses (e.g., fishing, swimming, drinking water, shellfish

harvesting, etc.). Progress in managing NPS pollution in Delaware is represented in this report. It was produced by the Department of Natural Resources and Environmental Control (DNREC) NPS Program to meet Clean Water Act, Section 319(h) Grant conditions and to demonstrate consistency with EPA's 2018-2022 Strategic Plan. The main area of EPA's Strategic Plan in which Delaware focuses its work is Goal 1: Core Mission: Deliver real results to provide Americans with clean air, land and water and ensure chemical safety, Objective 1.2, Provide for Clean and Safe Water.

I. The Delaware NPS Program

As part of the DNREC, the Delaware NPS Program is committed to addressing the issue of NPS pollution as it affects Delaware's numerous waterbodies. Efforts include grant funding, education, outreach, and partnerships with other organizations that work together to reduce NPS pollution in Delaware.

II. NPS Program Funding

NPS pollution constitutes the nation's largest source of water quality problems. Approximately 40 percent of the United States rivers, lakes, and estuaries surveyed to date are not clean enough to meet basic uses, such as fishing or swimming, due to NPS pollution.

To counter the ever expanding NPS pollution problem, Congress established the NPS Pollution Management Program under Section 319 of the Clean Water Act (CWA) in 1987. This program provides States with grants to implement NPS pollution controls to achieve goals that are described in NPS pollution management program plans.

On August 4, 1988, Delaware's original NPS Program was approved by the EPA, making it one of the first programs in the nation to comply with Section 319 of the CWA. Delaware administers its NPS Program utilizing the Five-Year Nonpoint Source Program Management Plan that was most recently updated in 2019. Using CWA Section 319 federal grant funding, Delaware's NPS Program administers a competitive grant program to solicit BMP implementation project proposals that address NPS pollution and enhance water quality efforts. The grant provides funding for projects designed to reduce NPS pollution in Delaware's impaired waterbodies. Reduction of NPS pollution is most often achieved through incorporation of specific BMPs into project workplans. Whenever possible, funds are focused in sub-watersheds where NPS control activities are likely to have the greatest positive impact. Funded restoration activities are implemented using the most effective measures and practices available in order to achieve water quality improvements. Eligible types of management program implementation activities include the following:

- Non-regulatory NPS reduction programs
- Technical assistance
- Financial assistance
- Education
- Training

- Technology transfer
- Demonstration projects

Proposals are solicitated annually from potential grant applicants through an advertised request for proposal (RFP) process. These grant application proposals are reviewed, evaluated, and prioritized to determine which are most suitable for implementation funding. At least 40 percent of the overall project cost must be represented by non-federal matching funds. Currently, Delaware requires a non-federal fund match of at least 67% of the total federal grant dollars awarded to section 319 grant recipients to implement water quality based BMP projects to enhance water quality efforts.

III. Delaware NPS Issues

More than 90 percent of Delaware's waterways are considered impaired. The State's list of impaired waters in 2020 Draft State of Delaware Combined Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303 (d) List of Waters Needing TMDLs, includes assessment units (waterbodies and stream segments) throughout the state with 10 different impairments. The most common impairments are NPS related pollutants including pathogens and nutrients (nitrogen and phosphorus). Most impairments come from nonpoint sources which are harder to control. As Delaware is a groundwater driven State, removing NPS pollutants becomes an even more difficult and complex problem to solve. Due to the rate that groundwater travels through the system, many NPS pollutants that entered the systems 30 years ago are just now entering surface water bodies at present day. As such, the effectiveness of current agricultural BMPs will not be realized until much further in the future.

"Impaired waters" are polluted waters. More technically, they are waters that do not meet water-quality standards for their designated uses, such as recreation, fishing, or drinking. Impaired waters could be suffering from excess nutrients, low dissolved oxygen, toxins, bacteria, heat, or any combination of these problems.

Reduction of NPS pollution is achieved through the incorporation or installation of specific BMPs addressing agriculture, silviculture, construction, septic systems, and hydromodification activities. To encourage and support the BMP installation, the NPS Program administers a competitive grant program currently made possible through Section 319 of the CWA. While this federal financial support has proven successful in complementing Delaware's NPS efforts, the NPS Program is currently seeking additional finances to expand activities to more systematically address Delaware's NPS concerns.

Additional roles and responsibilities of the NPS Program include geospatial BMP tracking and reporting, management of the Chesapeake Bay Implementation Grant (CBIG), management of the Surface Water Matching Planning Grant (SWMPG) and Community Water Quality Improvement Grant (CWQIG) administered through the Water Infrastructure Advisory Council (WIAC), management of the agricultural State Revolving Fund (SRF) Program, support for developing Pollution Control Strategies (PCS), and watershed plan development and/or coordination.

IV. Vision and Mission

The Department of Natural Resources and Environmental Control (DNREC) envisions a Delaware that offers a healthy environment where people are committed to the protection, enhancement, and enjoyment of the environment; where Delawareans' stewardship of natural resources ensures the sustainability of these resources for the appreciation and enjoyment of future generations; and where people recognize that a healthy environment and a strong economy support one another.

It's the mission of the Delaware DNREC to protect and manage the State's vital natural resources, protect public health and safety, provide quality outdoor recreation, and to serve and educate the citizens of the First State about the wise use, conservation, and enhancement of Delaware's Environment.

The NPS Management Program is a dynamic and open-ended program intended to facilitate and promote statewide efforts to manage NPS pollution. The following priorities will guide this program:

1. The NPS Program will support the identification and quantification of those problems that are caused specifically by NPS pollution through assessment updates;
2. The NPS Program will be implemented and updated to realistically reduce NPS pollution in a cost-effective manner;
3. The NPS Program will address NPS pollution through a program that balances education, research, technical assistance, financial incentives, and regulation;
4. The NPS Program will follow a non-degradation policy in areas where surface and ground waters meet State water quality standards and to realistically improve water quality in areas that do not meet these standards;
5. The NPS Program will continue to use the coordinated approach for implementation and maintain an open ended framework to incorporate new initiatives and support interactive approaches based on the effectiveness of existing policies and implementation mechanisms; and
6. The NPS Program will support the development and implementation of Pollution Control Strategies (PCS) and/or nine (9) element a-i watershed implementation plans for watersheds of identified impaired or threatened waters in accordance with the Unified Watershed Assessment List.

In Delaware, the lead agency for the development and implementation of the NPS 319 Program is the DNREC, Division of Watershed Stewardship.

V. Executive Summary

The Delaware NPS Program has focused this annual report on nine (9) priority watersheds in Delaware which include; the Appoquinimink River, Broadkill River, Chester and Choptank River, Christina Basin, Inland Bays, Nanticoke River, Pocomoke and Wicomico River, St. Jones

River and the Upper Chesapeake. All of these priority watersheds suffer from impairments linked to NPS water pollution.

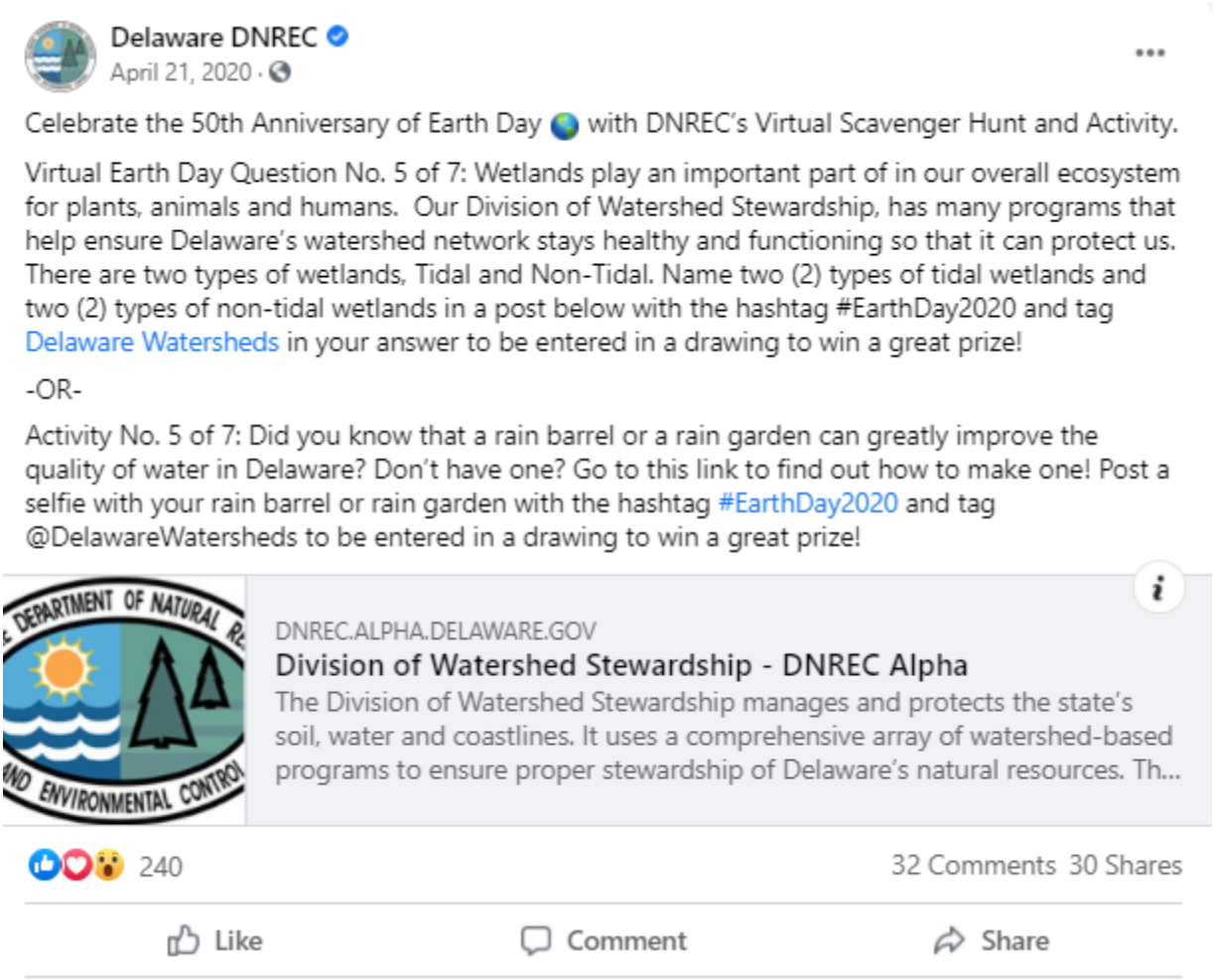
In Federal Fiscal Year (FY) 2019 (October 1, 2018 – September 30, 2019), the Delaware NPS Program received $1,174,612 in federal section 319(h) grant funds to focus on nonpoint source water pollution reduction efforts. For Federal FY2020 (October 1, 2019 – September 30, 2020), the Delaware NPS Program received $1,199,500. This annual report documents the activities and highlights of the DNREC NPS Program during the 2020 calendar year. It also fulfills the reporting requirements of Section 319 of the federal CWA. DNREC's NPS Program annually prepares this report to inform stakeholders on the state's progress in the area of NPS water pollution reduction. Although this report should not be considered a complete enumeration of all NPS pollution reduction activities, it describes the most important features and accomplishments of the NPS Program.

In 2020, the Delaware NPS Program continued to reduce water pollutant levels by working towards achievement of milestone targets. Milestone targets are near-term or long-term commitments that promote a steady pace of progress towards water quality improvement. This report identifies accomplishments during the 2020 calendar year that helped Delaware achieve long-term and short-term milestones (Appendix A), all of which have been identified in the State's NPS Management Program. Milestone activities successfully implemented during 2020 to support and/or enhance the program include but are not limited to: providing grant funding, education and outreach, and enhancing partnerships with other organizations to work together to reduce NPS pollution in Delaware.

- **Grant funding** – For Federal FY20 (October 1, 2019 – September 30, 2020), the Delaware NPS Program received $1,199,500 in federal section 319(h) grant funds to focus on nonpoint source pollution reduction efforts. Grant funding was used and leveraged to implement pollutant control projects, BMPs, and actions featured in the table below. The Federal FY21 grant cycle begins on October 1, 2020 and ends on September 30, 2025. The Delaware NPS Program submitted a federal section 319(h) grant application to the EPA in April 2020 for FY21.

- **Education and Outreach** – The COVID-19 pandemic began to cause major disruptions in normal business operations in mid-March 2020. In-person meetings, events, trainings, conferences and other workshops were either cancelled, postponed indefinitely and/or converted into a virtual format. The Delaware NPS Program experienced the same situations including all DNREC Department staff ordered to work remotely since mid-March 2020 due to the COVID-19 situation. The pandemic had a negative effect on the ability for the program to conduct otherwise normally scheduled education and outreach opportunities within communities throughout the state. The Delaware NPS Program was able to participate in a couple of events as detailed in the following.

  In April 2020, staff from the Delaware NPS Program participated in a virtual scavenger hunt designed to promote Earth Day and encouraged the general public to visit DNREC's website. The Delaware NPS Program provided virtual activities to constituents during the COVID-19 pandemic (see the social media post screenshot below):



Other virtual social media outreach efforts on the Delaware Watersheds Facebook page included offering consistent information about how to reduce nonpoint source pollution by adopting best practices around the home. Posts from other organizations were also shared on the Facebook page that offered virtual workshops that improve water quality.

During specific dates in September and October 2020, the Delaware NPS Program along with the DNREC Division of Solid and Hazardous Waste, co-sponsored a rain barrel and compost bin sale to the general public. Pre-order deadlines were established online and a drive through pickup was conducted at the DNREC Lewes Field Facility located in Lewes, Delaware. Two additional sites in Kent and New Castle Counties were utilized as well on separate dates in September and October. Delaware NPS Program staff assisted with the coordination and logistics of this outreach effort and a total of 375 rain barrels and 325 compost bins were sold to the general public to be utilized for water quality and conservation efforts as well as addressing nonpoint source pollution.

Partnerships – The Delaware NPS Program continues to develop long standing relationships with existing partners as well as attempt to foster working relationships with new partners. The NPS Program continues to work closely with the county Conservation

Districts to implement various agricultural related BMPs in the landscape. During the early months of 2020 prior to the COVID-19 pandemic, the NPS Program held meetings with prospective new partners in attempts to establish working relationships to implement BMPs including but not limited to; tree plantings, wetland creation and restoration, woodchip bioreactors, buffers, etc. As a direct result of these partner meetings, a couple of tree planting projects in priority watersheds were implemented and/or established to be implemented in the future.

The NPS Program's new Conservation Reserve Enhancement Program (CREP) Coordinator began in the summer of 2019. The calendar year of 2020 allowed the CREP Coordinator to be able to experience the full program cycle from handling contract renewals, soliciting for new program participation, as well as meeting various partner organizations and stakeholder contacts. Staff at the Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS) also experienced turnover during this time frame. Throughout 2020, the NPS Program, FSA, NRCS and Conservation Districts conducted both in-person and virtual meetings to further improve programmatic efficiencies within the CREP Program. This partnership collaboration was extremely important and will hopefully increase new enrollments within the program to add to Delaware's CREP conservation practice portfolio.

Overall Pollution Load Reduction from BMP Implementation

Overall, the NPS Program funded projects that were completed during the calendar year in approved watersheds resulting in pollutant load reductions of nitrogen at 1,246,923.5 pounds/year and phosphorus at 38,345.2 pounds/year (see table below for major BMP areas). Delaware continues to ensure that projects funded with CWA Section 319 dollars make progress towards restoring or protecting waters impaired by NPS pollution.

Pollutant Controls, Practices, and Actions	2020 Annual Progress	Unit
Cover Crop (traditional and commodity)	57,196.5	acres
Nutrient Relocation (net export from watershed)	23,466	tons
Nutrient Management	117,353.5	acres
Tree Planting (including Riparian Buffer)	35	acres
Grass Buffer	19	acres

Notes:

1. *Cover crop acres are reported annually and can vary from year to year due to both financial and weather-related circumstances. This figure represents the total acres of cover crops that were directly funded by section 319 grant dollars as well as those acres where grant funded Conservation Planners provided technical assistance in the signup, implementation and destruction verification of those cover crops within the various priority watersheds.*
2. *Nutrient relocation (manure relocation) tonnage is reported annually and can vary from year to year due to various agriculturally related logistics including weather and chicken house clean-out schedules which are directed by the poultry integrator.*
3. *Nutrient Management acres are reported annually and can vary from year to year due to the duration and expiration dates of nutrient management plans. This figure represents the total nutrient management acres that were directly funded by section 319 grant dollars through Conservation Planners and the Delaware Department of Agriculture's Nutrient Management Program with both technical and financial assistance provided.*

VI. Watersheds

This section will present each of the "priority" watersheds throughout the State of Delaware that have EPA approved a-i, nine (9) element watershed plans and where BMP projects are implemented utilizing CWA Section 319(h) funds. Each of the priority watersheds are represented individually within this section to highlight the watershed's characteristics, TMDL goals, and reflect implementation progress (both annually and cumulative) of BMPs that are funded directly with CWA Section 319(h) funds.

Delaware currently has nine (9) priority watersheds that have EPA approved watershed implementation plans as follows:

- Appoquinmink River
- Broadkill River
- Chester River and Choptank River
- Christina Basin
- Inland Bays
- Nanticoke River
- Pocomoke River and Wicomico River
- St. Jones River
- Upper Chesapeake

The BMP Progress Reporting Table found on each individual watershed's page are those BMPs funded directly with Clean Water Act Section 319(h) grant funds through the Delaware NPS Program. The WIP goal is established by the approved a-i, nine (9) element watershed implementation plan and reflects the implementation necessary to achieve the required TMDL nutrient loading reductions.

Notes:

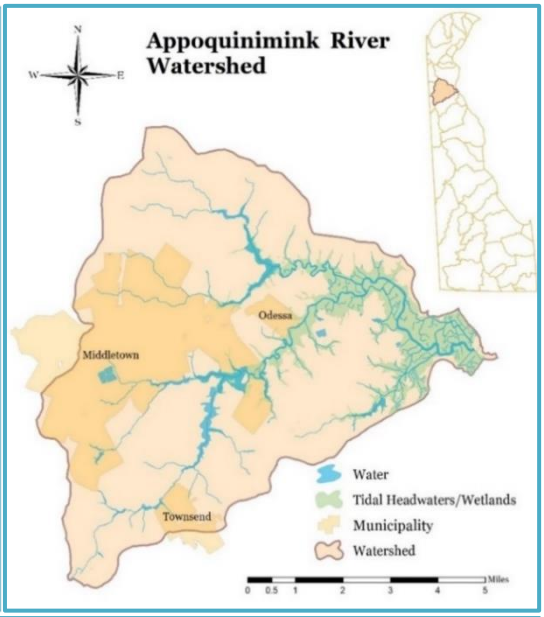
1. *The Christina Basin a-i watershed plan does not identify a numerical cover crop acre implementation goal. Based on the identified 2,738 acres of grain production area within the watershed, a best professional judgement of 1,369 acres (50%) would be allocated as the goal due to anticipated cropping rotation practices.*
2. *The Christina Basin a-i watershed plan does not identify a numerical nutrient management implementation goal. Based on the identified 7,560.6 acres of total agricultural land use in the subwatersheds, and subtracting 322.4 acres of trees and wildlife, the identified goal is 7,238.2 acres which represents grain production and pasture and hay acreage across the subwatersheds.*
3. *The entire Chesapeake Bay watershed has an approved Phase III Watershed Implementation Plan (WIP) with Region 3 EPA.*

Appoquininink River

Delaware Nonpoint Source Program 2020 Watershed Progress Report

Appoquinimink River

Watershed Description: The 16-mile Appoquinimink River meanders through farmlands and wetlands in southern New Castle County, Delaware, draining 47 square miles. The headwater drains mostly agricultural lands and feeds four major ponds. The tidal freshwater segment of the Appoquinimink is bound by the head of tide at Noxontown Pond and Silver Lake, and by Drawyer Creek's confluence with the Appoquinimink. The remainder of the watershed consists of a tidal marsh extending to the Delaware River. The Appoquinimink River system consists of five main tributaries, the Appoquinimink River main stem, Deep Creek, Dove Nest, Hangman's Run, and Drawyer Creek. There are several shallow, man-made small lakes and ponds in the watershed: Wiggins Mill Pond, Noxontown Pond, Silver Lake, and Shallcross Lake. The Appoquinimink River is tidal from the confluence with Delaware Bay to the dam at Noxontown Lake on the main stem, the dam at Silver Lake on Deep Creek, and the confluence with Drawyer Creek. Salinity intrusion from Delaware Bay typically reaches upstream to river kilometer 8.5, past the Drawyer Creek confluence.



Goals: TMDLs were established for the entire Appoquinimink River in December, 2003. These TMDLs called for 325,215 lbs/yr and 8,578 lbs/yr reductions in NPS nitrogen and phosphorus, respectively. An implementation plan was developed by a Tributary Action Team, a diverse group of citizens and government agency personnel, and presented to the Department for promulgation to reach the prescribed TMDLs. Load reductions will be achieved through the implementation of BMP's in agriculture, development, wastewater, and private stewardship. The strategy is designed to reduce nutrient loadings from current and future land practices. This combination of actions will lead to the achievement of the TMDL.

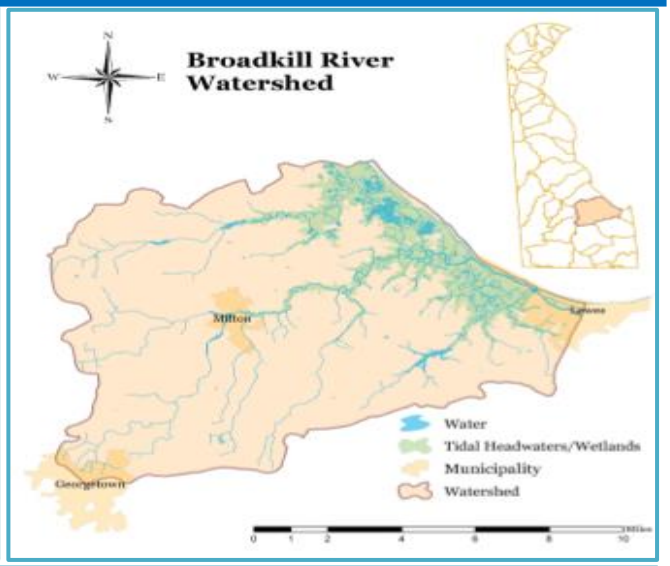
BMP Progress FY 2020							
BMP Name	**Units**	**2020 Progress**	**Cumulative Progress**	**WIP Goal**	**% Achieved**	**Practice & N Load Reductions (lbs/year)**	**Practice & P Load Reductions (lbs/year)**
Cover Crop (traditional & commodity)	Acres	0	Annual	3,460	0	0	0
Nutrient Management	Acres	7,584	Annual	12,584	60.3	25,413	122
Hardwood Tree Planting	Acres	2	3.73	-	100	190	4
Riparian Buffer (forest and vegetative)	Acres	0	36	6	600	1,832	35
Total Reductions						27,435	161
WIP Load Reduction Goal						325,215	8,578
Percent Load Reduction Achieved						8.44	1.88

Broadkill River

Delaware Nonpoint Source Program 2020 Watershed Progress Report

Broadkill River

Watershed Description: The Broadkill River Watershed is located in the east central portion of Sussex County, Delaware. It is bounded on the north by the Cedar Creek Watershed, on the west by the Gravelly Branch and Deep Creek Watersheds, on the south by the Lewes-Rehoboth Canal, Rehoboth Bay, and Indian River Watersheds, and on the east by the Delaware Bay. The mainstem of the Broadkill River is approximately 25 miles long. The major watercourse in this segment is the Broadkill River, which originates at the Town of Milton, and discharges into the Roosevelt Inlet near Lewes. Major impoundments in the area are Waggamons and Diamond ponds located near Milton. The Broadkill River flows generally eastward until it approaches the coast where it turns abruptly and flows south to discharge into the Roosevelt Inlet. The flow of this stream is sluggish and the water is turbid. The watershed drains an area of 107 square miles.



Goals: The established Total Maximum Daily Load (TMDL) requires a 40% reduction in NPS nitrogen and phosphorous from the 2002-2003 baseline levels of 1,353,055 lbs/yr (3,707 lbs/day) and 57,597 lbs/yr (157.8 lbs/day), respectively. The NPS nitrogen and phosphorous load reduction is 541,222 lbs/yr and 23,039 lbs/yr, respectively. As a result of land use changes from 2002-2007, the 2007 baseline NPS loads changed to total N of 2,891 lbs/day and P of 124.1 lbs/day. Total N reductions of 667.1 lbs/day (243,700 lbs/yr) and total P reductions of 29.4 lbs/day (10,740 lbs/yr) are required. This shall result in a yearly average total nitrogen and phosphorous load of 2,224.2 lbs/day (811,833 lbs/yr) and 94.7 lbs/day (34,565.5 lbs/yr), respectively, to achieve the 2025 TMDL.

BMP Progress FY 2020							
BMP Name	**Units**	**2020 Progress**	**Cumulative Progress**	**WIP Goal**	**% Achieved**	**Practice & N Load Reductions (lbs/year)**	**Practice & P Load Reductions (lbs/year)**
Cover Crop (traditional & commodity)	Acres	6,488	Annual	9,763.1	66.5	85,361	383
Nutrient Relocation (net export from watershed)	Tons	835	Annual	3,165	26.4	4,648	492
Nutrient Management	Acres	10,795.5	Annual	26,476	40.8	30,144	3,497
Hardwood Tree Planting	Acres	0	192.7	192	100.4	79.5	2.5
Rain Garden	Structure	0	5.4	N/A	100	108	3
Total Reductions						120,341	4,378
WIP Load Reduction Goal						243,700	10,740
Percent Load Reduction Achieved						49.4	40.8

Chester & Choptank River

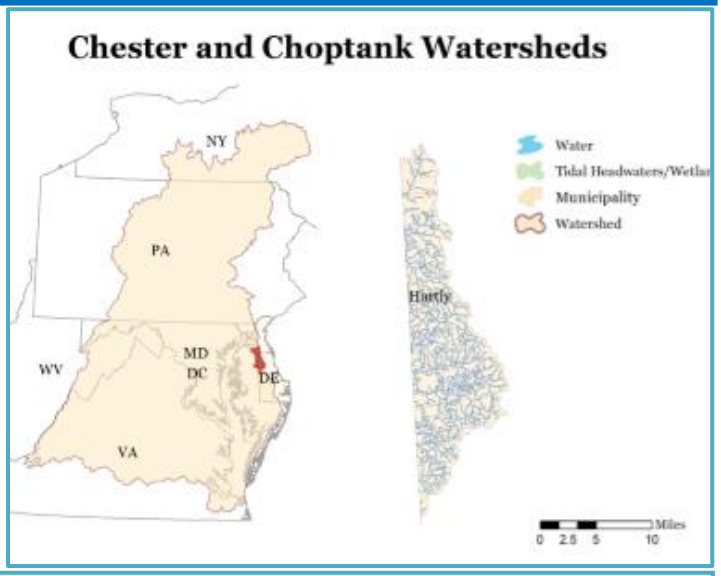
Delaware Nonpoint Source Program 2020 Watershed Progress Report

Chester and Choptank Watersheds

Watershed Description: The majority of the Chester and Choptank Watersheds are in Kent County, Delaware, while a portion of the Chester River originates in New Castle County, Delaware. Both rivers drain into Maryland's eastern shore, including Kent County, Queen Anne's County, and Caroline County. The Chester and Choptank Watersheds include 88,217.5 acres, or 137.8 square miles of land area.

Chester River in Delaware includes a 40.0 square mile drainage area with headwaters beginning at the divide between New Castle and Kent Counties. Delaware headwater segments, including Cypress Branch, Sewell Branch, and Gravelly Run, flow west into both Kent County and Queen Anne's County, Maryland.

The Choptank River Watershed, located immediately south of the Chester River, includes 62,191 acres. Headwater tributaries to the Choptank River includeTappahanna Ditch, Culbreth Marsh Ditch, and Cow Marsh Creek.



Goals: The TMDL established for the Chester and Choptank River Watersheds capped the nonpoint source nitrogen loads at the 2001 – 2003 baseline levels of 708 lbs/day (258,600 lbs/year) and 1,359 lbs/day (496,400 lbs/year), respectively. Phosphorous reductions of 40% from the 2001 – 2003 baseline levels for the Chester and Choptank Watersheds of 12.3 lbs/day and 51.1 lbs/day, respectively. Baseline loads in the Chester and Choptank for phosphorus are 19,940 lbs/year and 46,390 lbs/year, with TMDL allocated loads set to 11,800 lbs/year and 27,720 lbs/year, respectively. Total phosphorous load reductions of 26,810 lbs/year are required for the Chester and Choptank.

BMP Progress FY 2020

BMP Name	Units	2020 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional & commodity)	Acres	7,934.5	Annual	26,260.54	30.2	74,793	155.5
Nutrient Relocation (net export from watershed)	Tons	0	Annual	N/A	0	0	0
Nutrient Management	Acres	11,851	Annual	37,249.55	31.8	24,574	1,275
Hardwood Tree Planting	Acres	0	377	177.8	212	11,748	293
Water Control Structures	Acres	0	348	3,120.7	11.2	2,602	0
Stream Restoration	Feet	0	1,924	11,722	16.4	260	303
Wetland Restoration	Acres	0	551	2,113.4	26.1	12,791	441
Total Reductions						126,768	2,468
WIP Load Reduction Goal						755,000	26,810
Percent Load Reduction Achieved						16.1	8.7

Christina Basin

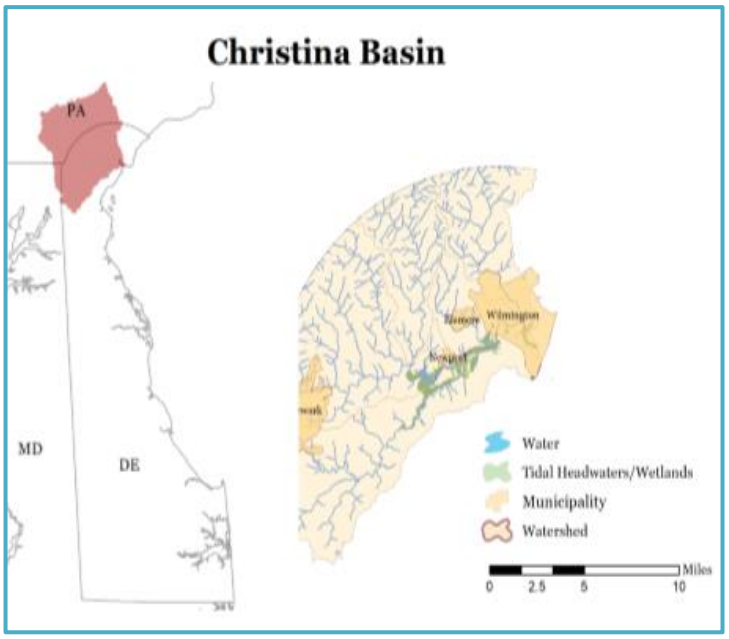
Delaware Nonpoint Source Program 2020 Watershed Progress Report

Christina Basin

Watershed Description: The Christina Basin is a 565 square mile basin contained in the larger Delaware River Basin. The Christina Basin, located in New Castle County in northern Delaware, includes four sub-watersheds:

- Brandywine Creek 325 sq. mi.
- Red Clay Creek 54 sq. mi.
- White Clay Creek 107 sq. mi.
- Christina River 78 sq. mi.

Although a small portion can be found within Maryland, the Christina Basin falls principally within two states which includes Pennsylvania to the north and Delaware to the south. The Pennsylvania portion is characterized by more open space including agricultural land and forests, while the more urban, southerly portion in Delaware tends to be more residential.
The Watershed Implementation Plan development for the Christina Basin Watershed was approved by EPA in the Spring of 2013.



Goals: The EPA TMDL bases its required reductions on a subwatershed basis. Delaware collects data on a watershed wide level basis. An estimate of nitrogen and phosphorous reduction loads from a subwatershed level basis were added together to make a total of estimated reductions that are required on a watershed wide level basis to achieve the TMDL. Estimated total nitrogen and phosphorous load reductions required to achieve TMDL requirements are 343.54 lbs/day (125,392.10 lbs/year) and 43.08 lbs/day (15,724.20 lbs/year), respectively.

BMP Progress FY 2020							
BMP Name	Units	2020 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional & commodity)	Acres	0	Annual	1,369	0	0	0
Nutrient Management	Tons	67	Annual	7,238.2	.9	218	10.5
Rain Garden	Structures	0	36	N/A	100	539	0
Stream Restoration	Feet	140	3,815	N/A	100	95.5	12.5
Hardwood Tree Planting	Acres	0	0.8	N/A	100	41	0
Total Reductions						894	23.00
WIP Load Reduction Goal						125,392	15,724
Percent Load Reduction Achieved						0.7	0.1

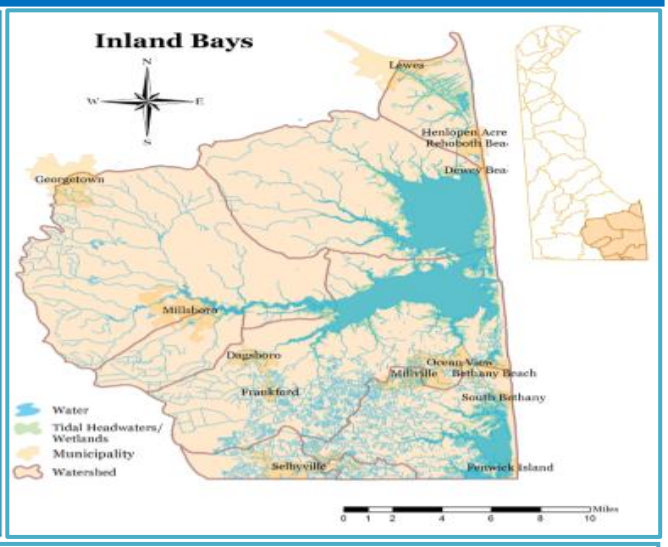
Inland Bays

Delaware Nonpoint Source Program 2020 Watershed Progress Report

Inland Bays

Watershed Description: The Inland Bays/Atlantic Ocean Basin comprises approximately 313 square miles of eastern Sussex County, Delaware. Starting at Lewes and Cape Henlopen State Park at the southern edge of the entrance to Delaware Bay, the area extends southward approximately 24 miles along the Atlantic shoreline to the Maryland State Line. It includes the coastal towns of Rehoboth Beach, Dewey Beach, Bethany Beach, South Bethany Beach, and Fenwick Island. State Route 1 (SR 1) extends parallel to the shoreline and connects the towns.

The three inland bays (Rehoboth Bay, Indian River Bay, and Little Assawoman Bay) are located just landward of the Atlantic Ocean shoreline. Rehoboth Bay contains the Lewes-Rehoboth Canal and Rehoboth Bay Watershed; the Indian River Bay contains the Indian River, Iron Branch, and Indian River Bay Watersheds; and the Little Assawoman Bay contains the Little Assawoman, Assawoman, and Buntings Branch Watersheds.



Goals: Goals call for the increased implementation of numerous NPS BMPs, especially in the agriculture sector. The approved watershed plan calls for a reduction in NPS total nitrogen loading of 3,764 lbs/day (1,373,860 lbs/year) and total phosphorous loading of 133 lbs/day (48,545 lbs/year). The goals are those that were presented by Inland Bays Pollution Control Strategy (PCS) which is also an approved EPA watershed plan. The PCS involves many strategies to reduce nitrogen and phosphorous to meet the TMDL, but presented here are initiatives of the 319 program.

BMP Progress FY 2020							
BMP Name	**Units**	**2020 Progress**	**Cumulative Progress**	**WIP Goal**	**% Achieved**	**Practice & N Load Reductions (lbs/year)**	**Practice & P Load Reductions (lbs/year)**
Cover Crop (traditional & commodity)	Acres	16,337	Annual	37,637	43.3	208,848	643
Nutrient Relocation (net export from watershed)	Tons	13,321	Annual	20,909	63.7	74,585	5,240
Nutrient Management	Acres	17,369	Annual	53,827	32.3	48,847	3,655
Riparian Buffer (forest and vegetative)	Acres	33	274	3,246	8.5	11,515	383
Wetland Restoration	Acres	0	29	4,175	0.70	913	47
Grass Buffers (CREP CP21)	Acres	19	70.2	1,772	4	1,958	66
Rain Garden	Structure	0	1	3	33.3	15	0
Total Reductions						346,681	10,034
WIP Load Reduction Goal						1,373,860	48,545
Percent Load Reduction Achieved						25.2	20.7

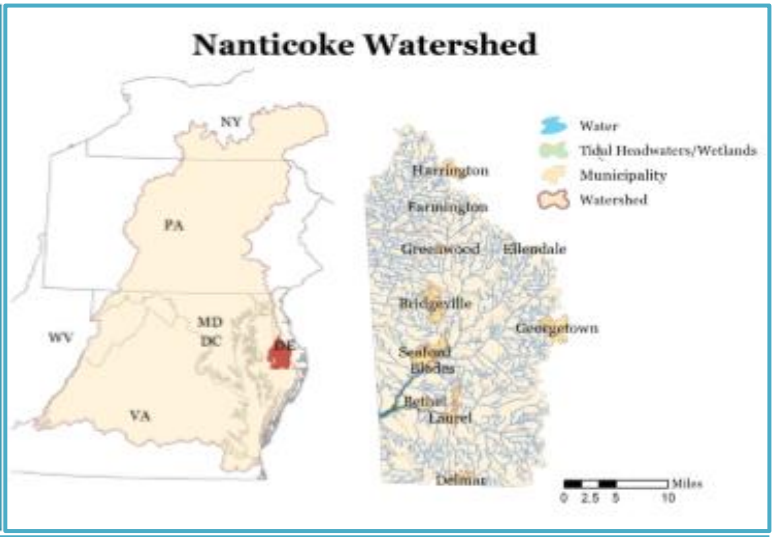
Nanticoke River

Delaware Nonpoint Source Program 2020 Watershed Progress Report

Nanticoke River Watershed

Watershed Description: The Nanticoke River Watershed includes the Middle Nanticoke and Upper Nanticoke Rivers. The majority of the two rivers originate in Sussex County, Delaware, while a portion of the Middle and Upper Nanticoke Rivers originate in Kent County, Delaware. Both rivers drain to the southwest into Maryland's eastern shore, including Caroline County, Dorchester County, and Wicomico County. The Nanticoke includes 315,890.7 acres, or 493.6 square miles, of land area.

The Middle Nanticoke River refers to the Marshyhope Creek. Headwater tributaries to the Upper Nanticoke River include Gum Branch, Gravelly Branch, Deep Creek and Broad Creek.



Goals: Current goals call for the increased implementation of numerous NPS BMPs, especially in the agriculture sector. The milestones allow jurisdictions the opportunity to adapt implementation strategies as necessary to meet the goals and achieve the TMDL standard. According to the approved Nanticoke River watershed plan, total nitrogen and phosphorous load reductions of 736,508 lbs/year and 33,941 lbs/year, respectively, are required to achieve the 2025 TDML load allocations.

BMP Progress FY 2020

BMP Name	Units	2020 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional & commodity)	Acres	20,381	Annual	43,343	47.0	269,673	750
Nutrient Relocation (net export from watershed)	Tons	5,890	Annual	Maximum Available	-	35,568	2,320
Nutrient Management	Acres	50,850	Annual	143,647	35.4	140,135	9,564
Hardwood Tree Planting	Acres	0	695.5	157	443	31,930	997
Water Control Structures	Acres	0	1,219	2,394	50.9	9,106	0
Stream Restoration	Miles	0	1.3	465	0.28	911	1,060
Wetland Restoration	Acres	0	1,929	74,043	2.6	65,480	3,098
Total Reductions						552,803.00	17,789.00
WIP Load Reduction Goal						736,508	33,941
Percent Load Reduction Achieved						75.1	52.4

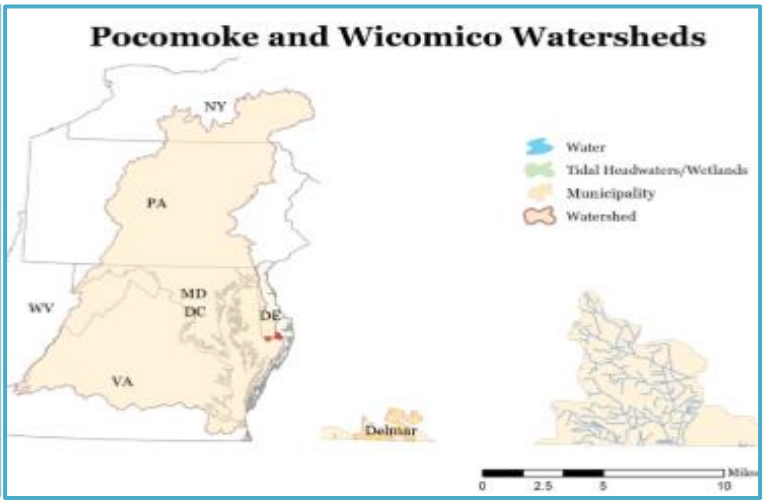
Pocomoke & Wicomico River

Delaware Nonpoint Source Program 2020 Watershed Progress Report

Pocomoke and Wicomico River Watershed

Watershed Description: The Pocomoke and Wicomico Rivers both originate in Sussex County, Delaware, and drain into Maryland's eastern shore, primarily in Wicomico County.

The Delaware portion of the Pocomoke River is comprised of 35 square miles and includes four headwater tributaries - Bald Cypress Branch, Gum Branch, Lewis Prong, and North Fork Green Branch. The headwaters for the Wicomico River begin at the Delaware-Maryland divide, with the Delaware portion contributing only 2.1 square miles. Four very small stream segments of the Wicomico watershed are located in Delaware, accounting for just 0.7 stream miles.



Goals: A TMDL was established in 2005 for the Pocomoke River. The Pocomoke nitrogen and phosphorous load allocations are 102.7lbs/day (37,256 lbs/year) and 6.1 lbs/day (2,228 lbs/year), respectively. The Wicomico nitrogen and phosphorus load allocations are 9,103 lbs/year and 708 lbs/year, respectively. The combined total nitrogen and phosphorous load reductions needed to achieve the 2025 TMDL in the Pocomoke and Wicomico watersheds are 49,060 lbs/year and 3,047 lbs/year, respectively.

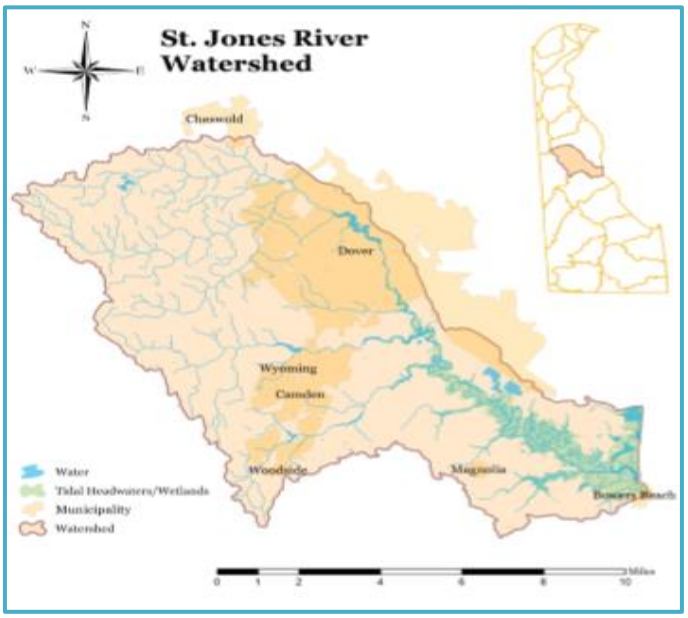
BMP Progress FY 2020							
BMP Name	**Units**	**2020 Progress**	**Cumulative Progress**	**WIP Goal**	**% Achieved**	**Practice & N Load Reductions (lbs/year)**	**Practice & P Load Reductions (lbs/year)**
Cover Crop (traditional & commodity)	Acres	2,659	Annual	2,217.48	119.9	18,800	105
Nutrient Relocation (net export from watershed)	Tons	2,447	Annual	Maximum Available	-	7,578	963
Nutrient Management	Acres	4,891	Annual	10,067.57	48.6	7,607	1,057
Hardwood Tree Planting	Acres	0	49.3	23.9	206.3	1,047	71
Water Control Structures	Acres	0	87	189.24	45.9	650	0
Stream Restoration	Feet	0	481	1,712.5	28.1	65	76
Wetland Restoration	Acres	0	138	153.62	89.8	2,403	222
Total Reductions						38,150	2,494
WIP Load Reduction Goal						49,060	3,047
Percent Load Reduction Achieved						77.8	81.9

St. Jones River

Delaware Nonpoint Source Program 2020 Watershed Progress Report

St. Jones River

Watershed Description: The St. Jones River Watershed is approximately 25.9 square miles (16,576 acres) and is located in the central portion of Kent County. It drains 90 square miles of land. The major watercourse in the watershed is the St. Jones River, which has its headwaters in the western part of the county, about 22 miles upstream from the Delaware Bay. Significant ponds in the watershed are Silver Lake, Moores Lake, and Wyoming Lake. Flat wetlands, usually forested, exist mostly in the upper portion of the watershed and eventually drain into creeks and streams. Non-tidal riverine wetlands and tidal wetlands line the banks of the river, sometimes up to a ½ mile wide toward the mouth of the river. Wetlands comprise 9,669 acres of the watershed and provide critical services such as nutrient removal, erosion control, habitat for plants and wildlife, flood reduction, and storm water storage to the citizens of Delaware.
The St. Jones Watershed has 5,236 acres of protected lands, including 3,750 acres preserved in the St. Jones River Reserve.



Goals: Reduce the overall levels of nitrogen and phosphorus in the waterway by 40% from the 2002-2003 baseline loads, or 869.5 lbs/day (317,368 lbs/year) and 63.4 lbs/day (23,141 lbs/year), respectively. NPS specific nitrogen and phosph orous load reductions of 838.5 lbs/day (306,053 lbs/ year) and 52.93 lbs/day (19,309 lbs/ year) are required. The TMDL also calls for a nitrogen and phosphorous reduction from its stormwater (MS4) discharges of 21.8 lbs/day (7,957 lbs/year) and 3.4 lbs/day (1,241 lbs/year), respectively.

BMP Progress FY 2020							
BMP Name	**Units**	**2020 Progress**	**Cumulative Progress**	**WIP Goal**	**% Achieved**	**Practice & N Load Reductions (lbs/year)**	**Practice & P Load Reductions (lbs/year)**
Cover Crop (traditional & commodity)	Acres	3,397	Annual	6,246.31	54.4	10,413	11
Nutrient Relocation (net export from watershed)	Tons	0	Annual	6,480.12	0	0	0
Nutrient Management	Acres	11,033	Annual	35,849	30.8	7,440	200
Hardwood Tree Planting	Acres	0	1.7	N/A	100	16	0.2
Grass Buffers (CREP CP21)	Acres	0	8.5	1,174	0.73	5.5	1
Riparian Buffers	Acres	0	7	1,161	0.61	65	1
Total Reductions						17,940	213
WIP Load Reduction Goal						317,368	23,141
Percent Load Reduction Achieved						5.7	0.9

Upper Chesapeake

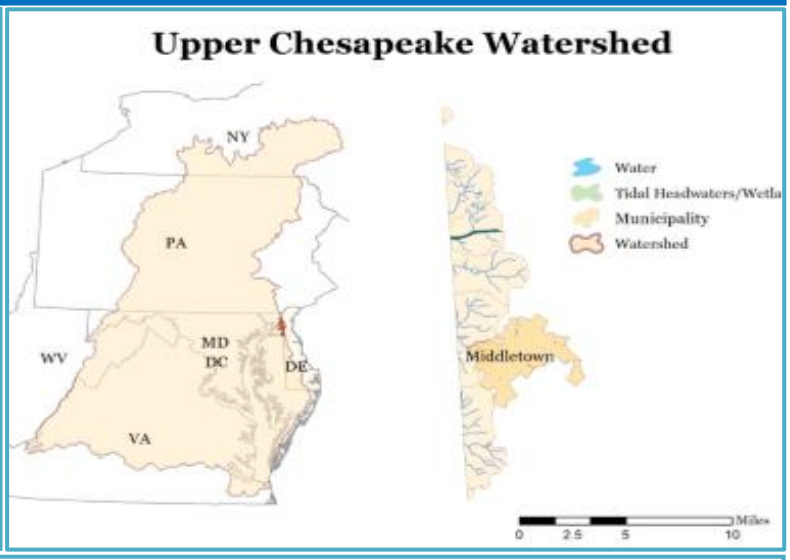
Delaware Nonpoint Source Program 2020 Watershed Progress Report

Upper Chesapeake Watershed

Watershed Description:

The Upper Chesapeake Watershed includes the Elk, Bohemia, and Sassafras Rivers and the C & D Canal, all of which originate in New Castle County, Delaware, and drain to the west into Maryland's upper eastern shore primarily in Cecil County. The Upper Chesapeake includes 23,351.7 acres or 36.5 square miles of land area.

The Upper Chesapeake as a whole is made up of a mixture of land uses, primarily including agriculture, forest, and developed lands. Over two-thirds of the Upper Chesapeake is agricultural use (38.4%) or developed land (34.0%) with the remaining land use largely comprised of forest (27.1%).



Goals: The watershed plan for the Upper Chesapeake states that load reductions proposed meet the allocations for the Upper Chesapeake in the Bay TMDL. By targeting the most effective BMPs to the critical areas with the greatest recovery potential, the total nitrogen (TN) agriculture load can be decreased from 112,510 to 60,365 lbs/year. The agricultural total phosphorous (TP) loads can be reduced from 19,235 to 6,134 lbs/year. The TN urban load is the second largest load and can be reduced from 67,790 to 60,138 lbs/year. Urban TP loads can be reduced from 4,332 to 3,668 lbs/year. The TN from septic systems can be reduced from 32,709 to 29,722 lbs/year.

BMP Progress FY 2020							
BMP Name	**Units**	**2020 Progress**	**Cumulative Progress**	**WIP Goal**	**% Achieved**	**Practice & N Load Reductions (lbs/year)**	**Practice & P Load Reductions (lbs/year)**
Cover Crop (traditional & commodity)	Acres	0	Annual	7,439.1	0	0	0
Nutrient Relocation (net export from watershed)	Tons	973	Annual	Maximum Available	0	4,018	191
Nutrient Management	Acres	2,913	Annual	14,279.8	20.4	6,432	371
Hardwood Tree Planting	Acres	0	49.55	N/A	100	1,544	38
Water Control Structures	Acres	0	87	155.4	56.0	650	0
Stream Restoration	Miles	0	481	2,732	17.6	65	76
Wetland Restoration	Structure	0	138	247	55.9	3,204	110
Total Reductions						15,913	786
WIP Load Reduction Goal						62,784	13,765
Percent Load Reduction Achieved						25.4	5.7

VII. Project Highlights

Delaware Botanic Gardens – Stormwater Management BMP Enhancements

Top left and right: The enhanced Rhyne Garden to act as a bioretention facility

The Delaware Botanic Gardens (DBG) at Pepper Creek utilized section 319 NPS grant funds to enhance stormwater management facility BMPs at their site located Dagsboro, Delaware. The DBG is situated on 37 acres along Pepper Creek which flows into the Indian River Bay watershed which makes up one of three of Delaware's Inland Bays. The Inland Bays consist of three interconnected bodies of water; the Rehoboth Bay, Indian River Bay, and Little Assawoman Bay, all of which are located in southeastern Sussex County that are further divided into subwatersheds. The DBG maintains a year-round living habitat to demonstrate the vital impacts of plants on the lives of the region's citizens and their environment. The site that DBG is located includes agricultural land as well as waterfront areas along the Pepper Creek.

The DBG submitted a proposal to the Delaware NPS Program for consideration of funding toward enhancements of stormwater management facilities to help further reduce the effects of NPS pollution as well as serve as a demonstration model for stormwater management and water quality. Existing dry ponds/basins had a biosoil layer incorporated and numerous plantings of native shrubs, forbs, and grasses were established to help the stormwater management facility enhance water quality. The stormwater swale in the main parking lot was retrofitted to function as a bioretention facility. This facility, named the Ryhne Garden, had various native herbaceous species planted over an approximately 12,800 square foot area to help filter NPS pollution being transported by stormwater runoff from the parking lot area.

These stormwater facility BMP enhancement projects included the planting of over 12,000 herbaceous perennials, over 30 semi-mature native trees, and over 300 native shrubs. The DBG is also incorporating an education and outreach component to this initiative in the form of interpretive signage, guided tours, and video promotion of the BMPs as a demonstration site to visitors.

Implementation began in early 2020 and is expected to conclude in early 2021. Fiscal Year 2019 grant funds were utilized to fund this project.

Delaware Wild Lands – Tree Planting Project

Top left: Prior to planting *Top right: Completion of tree planting*

The Delaware Wild Lands organization was a new partner to the Delaware NPS Program in 2020. The first BMP implementation project consisted of a 2-acre hardwood tree planting on their Armstrong property in Middletown, Delaware, along the headwaters of Augustine Creek within the Appoquinimink River watershed.

This project commenced and finished in April of 2020. 1,200 tree seedlings were planted as part of this reforestation effort of marginal agricultural crop production land. Some major goals of the project included; reducing NPS pollution from agricultural crop production practices and enhancing wildlife habitat area for migratory and resident bird species. Delaware Wild Lands staff, family and friends provided time and labor to complete this tree planting initiative. Originally, the plan was to solicit and secure numerous volunteers to help with the tree planting; however, the COVID-19 pandemic caused modifications to be made in order to complete this project.

The Delaware NPS Program is also working with Delaware Wild Lands on future BMP projects and hopes to continue to foster this new working relationship to implement additional water quality enhancement projects.

Delaware Nonpoint Source Program 2020 Watershed Progress

2020 Rain Barrel and Compost Bin Sale

After pre-ordering, participants could choose from three different pick-up dates and locations for rain barrels, compost bins, and accessories. Pick-up locations were provided in each county.

The Delaware Nonpoint Source Program partnered with the DNREC's Division of Solid and Hazardous Waste Program to organize a rain barrel and compost bin pick-up for constiutents on three different dates in September and October 2020. Advertising for the events was coordinated by the NPS and Hazardous Waste Programs and allowed people to pre-order the rain barrels and compost bins online. The Department purchased the amount of rain barrels and compost bins based on these pre-orders, so no revenue was generated. This helped to serve as outreach events to educate people about NPS pollution and ways to incorporate these BMPs to address those sources of pollution.

375 rain barrels, 325 compost bins & 522 compost accessories distributed

The "FreeGarden Earth" compost bins are made from recycled materials, and require no assembly. Compost bins have features that enhance the decomposition process and help make composting more efficient. These compact units transform food scraps and yard waste into a nutrient-rich soil amendment that replaces traditional fertilizers to produce healthier plants and vegetables in home gardens.

The 55-gallon "FreeGarden Rain" rain barrels are attractive and easy to move, install and use. Rain barrels collect and store the water from roofs and downspouts for future uses such as watering lawns, gardens, and house plants; cleaning off gardening tools; and car washing. Rain barrels help to lower water bills, particularly in the summer months by collecting free water each year. Rain barrels play an important role in protecting water resources by collecting stormwater runoff from homes before it reaches local streams and rivers.

VIII. Load Reductions

In 2020, the Delaware NPS Program load reductions were calculated for many of the 319 funded projects implemented on a watershed scale. The load reductions are calculated using guidance established during the Pollution Control Strategy development process.

2020 Project Load Reductions/Year by Watershed

Project	Nitrogen (lbs.)	Phosphorus (lbs.)
Upper Chesapeake Bay	15,913	786
Chester and Choptank	126,768	2,467.5
Nanticoke River	552,803	17,789
Pocomoke and Wicomico	38,150	2,494
St. Jones River	17,939.5	213.2
Inland Bays	346,681	10,034
Broadkill River	120,340.5	4,377.5
Appoquinimink River	27,435	161
Christina Basin	893.5	23
TOTAL	**1,246,923.5**	**38,345.2**

IX. 2020 Annual BMP Nutrient Reductions for Nitrogen & Phosphorous

Total Nitrogen Load Reductions by Watershed

Nitrogen Load Reductions (lbs./year)	Upper Chesapeake	Chester /Choptank	Nanticoke	Pocomoke/ Wicomico	St. Jones River	Inland Bays	Broadkill River	Appoquinimink River	Christina Basin	Total N (lbs./year)
Cover Crops	0	74,793	269,673	18,800	10,413	208,848	85,361	0	0	667,888
Nutrient Relocation	4,018	0	35,568	7,578	0	74,585	4,648	0	0	126,397
Nutrient Management	6,432	24,574	140,135	7,607	7,440	48,847	30,144	25,413	218	290,810
Hardwood Tree Planting	1,544	11,748	31,930	1,047	16	0	79.5	190	41	46,595.5
Riparian Buffer	0	0	0	0	65	11,515	0	1,832	0	13,412
Grass Buffer	0	0	0	0	5.5	1,958	0	0	0	1,963.5
Water Control Structures	650	2,602	9,106	650	0	0	0	0	0	13,008
Stream Restoration	65	260	911	65	0	0	0	0	95.5	1396.5
Wetland Restoration	3,204	12,791	65,480	2,403	0	913	0	0	0	84,791
Rain Garden	0	0	0	0	0	15	108	0	539	662
Total N Reductions	**15,913**	**126,768**	**552,803**	**38,150**	**17,939.5**	**346,681**	**120,340.5**	**27,435**	**893.5**	**1,246,923.5**

Total Phosphorous Load Reductions by Watershed

Phosphorus Load Reductions (lbs./year)	Upper Chesapeake	Chester /Choptank	Nanticoke	Pocomoke/ Wicomico	St. Jones River	Inland Bays	Broadkill River	Appoquinimink River	Christina Basin	Total P (lbs./year)
Cover Crops	0	155.5	750	105	11	643	383	0	0	2047.5
Nutrient Relocation	191	0	2,320	963	0	5,240	492	0	0	9,206
Nutrient Management	371	1,275	9,564	1,057	200	3,655	3,497	122	10.5	19,751.5
Hardwood Tree Planting	38	293	997	71	0.2	0	2.5	4	0	1405.7
Riparian Buffer	0	0	0	0	1	383	0	35	0	373
Grass Buffer	0	0	0	0	1	66	0	0	0	49
Water Control Structures	0	0	0	0	0	0	0	0	0	0
Stream Restoration	76	303	1,060	76	0	0	0	0	12.5	1,527.5
Wetland Restoration	110	441	3,098	222	0	47	0	0	0	3,918
Rain Garden	0	0	0	0	0	0	3	0	0	3
Total P Reductions	**786**	**2,467.5**	**17,789**	**2,494**	**213.2**	**10,034**	**4,377.5**	**161**	**23.0**	**38,345.2**

X. Future Changes and Challenges

Delaware has developed this report to highlight accomplishments made in 2020 to reduce nitrogen, phosphorus, and sediment NPS pollution. The charts and tables above signify the continued progress in reducing loads to impaired watersheds. Additional commitments were made between DNREC and EPA with the development of annual milestones identified in Delaware's 2019 NPS Management Plan. These milestones describe the outcomes and key actions expected over a determined timeframe. The NPS Management Plan includes objectives that address nonpoint sources of surface and ground water pollution as appropriate (including sources of drinking water) in alignment with the goals of the CWA. Objectives of the plan include both implementation steps and how results will be tracked (e.g., water quality improvements or load reductions). Additionally, long-term goals and short-term milestones are integrated with other key environmental and natural resource programs. The Nonpoint Source Program's goals and objectives are periodically revised to reflect progress or problems encountered, develop strategies to make progress towards achieving the goals, and develop indicators to measure progress. Updates to the NPS Milestones can be found in Appendix A.

Delaware continues to make progress toward meeting water quality goals with continued commitments of funding implementation activities to address the agriculture and urban sectors. For example, many of the key personnel working within the County Conservation Districts help to write nutrient management plans, install agriculture BMPs, and help farmers to identify resource concerns. Additional DNREC staff work with private landowners on buffers, wetland and stream restoration projects, as well as septic system pump-outs, repairs, and/or replacements. The Delaware Department of Agriculture staff work with farmers and the agricultural community to continue the implementation and enforcement of the Nutrient Management Law and Regulations. The Delaware NPS Program continues to provide funding to the Department of Agriculture's Nutrient Management Program toward manure relocation efforts and personnel to help implement the nutrient management program, assist with nutrient management plan cost share practices, and help track and report agricultural BMP practices that are inspected by the program. The Delaware NPS Program continues to try and develop new working relationships with BMP implementation partner organizations to further water quality enhancement efforts.

While some goals have been missed, Delaware has continued to make substantial progress and has invested significant effort into programmatic changes, such as regulations, permits, and reorganizing programs. Although these additional efforts improve accountability, they do not necessarily have an immediate impact on nutrient reductions. Delaware's agricultural community works every day to conserve and protect our water resources, with many of our farmers implementing BMPs that are not accounted for or reported. We are now capturing some of the previously unreported BMP data through statewide transect surveys and Chesapeake Bay related verification efforts. The cropland residue and cover crop transect surveys were established in 2014 and have continued on an annual basis until the COVID pandemic disrupted the survey in 2020. The cropland residue transect surveys help to quantify the amount of residue cover remaining on the field after the commencement of planting in the spring so farmers can get credit for conservation tillage practices. The cover crop transect surveys conducted throughout the state help to capture any additional, non-cost share funded, cover crop implementation acres

established by farmers that would otherwise function in reducing nutrient and sediment losses but not be reported and credited as such.

Funding for cover crop cost-share programs has increased farmer participation and allowed the state to increase cover crop BMP implementation acreages. In 2019, an additional $2.9M in state fiscal year 20 funds was allocated for conservation cost share practices specifically designated for cover crops. As a result of this increased funding, implementation of cover crop acres across all counties in Delaware increased. However, the COVID-19 pandemic that occurred in early 2020 and continues to be a global program has caused budgetary hardships at the state level. The additional $2.9M in state funds that was awarded in 2019 dropped to $1.0M in 2020 for state fiscal year 21. The state budget situation is ever evolving, so there is a possibility that this funding could be restored to previous levels in the future.

In terms of regulations, Delaware promulgated new On-Site Wastewater Regulations in 2013. The implementation of this new regulation is helping Delaware to meet future nutrient reduction goals for septic connections, pump-outs, and advanced treatment systems. In February 2019, the Delaware Sediment and Stormwater Regulations were updated and implemented which cover all land disturbing activities greater than 5,000 square feet. Also, in 2019, the Sediment and Stormwater Program drafted, submitted and received approval for a new Construction General Permit (CGP). The CGP is required for any land disturbing activities greater than one (1) acre that require National Pollutant Discharge Elimination System (NPDES) permit coverage. A public hearing on the CGP and the regulatory amendments required as a result of its development, was held in December 2020. Implementation of the CGP is anticipated in 2021.

Delaware's NPS Program in recent years has undergone an internal reorganization which aligned the following programs - 319 NPS program, Chesapeake Bay Implementation Program, Conservation Reserve Enhancement Program (CREP) as well as additional funding and resources through Delaware's Water Infrastructure Advisory Council (WIAC). The NPS Program now manages and administers two (2) grants under the WIAC umbrella which include the Surface Water Matching Planning Grant (SWMPG) and the Community Water Quality Improvement Grant (CWQIG). The newly enhanced NPS Program has proven its efficiency by centralizing and reducing data reporting requirements while increasing grant funding availability and leveraging capacity for federal grants while expanding partnerships.

A goal of the NPS Program in the future is to further enhance the Chesapeake Bay Implementation Team's BMP Tracker database to store statewide BMP data instead of just Chesapeake Bay watershed specific data. This BMP Tracker database was established in late 2019 and there is still much work to be done in order to merge historical data from an older database before the BMP Tracker can be expanded to hopefully encompass statewide BMP data.

Looking forward, Delaware's NPS Program will continue to make progress toward our goals and will work to align funding with water quality priorities. Although our state faces many challenges, we remain committed to working with our partners at the state, local, and federal levels to reduce the levels of NPS pollution from entering our waterbodies.

XI. List of Partner Organizations/Committee Members

The hard work and many hours of agency staff members, organization members and private individuals who have partnered with the NPS Program in 2020 to address, reduce, identify and/or measure NPS pollution in Delaware is greatly appreciated. It is a credit to our partners as they have cooperated in the face of many challenges to help support the initiatives of the NPS Program.

Name	Agency	Name	Agency
Absher, Debbie	Sussex Conservation District	Miller, Phil	DNREC – Nonpoint Source Program
Argo, Jaime	Farm Service Agency	Monteith, Tyler	DNREC – Watershed Assessment & Management
Arvay, Bonnie	DNREC – Sediment & Stormwater Program	Ness, Brenna	Delaware Wild Lands, Inc
Arthurs, Jayme	NRCS State Office	Nelson, Jennifer	Delaware Association of Conservation Districts
Bason, Chris	Center for the Inland Bays	Riley, Tim	Kent Conservation District
Beaven, Heather	NRCS – State Office	Sanders, Hannah	EPA – Region 3
Biddle, Mark	DNREC – Watershed Assessment & Management	Saveikis, David	DNREC – Fish & Wildlife
Bounds, Kenny	Delaware Department of Agriculture	Sevcik, Clare	DNREC – Nonpoint Source Program
Brosch, Chris	Delaware Department of Agriculture – Nutrient Management Program	Schmdit, Michelle	Center for the Inland Bays
Brown, Lori	DNREC – Watershed Assessment & Management	Sturgis, Brittany	DNREC – Nonpoint Source Program
Cassidy, Jim	DNREC – Ground Water Discharges Section	Suffian, Fred	EPA – Region 3
Cole, Kimberly	DNREC – Climate Coastal & Energy Program	Sullivan, Jim	DNREC – Nonpoint Source Program
Coleman, Bob	Delaware Department of Agriculture – Nutrient Management Program	Taylor, Kacey	NRCS – State Office
Coverdale, Ben	DNREC – Nonpoint Source Program	Webb, Patti	DNREC – Nonpoint Source Program
Donnelly, Kevin	New Castle County Conservation District	Volk, Jen	University of Delaware Cooperative Extension
Esposito, Sara	Delaware Department of Transportation	Walch, Marianne	Center for the Inland Bays
Fox, Marcia	DNREC – Division of Watershed Stewardship	Watson, Jessica	Sussex Conservation District – Stormwater Program
Garrahan, Tim	NRCS – State Office	Webb, Sharon	DNREC – Nonpoint Source Program
Hackett, Kate	Delaware Wild Lands, Inc	Wool, Lisa	Nanticoke Watershed Alliance
Hogan, Mark	DNREC – Nonpoint Source Program	Williams, Steve	DNREC – Watershed Assessment & Management
Kauffman, Jerry	University of Delaware Water Resources Agency	Wozniak, Sara	DNREC – Watershed Assessment & Management Section
Lewandowski, Ed	University of Delaware	Zeiters, Brenda	DNREC – Nonpoint Source Program

Appendices

Appendix A – 2020 Milestones

Type	Timeline	Milestone	Comments/Status Updates
Short Term	FY2019 - 2024	Increase number of outreach and education interactions by 10% over FY 2018 baseline (approx. 8,500 and 3,500 interactions, respectively)	2020 Update: A 10% increase in the number of outreach and education interactions over the FY2018 baseline of 8,500 and 3,500 interactions during FY19 – FY24 respectively, would be a combined total of 13,200 outreach and education interactions over the FY2019 – 2024 timeframe. In 2019, the NPS Program staff had a total of 7,500 interactions. In 2020, the NPS Program staff had a total of 1,637 interactions. 2019 and 2020 total interactions represent 69.22% of the interaction total goal during this measured timeframe of 2019 through 2024.
Short Term	FY2019 – 2024	Increase estimated nutrient load reductions from implementation of NPS BMPs in non-Chesapeake Bay and Chesapeake Bay priority watersheds by at least 5% and 20%, respectively. The modeling tools used for the Chesapeake Bay will be used for all watersheds to assess progress from the determined 2002-baseline year. Using the Chesapeake Assessment Scenario Tool, loads will be assessed to enumerate progress in the Management Plan.	2020 Update: Due to formatting and collection differences between GRTS submission and CB Program Progress submission, it is difficult to standardize data for a CAST analysis outside of the CB Watershed. Through use of Chesapeake Bay Regulatory and Accountability Program grant (CBRAP) funding, we have developed a new BMP Tracking and Reporting Tool which was used for CB watershed progress submission beginning in 2019. In 2020, the NPS Program had conversations with the contractor that developed the CB BMP tracking tool about the possibility of expanding it beyond the Chesapeake Bay watershed. Based on contractor feedback, this initiative seems to be very difficult without rebuilding the tool to make this accommodation and does not appear to be economically feasible at this point. It remains a longer term goal for the future, but there are historical BMP database issues that would need to be corrected as part of the BMP Tracker development process to integrate data from

			older database(s). The NPS Program for the section 319 grant will continue to utilize the EPA approved load reduction calculation tool as it has for many years. Based on load reductions calculated for all priority watersheds with the DNREC load reduction tool, the following load reduction analysis for nitrogen and phosphorous between 2019 and 2020 data was observed. For non-Chesapeake Bay watersheds, Broadkill River had an increase in nitrogen load reduction of 6.47%, the Inland Bays had an increase in nitrogen load reduction of 12.69%, and the St. Jones River had an increase in nitrogen load reduction of 39.2% and phosphorous of 10.8% as compared to 2019 reporting loads in pounds. All other 2020 non-Chesapeake Bay watersheds (Appoquinimink River and Christina Basin) did not increase nutrient load reduction levels by 5% or greater as compared to 2019 reporting levels and/or decreased from 2019 reporting levels. For Chesapeake Bay watersheds, the Chester & Choptank River had an increase in nitrogen load reduction of 33.66% and the Upper Chesapeake watershed had an increase in nitrogen load reduction of 22.89% and 29.52% for phosphorous as compared to 2019 reporting loads in pounds. All other 2020 Chesapeake Bay watersheds (Nanticoke River and Pocomoke & Wicomico River watersheds) did not increase nutrient load reduction levels by 20% or greater as compared to 2019 reporting levels and/or decreased from 2019 reporting levels.
Short Term	FY2019 – 2024	Characterize baseline conditions and establish timeframe for subsequent monitoring following BMP implementation in priority watersheds that do not have established baselines and re-evaluate old baselines.	2020 Update: The currently approved a-i watershed implementation plans (WIP) have WIP reduction goals. These goals are identified on the individual watershed progress report for all identified priority watersheds. BMP implementation and reporting to the NPS program is calculated and compared to the established WIP goals for each priority watershed. NPS baseline loads have been established by the DNREC's Watershed Assessment & Management Section (WAMS) for all priority watersheds within the NPS Program. Revaluation of baseline loads is at the discretion of WAMS.

Short Term	FY2019 – 2024	Demonstrate stable or improving water quality trends for the sub-watersheds of the Inland Bays and Chesapeake Bay relative to data established from 1990 to present.	2020 Update: Delaware maintains a General Assessment Monitoring Network (GAMN) of approximately 139 stations. Twenty-three of the stations are monitored monthly and the remaining stations are monitored either six or twelve times per year. Each station is monitored for conventional parameters such as nutrients, bacteria, dissolved oxygen, pH, alkalinity, and hardness. Some stations are monitored for dissolved metals. The data from this monitoring is entered into EPA's STORET database and used for the State of Delaware Combined Watershed Assessment (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs Report and other uses by interested parties. More information about Delaware's Water Quality monitoring is available online at: **http://www.dnrec.delaware.gov/swc/wa/Pages/WaterQualityMonitoring.aspx** In addition to uploading data to STORET, the Department also works in co-operation with the University of Delaware to share available water quality data in a more user friendly format in the Delaware Water Quality Portal at this URL: **http://demac.udel.edu/waterquality/** **Trend Analysis for Nitrogen and Phosphorus at 11 Freshwater Stream Sites:** Long-term nitrogen and phosphorus data collected from 11 – C1 monitoring sites throughout the State have been analyzed for trend using the Weighted Regressions on Time, Discharge, and Season (WRTDS) method. For total nitrogen concentrations, trends have been detected from 9 out of the 11 sites; an upward trend has been detected from 3 sites in Nanticoke River, Marshyhope Creek and Deep Creek Branch, and a downward trend from 6 sites in Beaverdam Ditch, Millsboro Pond, Blackbird Creek, Brandywine Creek, White Clay Creek and the Christina River. For total phosphorus concentrations, trends have been detected from 8 out of the 11 sites; an upward trend has been detected from 3 sites in Beaverdam Ditch,

			Silver Lake of St. Jones River, Deep Creek Branch, and a downward trend from 5 sites in Nanticoke River, Red Clay Creek, White Clay Creek, Brandywine River and Christina River.
Short Term	FY2019 - 2024	Remove an identified impairment from a Land River Segment currently included on Delaware's list of impaired waterways.	2020 Update: The 13.1-mile segment of Iron Branch (DE-150-001-01) in the Inland Bays watershed was removed from Delaware's list of impaired waters for bacteria in 2020.
Long Term	By FY2030	Show significant progress towards completion of implementation activities for all Delaware's priority watersheds with approved Nine Element Watershed Plans.	2020 Update: This is to be continually assessed and tracked through BMP data submissions to the NPS Program. Progress is reported in the GRTS system and reflected holistically in the NPS Program Annual Reports.
Long Term	By FY2030	Demonstrate water quality improvement in 20% or more of the priority and monitored priority watersheds as reported in the NPS Annual Report.	2020 Update: This will be assessed in the future as this milestone was just established in the 2019 Delaware NPS Management Plan. Water quality monitoring and trend data are maintained by the DNREC WAMS.
Long Term	Annually through FY2030	Show annual increases in funding and quantities of BMPs implemented in priority watersheds.	2020 Update: In 2020, the state fiscal year 21 budget appropriated $1.0 million of additional state general funds towards cover crop implementation efforts. The FY20 funds resulted in a significant increase in cover crop acres implemented by farmers in all three counties of Delaware and the FY21 funds for cover crops implemented in the fall of 2020 is expected to have similar results. These cover crop implementation acres were implemented across the priority watersheds established by the Delaware NPS Program.

Long Term	Annually through FY2030	Remove one water body currently listed for nutrient pollutants from the 303(d) List.	2020 Update: To be assessed and determined annually as additional BMPs are incorporated into priority watersheds. DNREC WAMS continuously monitors water quality trends throughout the various STORET monitoring stations in the state. The 13.1-mile segment of Iron Branch (DE-150-001-01) in the Inland Bays watershed was removed from Delaware's list of impaired waters for bacteria in 2020.

Appendix B – Water Quality Trend Data

Delaware maintains a General Assessment Monitoring Network (GAMN) of approximately 139 stations. Twenty three of the stations are monitored monthly and the remaining stations are monitored either six or twelve times per year. Each station is monitored for conventional parameters such as nutrients, bacteria, dissolved oxygen, pH, alkalinity, and hardness. Some stations are monitored for dissolved metals. The data from this monitoring is entered into EPA's STORET database and used for the State of Delaware Combined Watershed Assessment (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs Report and other uses by interested parties. More information about Delaware's Water Quality monitoring is available online at: **http://www.dnrec.delaware.gov/swc/wa/Pages/WaterQualityMonitoring.aspx**

In addition to uploading data to STORET, the Department also works in co-operation with the University of Delaware to share available water quality data in a more user-friendly format in the Delaware Water Quality Portal at this URL: **http://demac.udel.edu/waterquality/**

The Department's Watershed Assessment and Management Section (WAMS) periodically conducts a statewide water quality trend assessment. Based on the most recent statewide assessment, the following graphics provide a visual indicator of water quality trends in Delaware's priority watersheds for total nitrogen (TN), total phosphorous (TP) and total suspended solids (TSS). Thumbs up indicate improving water quality trends while thumbs down represent negative water quality trends for the identified nutrients and sediment.

Visual Representation of Priority Watershed Water Quality Trends:

Appoquinimink River Watershed

Broadkill River

Chester & Choptank Watersheds

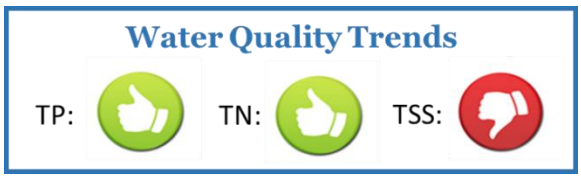
Christina Basin

Visual Representation of Priority Watershed Water Quality Trends Cont'd:

Inland Bays

Nanticoke River Watershed

Pocomoke & Wicomico River Watershed



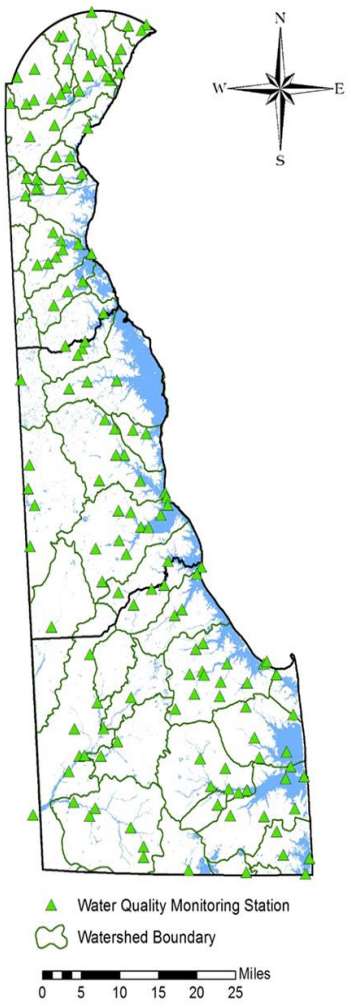
St. Jones River Watershed

Upper Chesapeake Watershed

Trend Analysis for Nitrogen and Phosphorus at 11 Freshwater Stream Sites:

Long-term nitrogen and phosphorus data collected from 11 – C1 monitoring sites throughout the State have been analyzed for trend using the Weighted Regressions on Time, Discharge, and Season (WRTDS) method. For total nitrogen concentrations, trends have been detected from 9 out of the 11 sites; an upward trend has been detected from 3 sites in Nanticoke River, Marshyhope Creek and Deep Creek Branch, and a downward trend from 6 sites in Beaverdam Ditch, Millsboro Pond, Blackbird Creek, Brandywine Creek, White Clay Creek, and the Christina River.

For total phosphorus concentrations, trends have been detected from 8 out of the 11 sites; an upward trend has been detected from 3 sites in Beaverdam Ditch, Silver Lake of St. Jones River, Deep Creek Branch, and a downward trend from 5 sites in Nanticoke River, Red Clay Creek, White Clay Creek, Brandywine River, and Christina River.



The Summary for Generalized Additive Model to Analyze Long Term Total Phosphorous and Nitrogen Concentrations Follows:

The Generalized Additive Model (GAM) was used to analyze long term (1998 – 2019) total phosphorous (TP) and total nitrogen (TN) trends in the 14 tidal stations of the Inland Bays. Decreasing trends of TP and TN in tidal stations of the Inland Bays can be attributed to full implementation of the requirements of the Inland Bays TMDLs for point sources and its partial implementation for the non-point sources.

The trend of TP concentration followed the flow pattern. TP concentrations in most of the stations were higher during peak flow, and thus were cyclic in nature following flow events throughout the 20 years. Similar to TN concentrations, TP concentrations in recent years in some of the stations were higher than the target value of 01. mg/L.

TN concentrations were decreasing in most of the stations except in station 306181 at Swan Creek. Even though TN concentration were decreasing, four (4) of the stations' concentration were higher than the target value of 1 mg/L in the Inland Bays, whereas some of the stations' recent years concentrations were higher than target value. Linear regression modeling techniques are more frequently used to identify long term trends in the water quality data, which sometime miss the temporal cycling trend or temporal changes in the data. GAM analysis of tidal stations data with the inclusion of smooth functions allow the model shapes from linear to nonlinear, including patterns that changes State of Delaware 2020 CWA 305(b) and 303(d) Integrated Report 29 direction over time, thus helped to identify changes of concentration over time in the Inland Bays.

Generalized additive model (GAM) is a statistical modeling technique that modeled response of interest as the sum of multiple smooth functions of independent or explanatory variables. In the state of Delaware, water quality data for 14 tidal stations in the Inland Bays was analyzed using GAM, with the exclusion of mixed effects, and taking time as explanatory variable. This gives a trend of dependent variables over time. Results presented are with the use of a restricted maximum likelihood (REML) algorithm run for the GAM. The *gam ()* function in R *mgcv* package was used for the analysis and plots was obtained by using *ggplot2* package (Wood 2018).

Linear regression modeling techniques are more frequently used to identify long term trends in the water quality data, which sometime miss the temporal cycling trend or temporal changes in the data. GAM with the inclusion of smooth functions allow the model shapes from linear to nonlinear, including patterns that change direction over time. GAM was used for the trend analysis of TP and TN concentrations in the tidal portion of the Inland Bays from 1998 to 2019. GAM is relatively new to water quality change analysis with few recent works in the Chesapeake Bay and in other places (Harding et al. 2016; Beck and Murphy 2017; Haraguchi et al. 2015). TP and TN data from 12 stations (Figure 1a) were sorted. Missing rows in the data (i.e. data gaps) for each nutrient were deleted and daily sampling duplicates were averaged.

Nutrient concentration changes in the Inland Bays were observed from 1998 to 2019 (Figures 1a & b) to track the progress towards achieving nutrient reduction targets as required by the Total Maximum Daily Load (TMDL) for the Inland Bays Watershed. TP and TN trends were compared with the flow data obtained from USGS stream gauge monitoring station 01484525 at Millsboro Pond in order to investigate potential causes impacting nutrient trends. In general, TP and TN concentrations in tidal stations within the Inland Bays are decreasing (Figures 2 – 15). Red-lines in figures 2 – 15 indicate target value for Inland Bays TP and TN concentration, i.e. 0.1 and 1 mg/L respectively. In most of the stations, TP trends since 1998 to 2019 showed some sort of cyclic patterns.

Table 1 and Figures 1b and 1c depicted long term trend of TP and TN concentrations in the 14 tidal stations. For TP concentration, dark green arrow indicates concentrations are decreasing, while light green indicates cyclic decreasing pattern (Table 1 and Figure 1b). These cyclic patterns of TP may be due to the annual changes in flow, as annual flow is fluctuating and can be seen in the discharge at USGS-01484525 (Figure 16). This indicates freshwater inflow to the tidal waters is the main source altering TP in Inland Bays. For TN concentration, green arrow indicates concentration are decreasing, red arrow indicates concentrations are increasing, and black line indicates concentrations are constant (Table 1 and Figure 1c). Only station 306181 at Swan Creek (a tributary of Indian River) had recent increasing trend of TN concentration. This may be related to the impact of Mountaire Farms discharge. Some of the stations data – i.e. TN at 305011; TP at 306181; TP & TN at 306341; TN at 310031 – showed linear decreasing trend even when running GAM. This showed there was no cycling pattern and the concentrations are decreasing over the time.

Decreasing trends of TP and TN in tidal stations of the Inland Bays can be attributed to full implementation of the requirements of the Inland Bays TMDLs for point sources and its partial implementation for the non-point sources. Decreasing trends of TN may also be because of the reduction in atmospheric nitrogen deposition resulted from implementation of the requirement of the Federal Clean Air Act. Even though most of the concentrations out of the 14 stations presented are decreasing, in some station's TP and TN concentrations are not yet meeting the TMDL target values for tidal stations in the Inland Bays, i.e. 0.1 mg/L of TP and 1 mg/L of TN. For example, TN concentrations are linearly decreasing in 11 tidal stations, however, 4 out of those 11 i.e. Island Creek, Indian River (Station 306331), Island Creek upper third, Indian River (Station 306341), Old Mill Bridge Rd (Station 310031), and Dirickson Creek at Old Mill Bridge Rd (Station 310031) showed TN concentrations above the target value. Likewise, recent years TP concentrations in Swan Creek, Indian River at Buoy 49 (Station 306181), Island Creek upper third, Indian River (Station 306341), and Dirickson Creek at Old Mill Bridge Rd (Station 310031) are above target value. It is thus important to note that even though concentrations in most of the stations are decreasing they are still not meeting target values in all the tidal stations.

Figure 1a Map of Inland Bays with twelve tidal stations used for trend analysis.

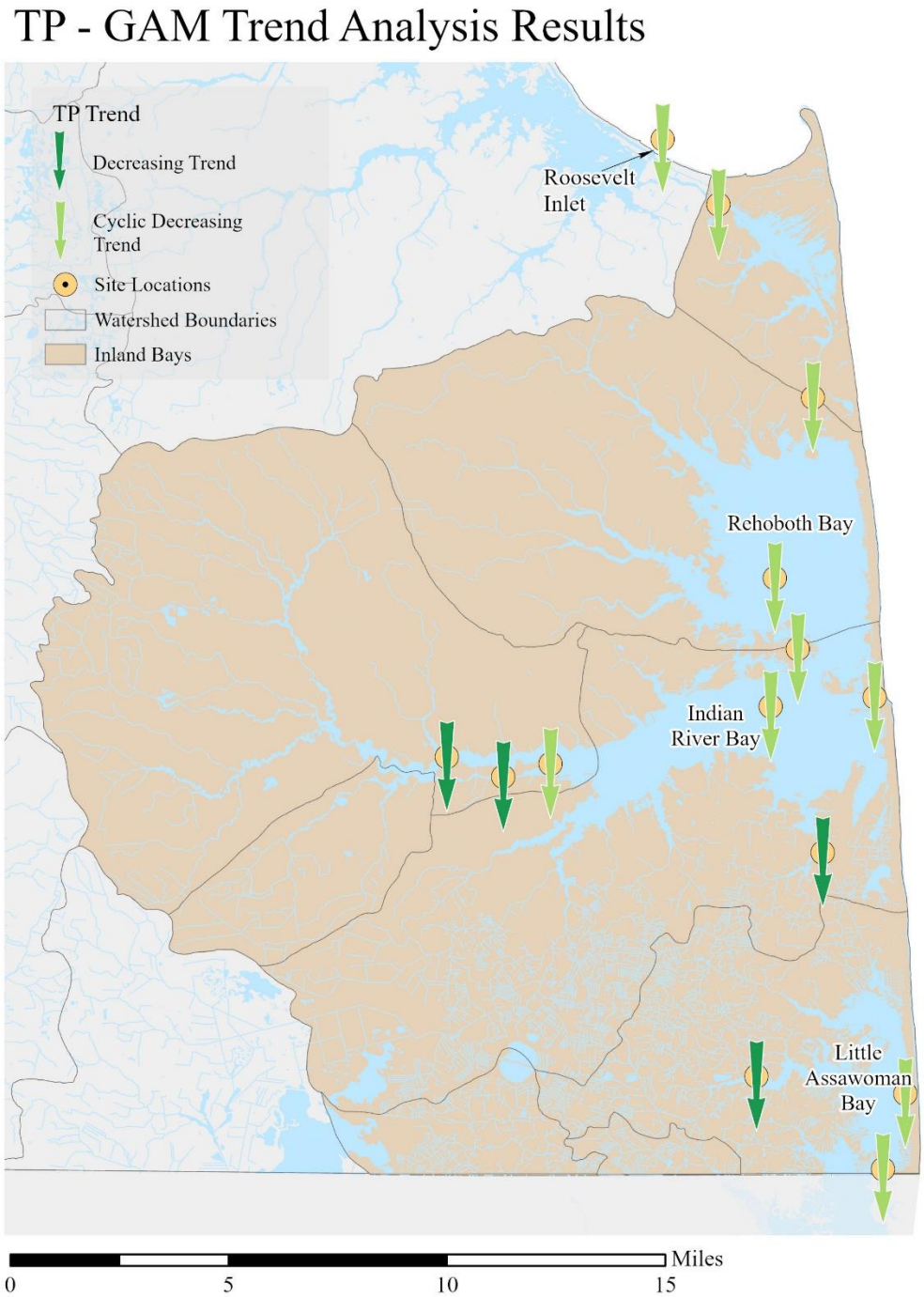


Figure 1b Map of Inland Bays with twelve tidal stations showing TP concentration.

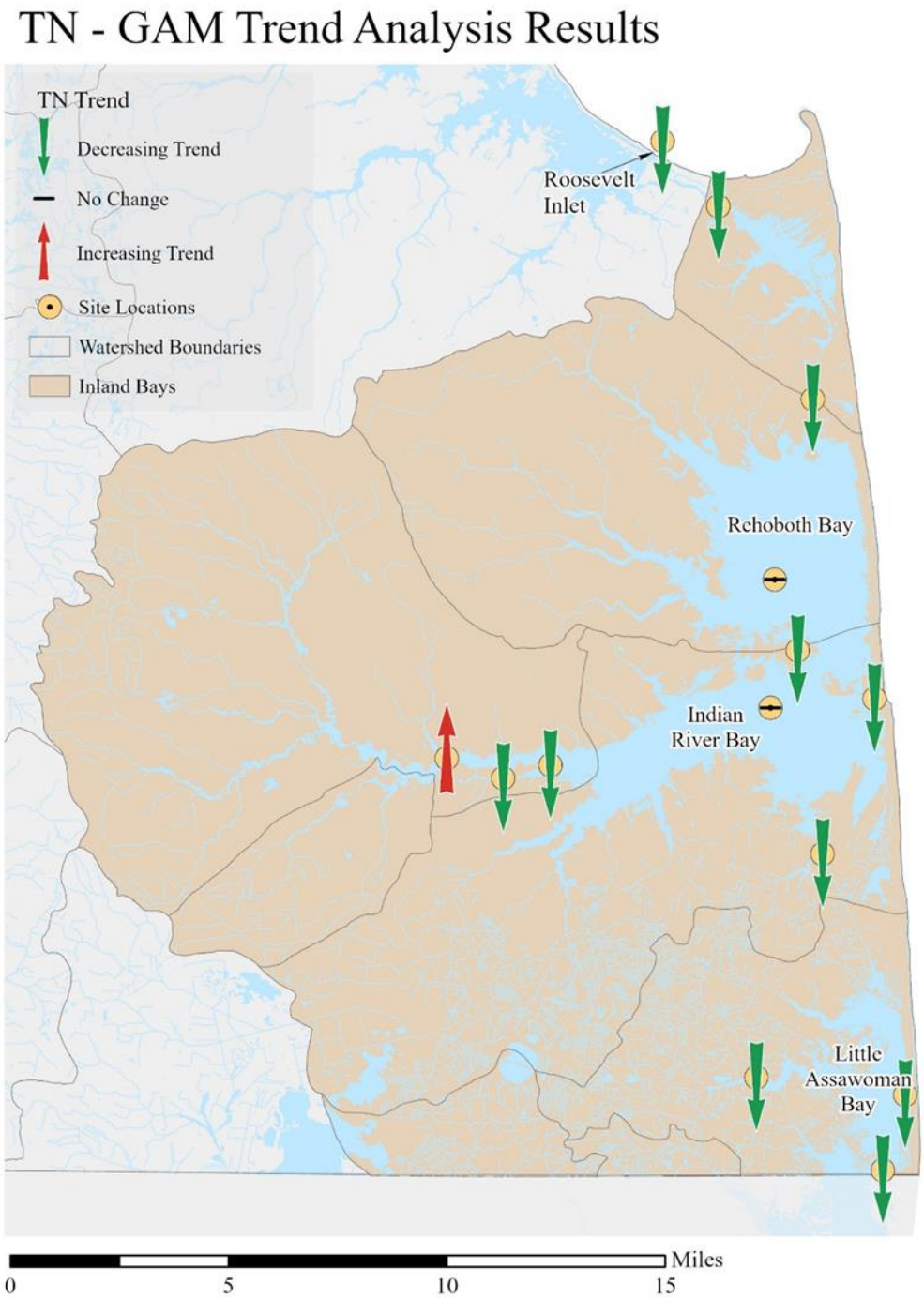


Figure 2c Map of Inland Bays with twelve tidal stations showing TN concentration.

Table 1: Red arrow indicate concentration is increasing; Dark green indicate concentration is decreasing; Light green indicate concentration is decreasing but with cyclic trend.

Station	Site Description	TP concentration	TN concentration
305011	Lewes & Rehoboth Canal Rt 1	↓	↓
305041	Lewes & Rehoboth Canal Rt 9	↓	↓
306181	Indian River @ Buoy 49; Swan Creek	↓	↑
306111	Massey Ditch @ Buoy 17	↓	↓
306331	Indian River @ Island Creek	↓	↓
306321	Indian River Inlet @ Coast guard Station	↓	↓
310011	Little Assawoman Bay Rt 54; the ditch	↓	↓
306341	Island Creek Upper Third, Indian River	↓	↓
310071	Little Assawoman Bay Mid Bay Ocean Park Lane	↓	↓
310031	Dirickson Creek @ Old Mill Bridge Rd	↓	↓
312011	White Creek @ mouth of Assawoman Canal	↓	↓
401011	Roosevelt Inlet	↓	↓
306091	Rehoboth Bay @ Buoy 7	↓	–
306121	Indian River Bay @ Buoy 20	↓	–

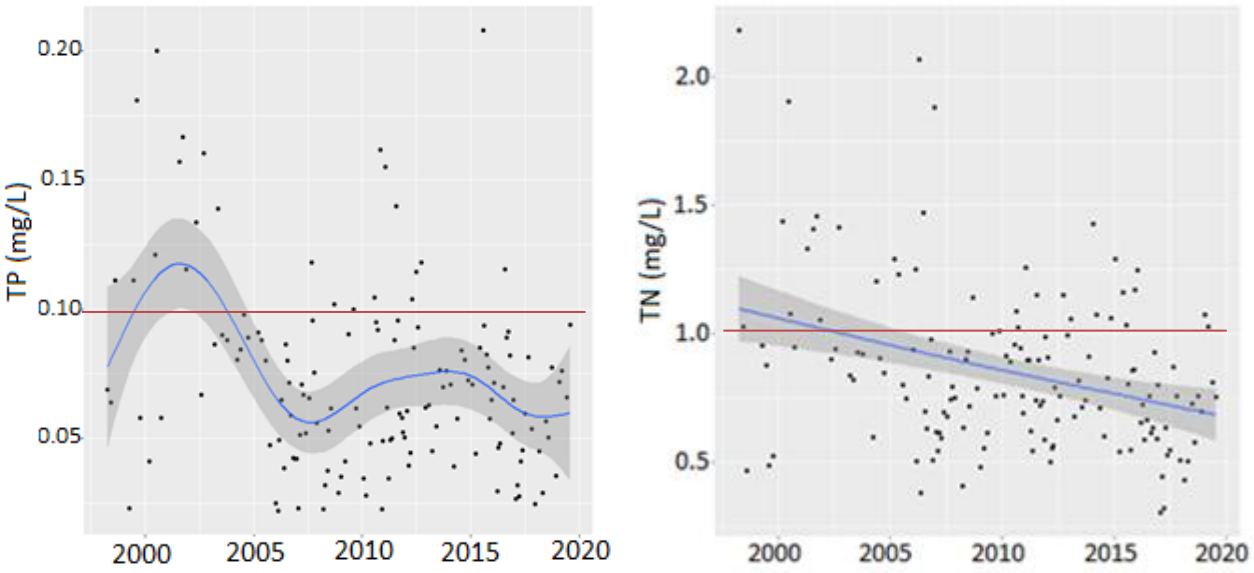


Figure 2 Changes in TP and TN since 1998 in Lewes & Rehoboth Canal at Rt 1 (Station 305011). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

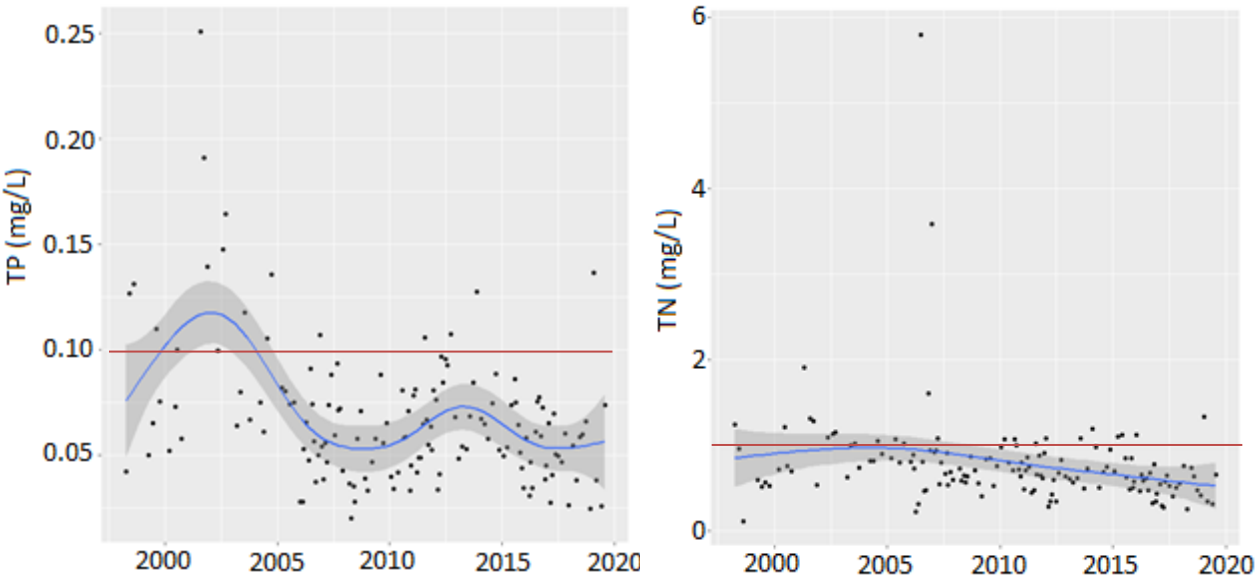


Figure 3 Changes in TP and TN since 1998 in Lewes and Rehoboth Canal at Rt 9 (Station 305041). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

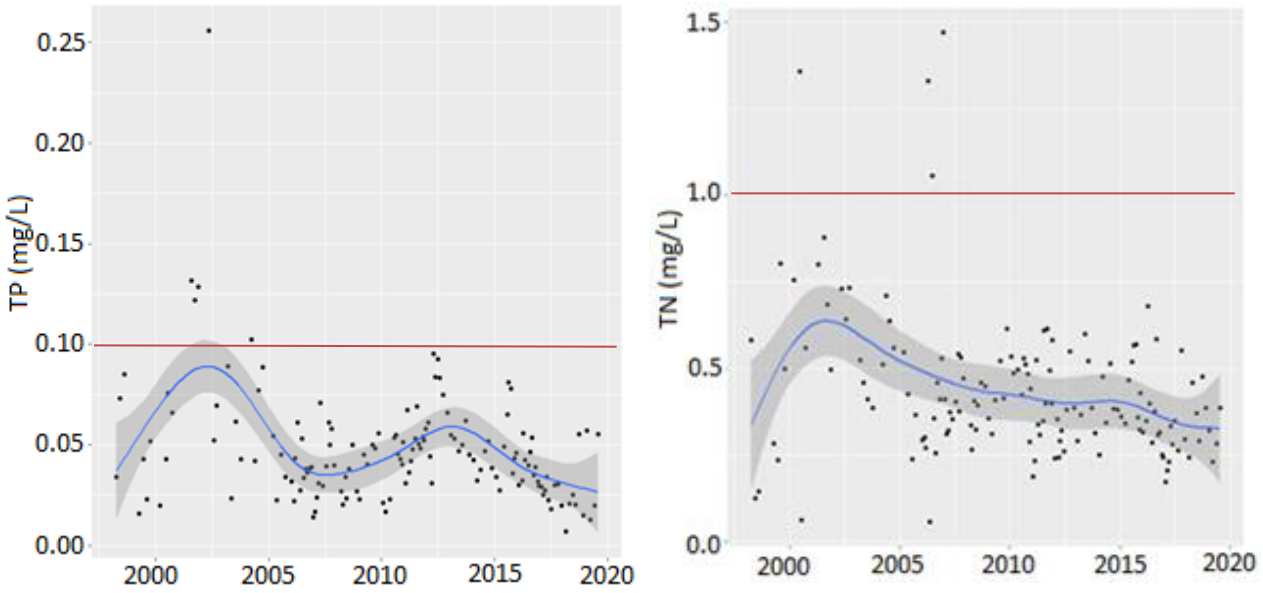


Figure 4 Changes in TP and TN since 1998 in Massey Ditch at Buoy 17 (Station 306111). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

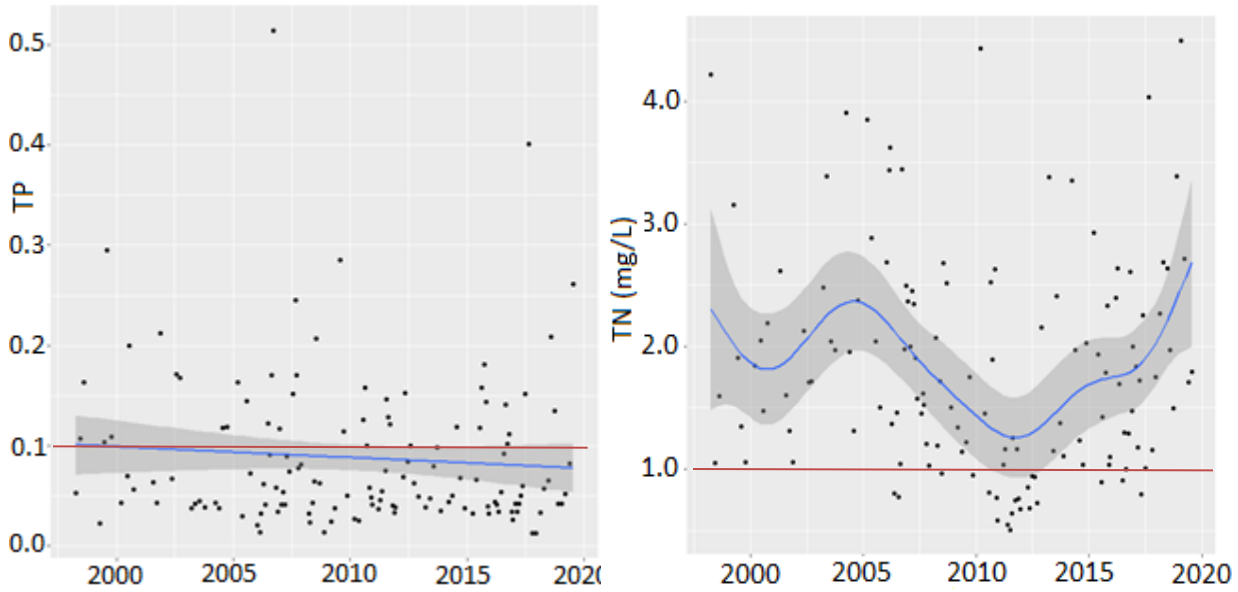


Figure 5 Changes in TP and TN since 1998 in Swan Creek, Indian River at Buoy 49 (Station 306181). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

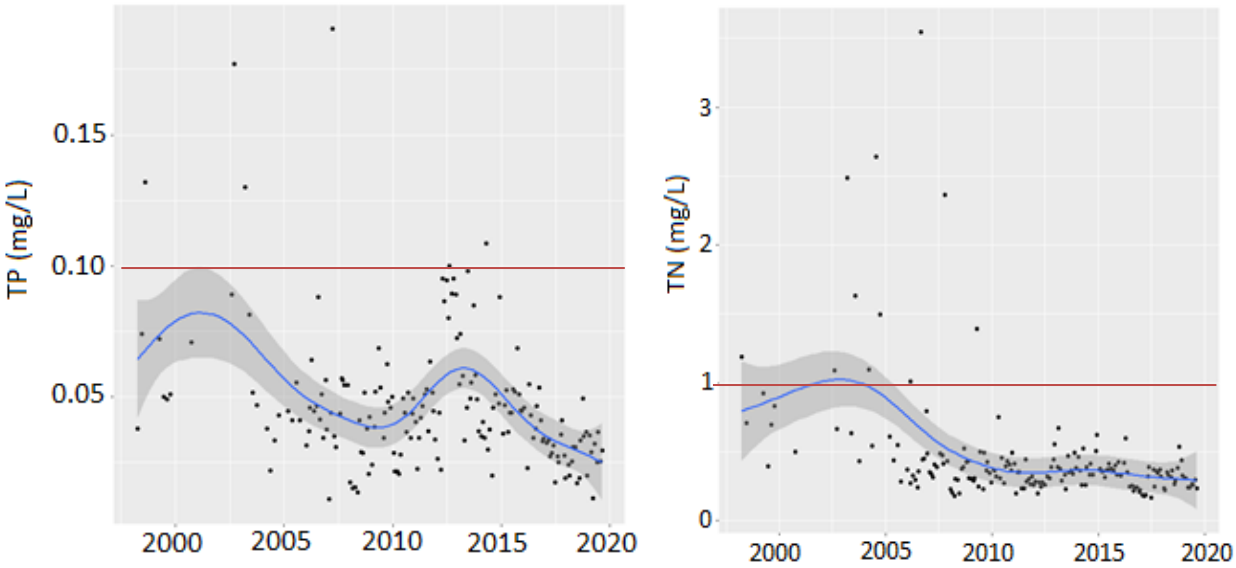


Figure 6 Changes in TP and TN since 1998 at Indian River inlet at coast guard station (Station 306321). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

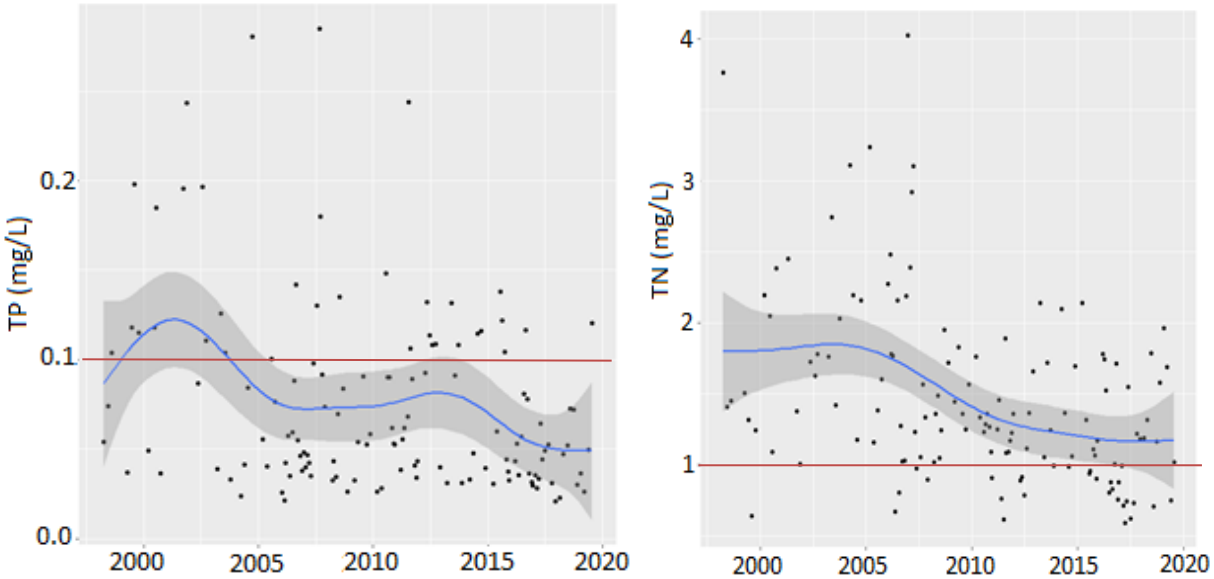


Figure 7 Changes in TP and TN since 1998 at Island Creek, Indian River (Station 306331). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

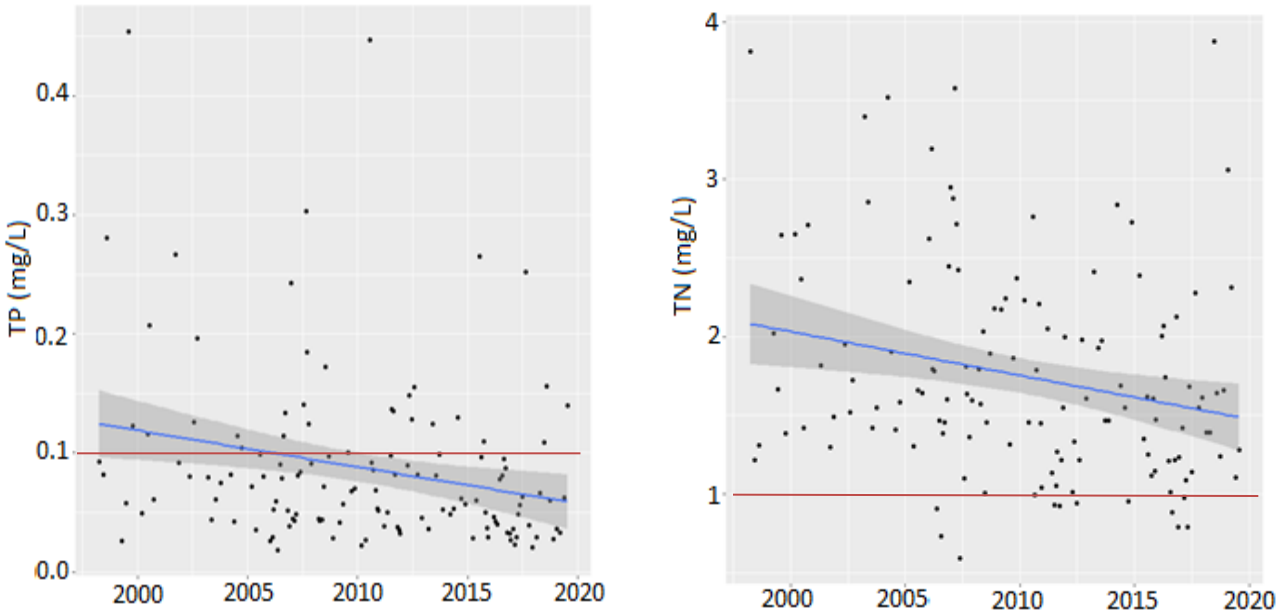


Figure 8 Changes in TP and TN since 1998 at Island Creek upper third, Indian River (Station 306341). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

Figure 9 Changes in TP and TN since 1998 in Little Assawoman Bay Rt 54 (Station 310011). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

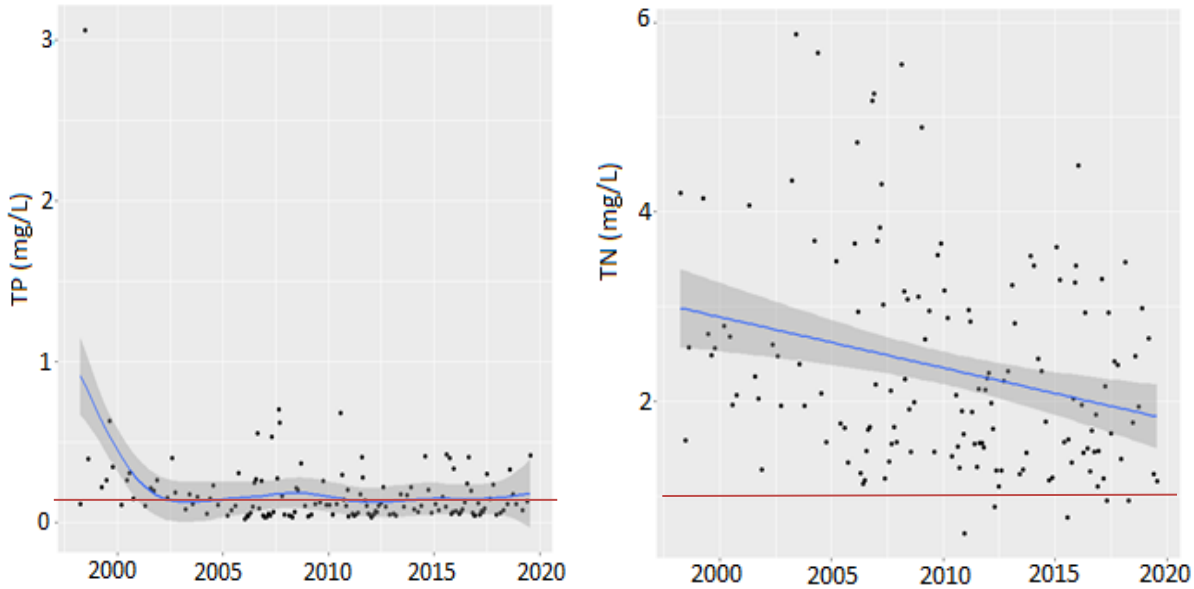


Figure 10 Changes in TP and TN since 1998 in Dirickson Creek at Old Mill Bridge Rd (Station 310031). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

Figure 11 Changes in TP and TN since 1998 in Mid Bay, Little Assawoman Bay (Station 310071 @ Ocean Park Lane). Gray band shows model fit with the data. Red line indicates target value of TP =0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

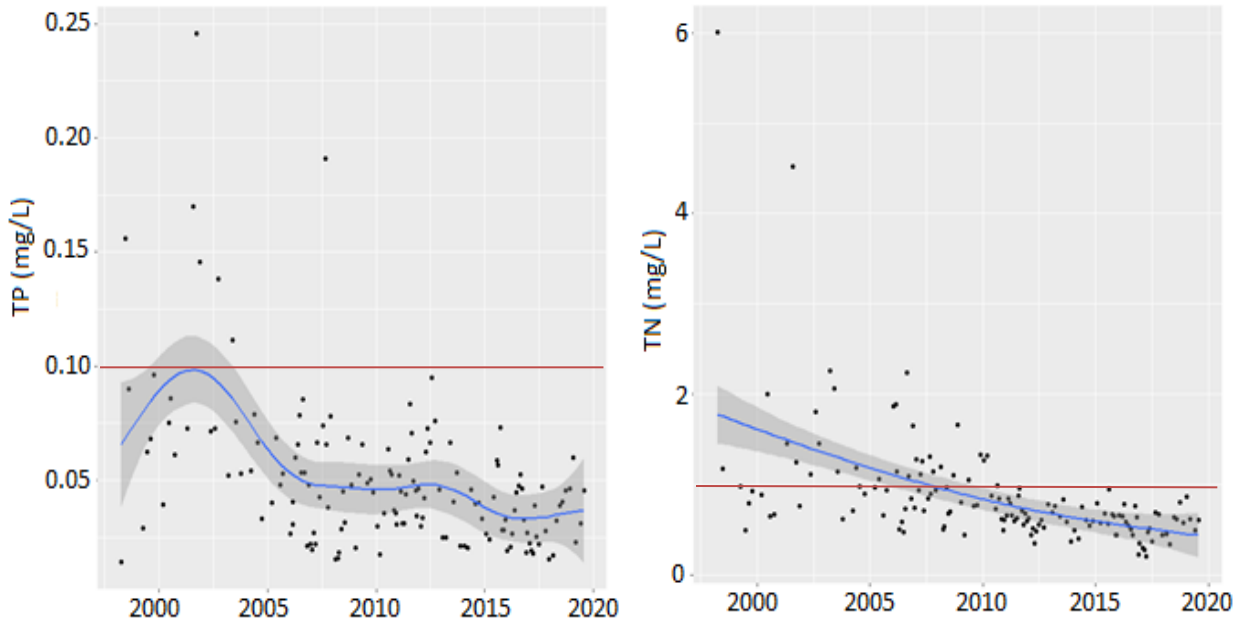


Figure 12 Changes in TP and TN since 1998 in White Creek at the mouth of Assawoman Canal (Station 312011). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

Figure 13 Changes in TP and TN since 1998 in Roosevelt Inlet (Station 401011). Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

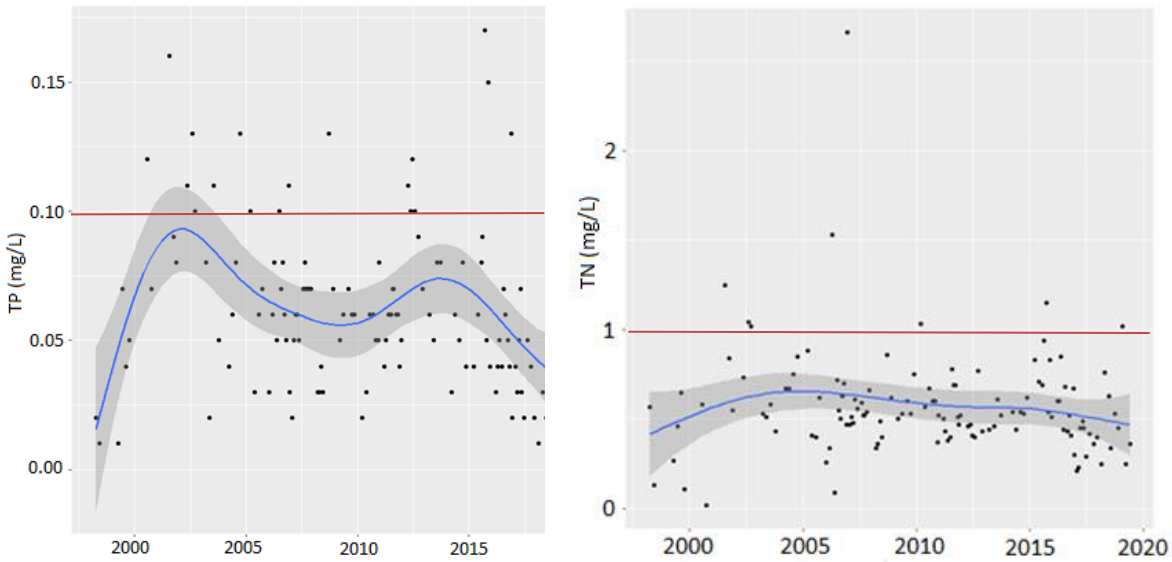


Figure 14 Changes in TP and TN since 1998 in Rehoboth Bay (Buoy 7) Station 306091. Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

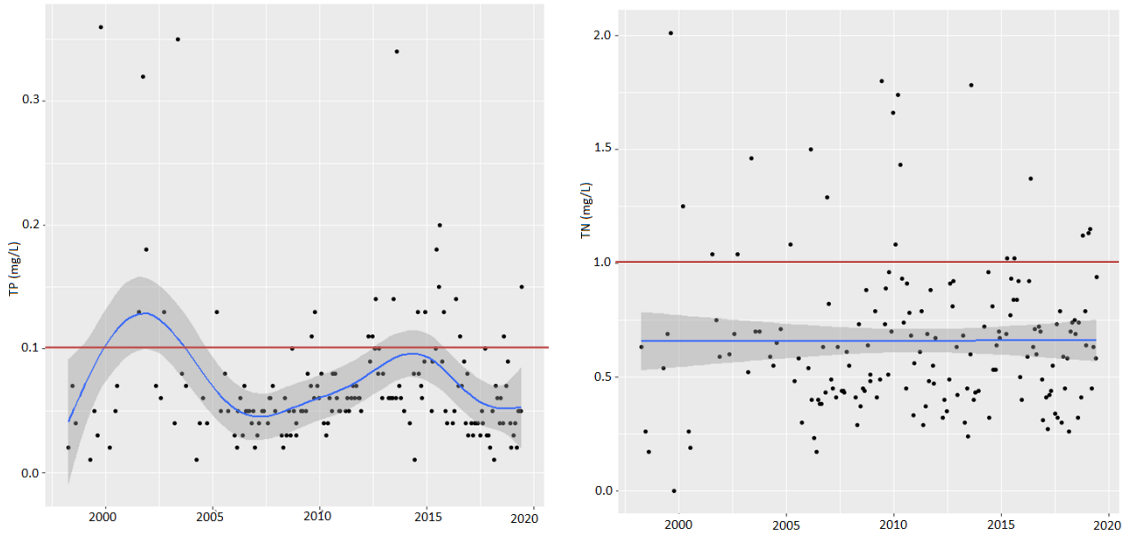


Figure 15 Changes in TP and TN since 1998 in Indian River Bay (Buoy 20) Station 306121. Gray band shows model fit with the data. Red line indicates target value of TP=0.1 mg/L and TN=1 mg/L for tidal stations in Inland Bays.

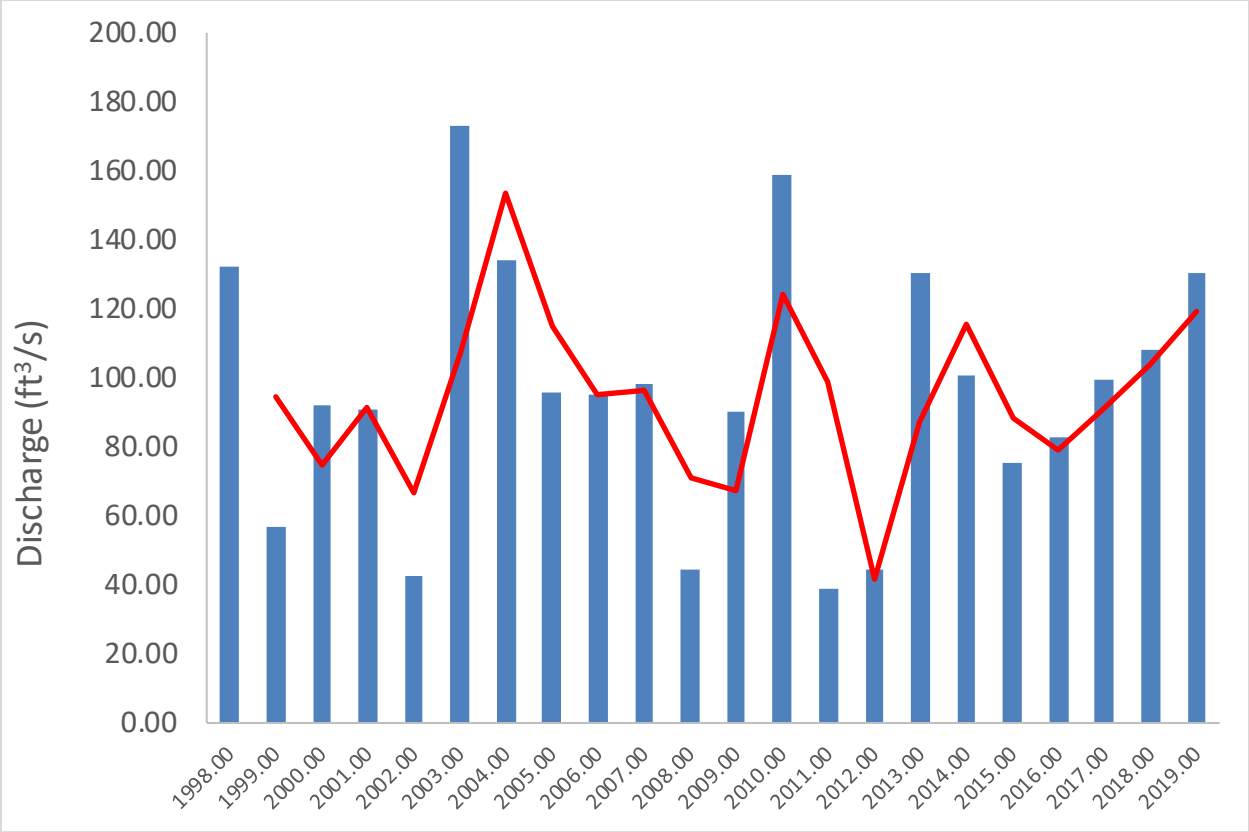


Figure 16 Discharge at USGS Station (01484525) at Millsboro Pond. Red line indicates two years moving average flow.

2020
Delaware Nonpoint Source Program
Delaware Department of Natural Resources and Environmental Control