

2024 State of Delaware Ambient Surface Water Quality Monitoring Program

FY 2024 (July 1, 2023 to June 30, 2024)



DELAWARE DEPARTMENT OF
**NATURAL RESOURCES AND
ENVIRONMENTAL CONTROL**

Division of Watershed Stewardship

Watershed Assessment and Management Section

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Executive Summary

Delaware's Surface Water Quality Monitoring Program for Fiscal Year 2024 as conducted by Delaware Department of Natural Resources and Environmental Control (DNREC) is described in this report. Elements of Delaware's monitoring program include General Assessment Monitoring, Chesapeake Nontidal Monitoring, Continuous Water Quality Monitoring, Biological Assessment Monitoring, and monitoring under the Watershed Approach to Toxics Assessment and Restoration (WATAR) Plans, which include Toxics in Biota Monitoring and Toxics in Sediment/Surface Water Monitoring. Each element of the monitoring program is briefly described below:

- Delaware DNREC maintains a General Assessment Monitoring Network (GAMN). GAMN stations are considered long term stations whose data is used to perform long term status and trend assessments of water quality conditions of the state's surface waters and support compilation of watershed assessment reports as mandated by the Clean Water Act under section 305(b). In addition, the data is used to calculate annual nutrients and other pollutant loads, and to track progress toward achieving the targets established by the Total Maximum Daily Loads (TMDLs) for many of the state's watersheds. Furthermore, the data is used to identify the impacts of land use on nitrogen (N) and phosphorus (P) concentrations and nutrient conditions throughout the state. The state's GAMN currently has a total of 136 stations (Figure 1). Twenty-two of the monitoring stations are considered Category 1 stations (C1) and are monitored monthly. These stations are co-located with a United States Geological Survey (USGS) stream gaging station or are located at the mouth of a tidal river. The remaining 114 monitoring stations are Category 2 (C2) stations and are monitored monthly for two years and bi-monthly for three years according to a 5-year rotating basin schedule. Four storm samples (one per season) are collected annually at 12 GAMN stations statewide shown at the end of Table 1. During FY 2024, the Piedmont and Lower Delaware Bay Drainage Basins are the priority basins and all stations in these two basins are monitored every month. Monitoring frequency at C2 stations in the other three basins (Upper Delaware Bay, Inland Bays, and Chesapeake Bay) will be bi-monthly.
- Delaware DNREC is participating in the Chesapeake Bay Program's Nontidal Monitoring Program and collects samples from two of the nontidal stations located in Delaware. These two stations are Nanticoke River near Bridgeville and Marshyhope Creek at Fishers Bridge Rd. The data collected at these two stations are provided to the Chesapeake Bay Program and are used for calibrating the Chesapeake Bay Watershed Model. The data are also used to monitor water quality status and to perform trend analysis. Monthly samples at these two stations are collected according to sample collection protocol developed by the Chesapeake Bay Program Nontidal Monitoring Workgroup. Eight storm samples per year (two storm samples per season) are also collected.
- Delaware DNREC, in cooperation with the Delaware Geological Survey (DGS) and the United States Geological Survey (USGS), is maintaining seven continuous water quality monitoring stations. At the seven continuous water quality monitoring stations, monitoring of water temperature, dissolved oxygen (DO), pH, and specific conductance

are conducted at 15-minute intervals by using multi-parameter water-quality sondes (YSI sondes).

- During FY 2024, Delaware DNREC anticipates new habitat/biological survey of approximately 20-30 sites aiming to find reference-quality sites in the Piedmont. With additional data collected in 2022 and 2023, DNREC plans to refine Delaware's index of biological integrity (IBI) and habitat index to better characterize biological conditions. The direction of future habitat/biological monitoring will be based on the findings of this data review and analysis.
- During FY2024 DNREC's WATAR team plans to focus on fish tissue sample collection from Delaware's Chesapeake Bay drainages, specifically the Marshyhope Creek, Nanticoke River, Broad Creek, and 12 ponds (Mud Mill, Concord, Craigs, Hearn's, Chipman, Horseys, Portsville, Racoon, Records, Trap, Trussum and Tussock). During FY2024 DNREC's WATAR team plans to focus on data evaluation and reporting related to the FY2023 statewide surface water sampling for evaluation of Per- and Polyfluoroalkyl Substances (PFAS), and evaluation of sediment sample data collected in FY2023 from behind dams in the White Clay Creek. No additional surface water or sediment sampling is being planned for FY2024.

Ambient Surface Water Quality Monitoring Program - FY 2024

The purpose of the Ambient Surface Water Quality Monitoring Program is to collect data on the chemical, physical, and biological characteristics of Delaware's surface waters. The information that are collected under this program are used to:

- Describe surface water quality conditions in the state
- Identify long term trends in surface water quality
- Determine the suitability of Delaware surface waters for water supply, recreation, fish and aquatic life, and other uses
- Monitor achievement of Surface Water Quality Standards
- Identify and prioritize high quality and degraded surface waters
- Calculate annual nutrient and select metal loads and track progress toward achieving Total Maximum Daily Load (TMDL) targets
- Evaluate the overall success of Delaware's water quality management efforts

Major components of Delaware's Surface Water Quality Monitoring Program include the following:

- General Assessment Monitoring
- Chesapeake Nontidal Monitoring
- Continuous Water Quality Monitoring
- Biological Assessment Monitoring
- Monitoring under the Watershed Approach to Toxics Assessment and Restoration (WATAR) Plan
 - Toxics in Biota Monitoring
 - Toxics in Sediment/Surface Water Monitoring

This report discusses the General Assessment Monitoring in detail. In addition, it briefly discusses other components of the Delaware Surface Water Quality Monitoring Program including the Biological Assessment Monitoring, Toxics in Biota Monitoring, Toxics in Sediment/Surface Water Monitoring.

Delaware Watersheds

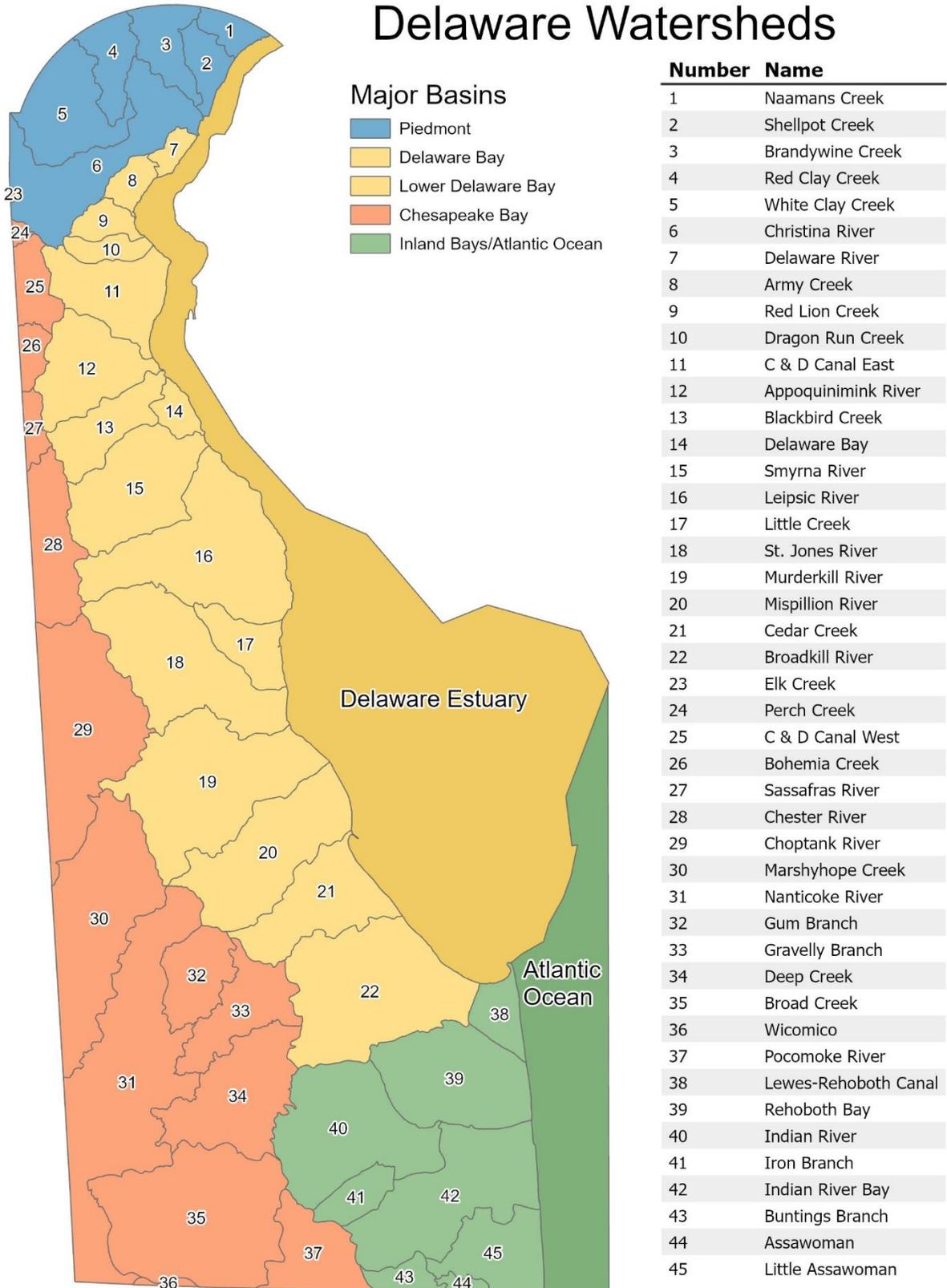


Figure 1 – Delaware’s major basins and watersheds

The General Assessment Monitoring Network

The General Assessment Monitoring Network (GAMN) provides for routine water quality monitoring of surface waters throughout the state of Delaware. Currently the monitoring network includes 136 monitoring stations (Figure 2 and Table 1). Each station is monitored for conventional parameters such as nutrients, bacteria, dissolved oxygen, pH, alkalinity, and hardness (Table 2). Some stations are monitored for dissolved metals as well as the parameters that are needed to conduct Biotic Ligand Model (BLM) analysis for metals toxicity (Tables 1, 3 and 4).

The data collected as part of this effort are entered into the EPA's STORET database. In addition, the data are reviewed and analyzed to assess water quality condition of the state's waters to be included in the Integrated Watershed Assessment Report (CWA Sections 305 (b)/303(d) Report) which Delaware DNREC produces on even numbered years. Furthermore, the data are used to assess water quality status and trends as well as tracking progress toward achieving water quality standards and TMDL targets.

As stated earlier, the GAMN currently has a total of 136 stations. These stations fall into two categories:

- C1 – These are considered high priority stations. Currently, GAMN contains 22 C1 stations. Data collected at C1 stations are used for calculating annual loads and long-term trends. These stations are generally co-located with a United States Geological Survey (USGS) stream gaging station or are located at the mouth of a tidal river. Monitoring at these stations is conducted monthly, regardless of rotating priority basin schedule.
- C2 - The remaining 114 stations are Category 2 stations and are monitored monthly for two years and bi-monthly for three years according to a five-year rotating priority basins schedule.

Figure 2 shows the locations of the and C1 and C2 stations. During FY 2024, the Piedmont and Lower Delaware Bay Drainage Basins are priority basins (Figure 3) and all stations in these two basins are monitored monthly. Stations in the three remaining basins (Upper Delaware Bay, Inland Bays, and Chesapeake Bay) are monitored six times per year (bi-monthly).

Data collected as part of this monitoring effort are archived in the US EPA's STORET database and can be accessed through the National Water Quality Monitoring Council's Water Quality Portal at <https://www.waterqualitydata.us/>. In addition, the data can be viewed or downloaded from the University of Delaware's Environmental Observatory System (DEOS) Water Quality Data Portal at <https://cema.udel.edu/applications/waterquality/>.

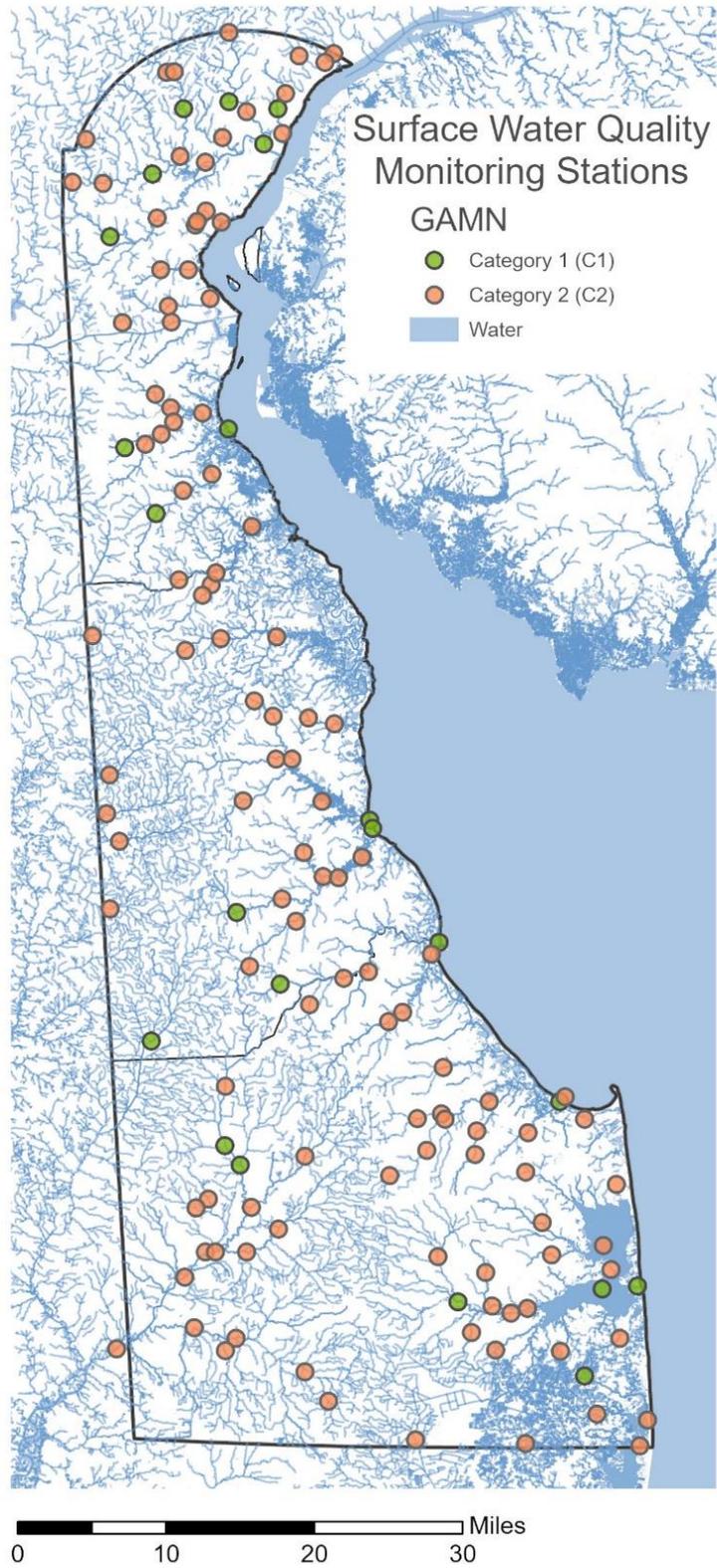


Figure 2 - Delaware's surface water quality monitoring stations

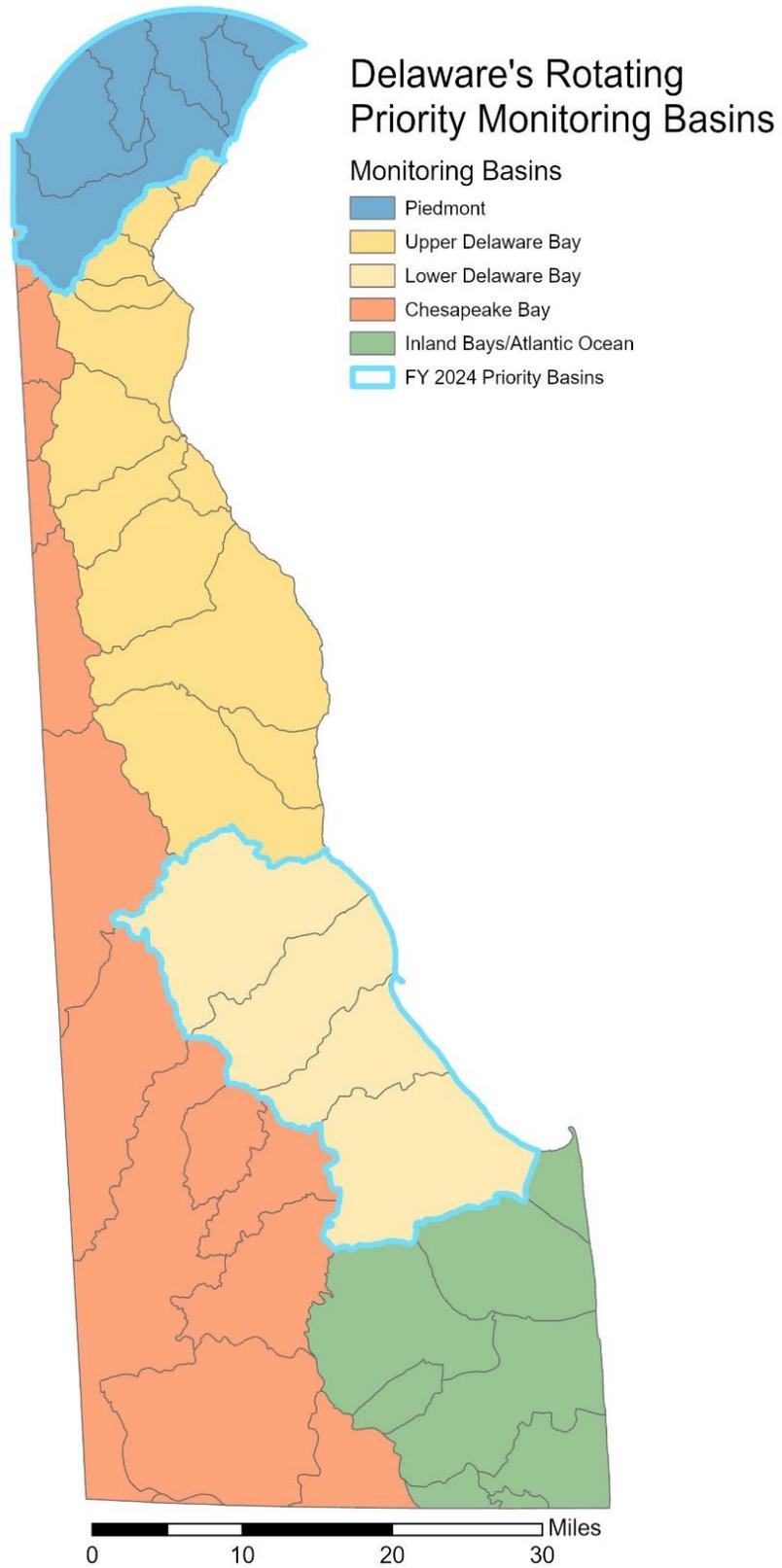


Figure 3 - Delaware's rotating priority monitoring basins

Chesapeake Bay Nontidal Monitoring

Delaware DNREC is participating in a multi-state nontidal monitoring program coordinated by the Chesapeake Bay Program. Chesapeake Bay Watershed jurisdictions including Maryland, Virginia, West Virginia, Pennsylvania, New York, and the District of Columbia all participate. The Chesapeake Bay Nontidal Monitoring Network has 123 monitoring stations with the following two stations in Delaware:

- Nanticoke River near Bridgeville
- Marshyhope Creek at Fishers Bridge Rd.

The locations of the Chesapeake Bay Nontidal monitoring stations in Delaware are shown in Figure 4. Monitoring at these two stations is conducted monthly using sample collection protocols developed by the Chesapeake Bay Program Nontidal Monitoring Workgroup [1]. In addition to monthly sampling, eight storm samples per year (two per season) are collected at these stations.

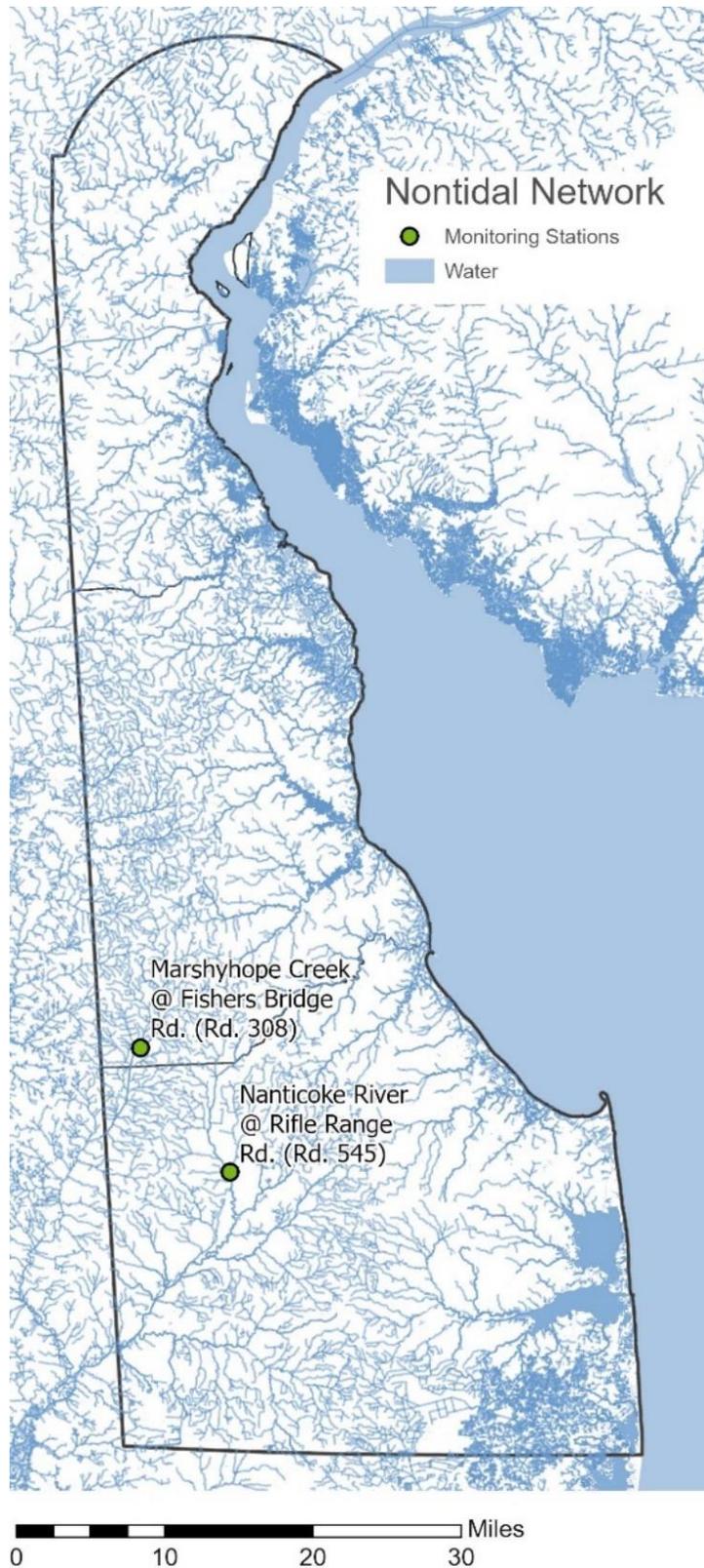


Figure 4 - Delaware's Chesapeake Bay Nontidal Network monitoring stations

Continuous Water Quality Monitoring

Delaware DNREC, in cooperation with the Delaware Geological Survey (DGS) and the USGS, is maintaining a number of continuous monitoring stations in the State. During FY 2024, seven stations in Delaware are being monitored continuously. These sites include:

- Brandywine Creek at Wilmington
- Christina River at Newport
- Appoquinimink River near Odessa
- Murderkill River at Frederica
- Millsboro Pond Outlet at Millsboro
- Broadkill River near Milton
- Massey Ditch at Massey Landing

Figure 5 shows the locations of the continuous monitoring stations. Measurements of water temperature, dissolved oxygen (DO), pH, and specific conductance at these sites are conducted at every fifteen minutes interval by using multi-parameter water quality data sondes (YSI sondes). All data are collected following USGS protocols and are stored in USGS National Water Information System (NWIS) databases which can be accessed at <http://waterdata.usgs.gov/de/nwis/current/?type=quality>.



Figure 5 - Delaware's continuous monitoring stations

Biological Assessment Monitoring

To assess habitat and biological integrity of Delaware's surface waters, Delaware DNREC conducts habitat and biological monitoring of its streams. Prior to 2017, macroinvertebrate and habitat assessments were generally performed at perennial, nontidal and wadable streams throughout the state of Delaware using a probabilistic design. Random sites were selected with assistance from the Environmental Protection Agency (EPA) using the Environmental Monitoring and Assessment Program (EMAP) approach. Data from these surveys are used for 305(b) analysis.

During FY 2024, Delaware DNREC anticipates a new habitat/biological survey of approximately 20-30 sites that will focus on finding more reference-quality sites in the Piedmont. With the additional data collected in 2022 and 2023, DNREC plans to refine Delaware's index of biological integrity (IBI) and habitat index to better characterize biological conditions. The direction of future habitat/biological monitoring will be based on the findings of this data review and analysis.

Monitoring under the Watershed Approach to Toxics Assessment and Restoration (WATAR) Plan

The WATAR program was conceived by Delaware DNREC in 2012 with the intention of building a bridge between the Watershed Assessment & Management Section and the Remediation Section. The focus of the WATAR program is surface waters, sediments, fish and other aquatic life impacted by toxics, the health of fish and shellfish consumers and other users of Delaware's natural resources, and the link to the sources/sites responsible for impacts to those focus areas. Data and information collected in conjunction with this program are intended to be used to document progress toward implementing Total Maximum Daily Loads (TMDLs) for PCBs and other toxic compounds in Delaware, among other things. The data and information collected will also be used to identify other contaminants that may need TMDLs, Advanced Restoration Plans or other clean up actions in order to help restore water quality [4].

Toxics in Biota Monitoring

The FY 2024 toxics in biota monitoring will focus its annual sampling efforts on fish tissue in Delaware's Chesapeake drainages that include Marshyhope Creek, Broad Creek, Nanticoke River and 12 ponds.

Toxics in Surface Water/Sediment Monitoring

In FY 2024, the WATAR team plans to spend time analyzing and evaluating the PFAS data collected from surface waters across the state in late FY2023, as opposed to collecting additional surface water samples. Figure 6 shows the sampling locations that were included in the study.

In FY 2024, there are currently no planned sediment sampling efforts, although time will be spent evaluating and summarizing sediment data from an unplanned sampling in FY2023. Specifically, the WATAR team analyzed sediment samples from behind the dams in Delaware's White Clay Creek.

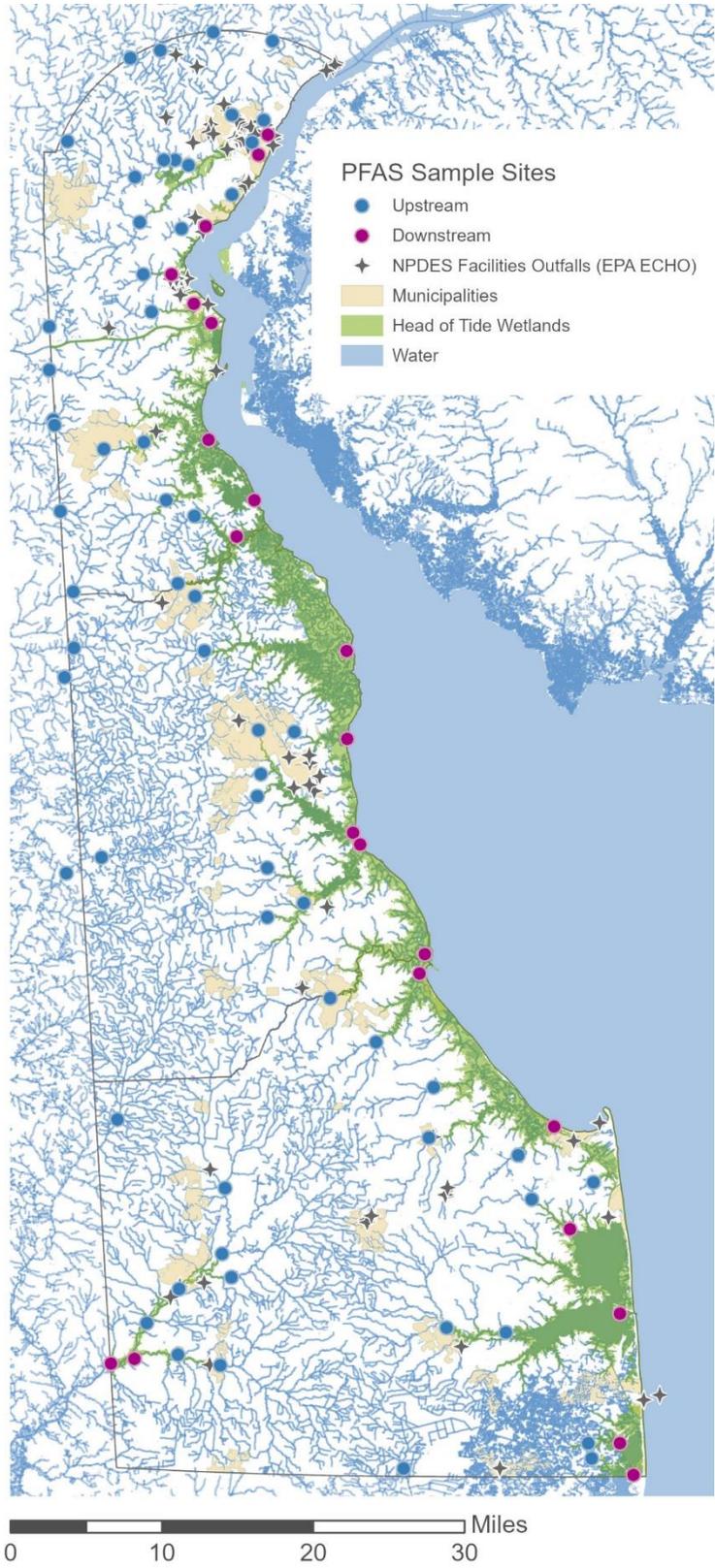


Figure 6 - Delaware's surface water sampling sites for PFAS

Field and Laboratory Procedures

Field procedures for sample collection activities are detailed in DNREC's Environmental Laboratory Services Quality Manual [2]. Method references, STORET codes and reporting levels for parameters listed in Table 2 are provided by the DNREC's Environmental Laboratory Section (ELS). Any deviation from standard field, laboratory procedures, or this sampling plan shall be documented with a complete description of the alteration.

Quality Assurance, Documentation, Data Usage and Reporting

The quality assurance objectives and quality control procedures for these surveys are documented in the Quality Assurance Program Plan prepared by the Watershed Assessment and Management Section, Division of Watershed Stewardship [3].

A duplicate water column sample will be collected and analyzed for 10% of the samples from this project. All analytical results from the duplicate analyses shall be reported with the other data.

All analytical results shall be reported to the Watershed Assessment and Management Section digitally (using standard ELS data report forms).

Table 1 - Station locations, descriptions, parameters and sampling frequency

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
Piedmont	North Piedmont	Little Mill Creek @ DuPont Rd.	106281	C2	12			X	X
		Christina River near Conrail Bridge	106291	C1	12	X		X	X
		Brandywine Creek @ Foot Bridge in Brandywine Park	104011	C2	12			X	X
		Brandywine Creek @ New Bridge Rd. (Rd. 279)	104021	C1	12	X		X	X
		Red Clay Creek @ Lancaster Pike (Rt. 48)	103031	C1	12	X		X	X
		Red Clay Creek @ Barley Mill Rd. (Rd. 258A)	103041	C2	12			X	X
		Burroughs Run @ Creek Rd. (Rt. 82)	103061	C2	12			X	X
		Brandywine Creek @ Smith Bridge Rd. (Rd. 221)	104051	C2	12			X	X
		Christina River beneath Rt. 141 Bridge	106021	C2	12			X	X
		Red Clay Creek @ W. Newport Pike (Rt. 4)	103011	C2	12			X	X
		White Clay Creek @ Delaware Park Blvd.	105151	C1	12	X		X	X
		White Clay Creek @ McKees Lane	105171	C2	12			X	X

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Christina River @ Nottingham Rd. (Rt. 273)	106191	C2	12			X	X
		White Clay Creek @ Chambers Rock Rd. (Rd. 329)	105031	C2	12			X	X
		Christina River @ Sunset Lake Rd. (Rt. 72)	106141	C1	12	X		X	X
		Smalleys Dam Spillway @ Smalleys Dam Rd.	106031	C2	12			X	X
	Northeast Piedmont	Naaman Creek S. Branch @ Darley Rd. (Rd. 207)	101031	C2	12				
		Naaman Creek @ State Line near Hickman Rd.	101021	C2	12				
		Naaman Creek South Branch @ Marsh Rd. (Rt. 3)	101061	C2	12				
		Shellpot Creek @ Carr Rd.	102081	C2	12				
		Shellpot Creek @ Market St. (Rt. 13 Bus.)	102051	C1	12	X			
		Shellpot Creek @ Hay Rd. (Rd. 501)	102041	C2	12		X		
	Upper Delaware Bay	North Delaware Bay	Army Creek @ S. DuPont Hgwy. (Rt. 13)	114021	C2	6			
Army Creek @ Rt. 13 near Rt. 40			114051	C2	6				
Trib Army Crk. @ Rt. 13 near Airport Ind. Park			114041	C2	6				

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Army Creek @ River Rd. (Rt. 9)	114011	C2	6				
		Red Lion Creek @ Rt. 9	107031	C2	6				
		Dragon Creek @ Wrangle Hill Rd. (Rt. 9)	111011	C2	6				
		C & D Canal @ DuPont Pkwy. (Rt. 13) N. side	108021	C2	6				
		Dragon Creek @ S. DuPont Hwy. (Rt. 13)	111031	C2	6				
		Red Lion Creek @ Bear Corbitt Rd. (Rt. 7)	107011	C2	6				
		Lums Pond @ Boat Ramp	108111	C2	6				
	Appoquinimink River	Drawyer Creek off Rt. 13 @ parking area	109071	C2	6			X	X
		Shallcross Lake @ Shallcross Lake Rd. (Rd. 420)	109191	C2	6			X	X
		Deep Creek Branch @ Summit Bridge Rd. (Rt. 71)	109251	C1	12	X		X	X
		Noxontown Pond @ Noxontown Rd. (Rd. 38)	109131	C2	6			X	X
		Appoquinimink River @ DuPont Pkwy. (Rt. 13)	109041	C2	6			X	X
		Appoquinimink River @ MOT Gut (west bank)	109171	C2	6			X	X

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Appoquinimink River @ Silver Run Rd. (Rt. 9) NE	109121	C2	6			X	X
		Appoquinimink River @ Mouth	109091	C1	12	X		X	X
	Delaware Bay Drainage	Little River @ Bayside Dr. (Rt. 9)	204031	C2	6				
		Little River @ N. Little Creek Rd. (Rt. 8)	204041	C2	6				
		Leipsic River @ Denny St. (Rt. 9)	202031	C2	6				
		Smyrna River @ Flemings Landing (Rt. 9)	201041	C2	6				
		Blackbird Creek @ Taylors Bridge Rd. (Rt. 9)	110041	C2	6				
		Blackbird Creek @ Blackbird Station Rd. (Rd. 463)	110011	C1	12	X			
		Blackbird Creek @ Blackbird Landing Rd. (Rd. 455)	110031	C2	6				
		Duck Creek @ Smyrna Landing Rd. (Rd. 485)	201051	C2	6				
		Mill Creek (Lake Como outfall) @ Rt. 13	201011	C2	6				
		Providence Creek @ Duck Creek Rd. (Rt. 15)	201161	C2	6				
Mill Creek @ Carter Rd. (Rd. 137)	201021	C2	6						

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Garrisons Lake @ DuPont Hwy. (Rt. 13)	202021	C2	6				
		Leipsic River @ Mt. Friendship Rd. (Rt. 15)	202191	C2	6				
	St. Jones River	St. Jones River @ mouth, Bowers Beach	205011	C1	12	X			
		St. Jones River @ Barkers Landing	205041	C2	6				
		St. Jones River @ East Lebanon Rd. (Rt. 10)	205091	C2	6				
		Derby Pond @ Boat Ramp (Rt. 13A)	205211	C2	6				
		Moores Lake @ S. State St. (Rd. 27)	205181	C2	6				
		Fork Branch @ State College Rd. (Rd. 69)	205151	C2	6				
		Silver Lake @ Spillway (Dover City Park)	205191	C1	12	X			
Lower Delaware Bay	Murderkill River	Murderkill River @ Rt. 13	206011	C1	12	X		X	X
		Browns Branch @ Milford-Harrington Hwy. (Rt. 14)	206041	C2	12			X	X
		McColley Pond @ Canterbury Rd. (Rt. 15)	206361	C2	12			X	X
		Coursey Pond @ Canterbury Rd. (Rt. 15)	206451	C2	12			X	X

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete	
		Double Run @ Barratts Chapel Rd. (Rd. 371)	206561	C2	12			X	X	
		Murderkill River @ Bowers Beach Wharf (mouth)	206101	C1	12	X		X		
		Murderkill River near levee @ MNWA (RM 3.25)	206141	C2	12			X	X	
		Murderkill Rv. @ confl. of KCWWTF discharge ditch	206231	C2	12			X	X	
		Murderkill River @ Bay Rd. (Rt. 1/113)	206091	C2	12			X	X	
	South Delaware Bay	Beaverdam Branch @ Deep Grass Ln. (Rd. 384)	208231	C1	12	X				
		Abbotts Pond @ Abbotts Pond Rd. (Rd. 620)	208181	C2	12					
		Silver Lake @ Maple Ave.	208211	C2	12					
		Mispillion River @ Rt. 1	208021	C2	12					
		Mispillion River @ Cedar Creek confluence	208061	C1	12	X				
		Cedar Creek @ Cedar Beach Rd. (Rt. 36)	301091	C2	12					
		Cedar Creek @ Coastal Hwy. (Rt. 1)	301031	C2	12					
		Swiggetts Pond @ Cedar Creek Rd. (Rt. 30)	301021	C2	12					

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
	Broadkill River	Savannah Ditch @ Savannah Drive (Rd. 246)	303011	C2	12				
		Ingram Branch @ Gravel Hill Rd. (Rd. 248)	303021	C2	12				
		Beaverdam Creek @ Carpenter Rd. (Rd. 259)	303181	C2	12				
		Beaverdam Creek @ Cave Neck Rd. (Rd. 88)	303171	C2	12				
		Round Pole Branch @ Cave Neck Rd. (Rd. 88)	303311	C2	12				
		Broadkill River @ Union St (Rt. 5)	303031	C2	12				
		Pemberton Branch @ Gravel Hill Rd. (Rt. 30)	303341	C2	12				
		Red Mill Pond @ Rt. 1	303051	C2	12				
		Broadkill River 0.10 Miles from Mouth	303061	C1	12	X			
		Broadkill River @ Rt. 1 Bridge	303041	C2	12				
		Waples Pond @ Rt. 1	303331	C2	12				
		Inland Bays	Inland Bays w/ Pocomoke & Delaware Bay	Indian River Inlet @ Coast Guard Station	306321	C1	12	X	
Little Assawoman Bay Mid-Bay (Ocean Park Lane)	310071			C2	6	X		X	

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Little Assawoman Bay @ Rt. 54 (The Ditch)	310011	C2	6	X		X	
		Dirickson Creek @ Old Mill Bridge Rd. (Rd. 381)	310031	C2	6	X		X	X
		Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)	310121	C1	12	X		X	X
		Blackwater Creek @ Omar Rd. (Rd. 54)	308361	C2	6	X		X	X
		White Creek @ mouth of Assawoman Canal	312011	C2	6	X		X	
		Bundicks Branch @ Rt. 23	308371	C2	6	X		X	X
		Pocomoke River @ Bethel Rd. (Rd. 420)	313011	C2	6				
		Whartons Branch @ Rt. 20 (Dagsboro Rd.)	309041	C2	6	X		X	X
		Pepper Creek @ Rt. 26 (Main St.)	308091	C2	6	X		X	X
		Buntings Branch @ Rt. 54 (Polly Branch Rd.)	311041	C2	6	X		X	X
		Millsboro Pond @ Rt. 24	308071	C1	12	X		X	X
		Cow Bridge Branch @ Zoar Rd. (Rd. 48)	308281	C2	6	X		X	X
		Swan Creek @ Mount Joy Rd. (Rd. 297)	308341	C2	6	X		X	X

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Guinea Creek @ Banks Rd. (Rd. 298)	308051	C2	6	X		X	X
		Burton Pond @ Rt. 24	308031	C2	6	X		X	X
		Indian River @ Buoy 49 (Swan Creek)	306181	C2	6	X		X	
		Indian River @ Island Creek	306331	C2	6	X		X	
		Island Creek upper third	306341	C2	6	X		X	
		Indian River Bay @ Buoy 20	306121	C1	12	X		X	
		Massey Ditch @ Buoy 17	306111	C2	6	X		X	
		Rehoboth Bay @ Buoy 7	306091	C2	6	X		X	
		Lewes & Rehoboth Canal @ Rt. 1	305011	C2	6	X		X	
		Lewes & Rehoboth Canal @ Rt. 9	305041	C2	6	X		X	
		Roosevelt Inlet, mouth	401011	C2	6	X		X	
Chesapeake	Nanticoke River	Raccoon Prong @ Pepperbox Rd. (Rd. 66)	307371	C2	6			X	X
		Hitch Pond Branch @ Pepper Pond Rd. (Rd. 449)	307081	C2	6			X	X
		Nanticoke River @ Rt. 13	304471	C2	6			X	X

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Concord Pond @ German Rd. (Rd. 516)	304311	C2	6			X	X
		Deep Creek @ Old Furnace Rd. (Rd. 46)	304741	C2	6			X	X
		Gravelly Branch @ Coverdale Rd. (Rd. 525)	316011	C2	6			X	X
		Gravelly Branch @ Deer Forest Rd. (Rd. 565)	316031	C2	6			X	X
		Nanticoke River @ Beach Hwy. (Rt. 16)	304681	C2	6			X	X
		Clear Brook @ Cannon Rd. (Rt. 18)	304371	C2	6			X	X
		Bucks Branch @ Conrail Rd. (Rd. 546)	304381	C2	6			X	X
		Williams Pond @ East Poplar St.	304321	C2	6			X	X
		Broad Creek @ Bethel Rd. (Rd. 493)	307031	C2	6			X	X
		Records Pond @ Willow Street	307011	C2	6			X	X
		Horsey Pond @ Sharptown Rd. (Rt. 24)	307171	C2	6			X	X
		Nanticoke River @ Sharptown	304011	C2	6			X	X
		Nanticoke River @ Buoy 66 (mouth of DuPont Gut)	304151	C2	6			X	X

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
	Chesapeake Drainage	Sewell Branch @ Sewell Branch Rd. (Rd. 95)	112021	C2	6				
		Tappahanna Ditch @ Sandy Bend Rd. (Rd. 222)	207081	C2	6				
		Culbreth Marsh Ditch @ Shady Bridge Rd. (Rd. 210)	207091	C2	6				
		Cow Marsh Creek @ Mahan Corner Rd. (Rd. 208)	207021	C2	6				
		White Marsh Br. @ Cedar Grove Church Rd. (Rd. 268)	207111	C2	6				
	Chesapeake Bay Nontidal	Nanticoke River @ Rifle Range Rd. (Rd. 545)	304191	C1	12	X		X	X
		Marshyhope Creek @ Fishers Bridge Rd. (Rd. 258)	302031	C1	12	X		X	X
	Chesapeake Bay Nontidal Storm	Nanticoke River @ Rifle Range Rd. (Rd. 545)	304191	C1	8	X		X	X
		Marshyhope Creek @ Fishers Bridge Rd. (Rd. 258)	302031	C1	8	X		X	X
	State-Wide Storm	Shellpot Creek @ Market St. (Rt. 13 Bus.)	102051	C1	4	X			
Brandywine Creek @ New Bridge Rd. (Rd. 279)		104021	C1	4	X		X	X	
Red Clay Creek @ Lancaster Pike (Rt. 48)		103031	C1	4	X		X	X	
White Clay Creek @ Delaware Park Blvd.		105151	C1	4	X		X	X	

Basin	Project	Station Description	STORET ID	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Paramete
		Christina River @ Sunset Lake Rd. (Rt. 72)	106141	C1	4	X		X	X
		Deep Creek Branch @ Summit Bridge Rd. (Rt. 71)	109251	C1	4	X		X	X
		Blackbird Creek @ Blackbird Station Rd. (Rd. 463)	110011	C1	4	X			
		Murderkill River @ Rt. 13	206011	C1	4	X		X	X
		Millsboro Pond @ John Williams Hwy. (Rt. 24)	308071	C1	4	X		X	X
		Silver Lake @ Spillway (Dover City Park)	205201	C1	4	X			
		Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)	310121	C1	4	X		X	X
		Beaverdam Branch @ Deep Grass Ln. (Rd. 384)	208231	C1	4	X			

Table 2 - Water quality parameters to be monitored at all stations

Parameter	Method Reference ¹	Reporting Level ²
Water Column Nutrients		
Ammonia Nitrogen	EPA 350.1, Rev. 2.0 (1993)	0.010 mg/l N
Nitrite+Nitrate Nitrogen	EPA 353.2, Rev. 2.0 (1993)	0.030 mg/l N
Nitrogen, Total, Alkaline Persulfate	SM 4500-P J-2011	0.100 mg/l N
Soluble Ortho-phosphorus	EPA 365.1, Rev. 2.0 (1993)	0.004 mg/l P
Phosphorus, Total, Alkaline Persulfate	SM 4500-P J-2011	0.010 mg/l P
Carbon and Organics		
Total Organic Carbon	SM 5310 B-2011	1 mg/l
Dissolved Organic Carbon	SM 5310 B-2011	1 mg/l
Chlorophyll-a (Corr)	EPA 445.0, Rev. 1.2 (1997)	1 µg/l
Biochemical Oxygen Demand		
BOD ₅ , N-Inhib (CBOD)	SM 5210 B-2011	2.4 mg/l
BOD ₂₀ , N-Inhib (CBOD)	SM 5210 B-2011	2.4 mg/l
Field Measurements		
Conductivity	SM 2510 B-2011	1 µS/cm
Dissolved oxygen	SM 4500-O G-2011 or ASTM D888-09 (C)	0.1 mg/l
pH - Field	SM 4500-H+ B-2011	0.2 pH units
Salinity	SM 2520 B-2011	0.1 ppt
Temperature	SM 2550 B-2010	Water - 5.00 °C Air - 10 °C
Secchi Depth ³	EPA-841-R-14-007	0.1 meters
Light Attenuation ⁴	EPA-841-R-14-007	0.1 µmol/s/m ²

Parameter	Method Reference ¹	Reporting Level ²
General		
Alkalinity	SM 2320 B-2011	2.3 mg/l
Chloride	SM 4500-Cl ⁻ E-2011	5 mg/l
Hardness	SM 2340 C-2011	5 mg/l as CaCO ₃
Total Suspended Solids	SM 2540 D-2011	2.5 mg/l ⁵
Turbidity	SM 2130 B-2011	1 NTU
Bacteria		
Enterococcus	Enterolert®	1 mpn/100 ml

¹ SM refers to Standard Methods

² The Environmental Laboratory Section (ELS) defines the limit of quantitation (LOQ) as the lowest standard in the calibration curve or, in instances where a standard curve is not specified by the procedure, LOQ represents the limitations of the method. For those tests where reference spiking material exists, the ELS measures method detection limit (MDL), as defined in the Federal Register 40 CFR Part 136 Appendix B. MDL values are generated or verified once per year. Results less than the MDL are considered to be not detected and "< MDL" is reported. Results greater than the MDL but less than the LOQ are qualified with a J to indicate a result that is extrapolated or estimated. For tests where MDL is not applicable, results less than the LOQ are reported as "< LOQ". ELS MDLs meet or exceed (i.e., are lower than) the reporting level requirements listed in Table 3. The reporting levels listed represent the LOQ or method defined limit.

³ Secchi depth to be measured at designated stations. The reappearance depth is recorded.

⁴ Light attenuation to be conducted as practical to obtain correlation with Secchi disk readings. PAR at the surface and at one meter depth is recorded and reported.

⁵ Reporting limit based on 1000 ml filtration volume. The reporting limit will be adjusted according to actual volume filtered. The method specifies to decrease volume if complete filtration takes more than 10 minutes.

Table 3 - Metal parameters

Dissolved Metals	Method Reference (EPA)	Reporting Level ⁶
Copper	EPA 200.8, Rev. 5.4 (1994)	0.25 ug/l
Lead	EPA 200.8, Rev. 5.4 (1994)	0.25 ug/l
Zinc	EPA 200.8, Rev. 5.4 (1994)	2.0 ug/l
Iron	EPA 200.7, Rev. 4.4 (1994)	100 ug/l
Arsenic	EPA 200.8, Rev. 5.4 (1994)	0.25 ug/l

⁶ High levels of dissolved solids in the sample may cause analytical interferences. For example, EPA method 200.8 recommends that the dissolved solids levels not exceed 0.2% (w/v) (~2,000 mg/L) to reduce such effects. Samples may be diluted during analysis to minimize the instrument interferences associated with high salinity/conductivity. The reported MDLs and LOQs for the parameters will be adjusted due to the sample dilution.

Table 4 - Additional parameters needed for freshwater stations with Biotic Ligand Model (BLM) sampling for copper

Dissolved Parameters	Method Reference (EPA)	Reporting Level
Alkalinity	SM 2320 B-2011	2.3 mg/l
Chloride	SM 4500-Cl ⁻ E-2011	3 mg/l
Calcium	EPA 200.7, Rev. 4.4 (1994)	1000 ug/l
Magnesium	EPA 200.7, Rev. 4.4 (1994)	1000 ug/l
Potassium	EPA 200.7, Rev. 4.4 (1994)	1000 ug/l
Sodium	EPA 200.7, Rev. 4.4 (1994)	1000 ug/l
Sulfate	EPA 300.0	0.75 mg/l

References

1. Chesapeake Bay Program. 2008. Chapter V, Nontidal Water Quality Monitoring. Annapolis, MD.
2. DNREC. 2019. Quality Manual for DNREC Environmental Laboratory and Field Operations, Environmental Laboratory Section, Division of Water.
3. DNREC. 2019. Delaware Ambient Surface Water Quality Monitoring Program Quality Assurance Program Plan (QAPrP), Division of Watershed Stewardship, Watershed Assessment and Management Section.
4. DNREC. 2018. Watershed Approach to Toxics Assessment and Restoration 2018-2022. DNREC Division of Watershed Stewardship and Division of Waste and Hazardous Substances.