

State of Delaware Ambient Surface Water Quality Monitoring Program FY 2022 (July 1, 2021-June 30, 2022)



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

Division of Watershed Stewardship

Watershed Assessment and Management Section

June 1, 2021

Table of Contents

Executive Summary	1
Ambient Surface Water Quality Monitoring Program - FY 2022	3
The General Assessment Monitoring Network (GAMN)	5
Chesapeake Bay Non-tidal Monitoring	8
Continuous Water Quality Monitoring.....	9
Biological Assessment Monitoring	11
Toxics in Biota Monitoring	11
Toxics in Sediment Monitoring.....	11
Monitoring under the Watershed Approach to Toxics Assessment and Restoration (WATAR) Plan.....	11
Field and Laboratory Procedures	12
Quality Assurance, Documentation, Data Usage and Reporting.....	12

List of Tables

Table 1 - Station Locations, Descriptions, Parameters, and Sampling Frequency	13
Table 2 - Water Quality Parameters to be monitored at all stations - FY 2022.....	19
Table 3 - Metal Parameters	20
Table 4 - Additional parameters needed for freshwater stations with Biotic Ligand Model Sampling for Copper (BLM Parameters).....	21

List of Figures

Figure 1 – State of Delaware Watersheds and Basins	4
Figure 2 - Delaware's Surface Water Quality Monitoring Sites	6
Figure 3 - Delaware's Rotating Priority Monitoring Basins	7
Figure 4 - Delaware's Non-tidal Monitoring Sites.....	8
Figure 5 - Delaware's Continuous Monitoring Sites.....	10

Executive Summary

Delaware's Surface Water Quality Monitoring Program for Fiscal Year 2022 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 Non-tidal Monitoring, Continuous Water Quality Monitoring, Biological Assessment Monitoring, Toxics in Biota Monitoring, Toxics in Sediment Monitoring, and Monitoring under the Watershed Approach to Toxics Assessment and Restoration (WATAR) Plans. Each element of the monitoring program is briefly described below:

- Delaware 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 pollutants loads, and to track progress toward achieving the targets established by the Total Maximum Daily Loads (TMDLs) for many of the watersheds of the State. Furthermore, the data will be used to identify effect of land use on N and P concentrations. The State's GAMN currently has a total of 139 stations. 23 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 116 monitoring stations are Category 2 (C2) stations and are monitored monthly for 2 years and bi-monthly for 3 years according to a 5-year rotating basin schedule. 4 storm samples (one per season) are collected annually at 12 C1 and C2 sites statewide shown at the end of Table 1. During FY 2022, Inland Bays and Upper Delaware Bay Drainage Basins are the priority basins and all stations in these two basins are monitored every month. Monitoring frequency at stations in the other 3 basins (Lower Delaware Bay, Piedmont, and Chesapeake Bay) will be bi-monthly.
- Delaware DNREC is participating in the Chesapeake Bay Program's Non-tidal Monitoring Program and collects samples from two of the non-tidal sites located in Delaware. These two sites are Nanticoke River near Bridgeville and Marshyhope Creek at Fishers Bridge Rd. Samples at these two sites are collected according to sample collection protocol developed by the Chesapeake Bay Program Non-tidal Monitoring Workgroup. Monthly samples and 8 storm samples per year (2 storm samples per season) are collected at these two sites. The data collected at these two sites 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.
- Delaware DNREC, in cooperation with the Delaware Geological Survey (DGS) and the United States Geological Survey (USGS), is maintaining 6 continuous water quality monitoring sites. In the 6 continuous water quality monitoring sites, monitoring of water temperature, dissolved oxygen (DO), pH, and specific conductance at these sites are conducted at fifteen-minute intervals by using multi-parameter water-quality sondes (YSI sondes).

- During FY 2022, Delaware DNREC will not conduct any new habitat/biological survey. Instead, it will review the results of surveys conducted during the past several years to evaluate the condition of habitat/biota and to identify any areas where data gap exist and where additional monitoring is needed. Future habitat/biological monitoring will be based on the findings of this data review and analysis.
- During FY2022 DNREC's WATAR Team plans to focus on fish tissue sample collection from the Christina Basin and Shellpot Creek. In addition, the team will attempt to sample fish tissue from Army Creek and the Appoquinimink River, which sampling team were unable to collect in FY 2021 due to COVID related sampling restrictions.

Ambient Surface Water Quality Monitoring Program - FY 2022

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 is collected under this program is 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; and

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 Non-tidal Monitoring

Continuous Water Quality Monitoring

Biological Assessment Monitoring

Toxics in Biota Monitoring

Toxics in Sediment Monitoring

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

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

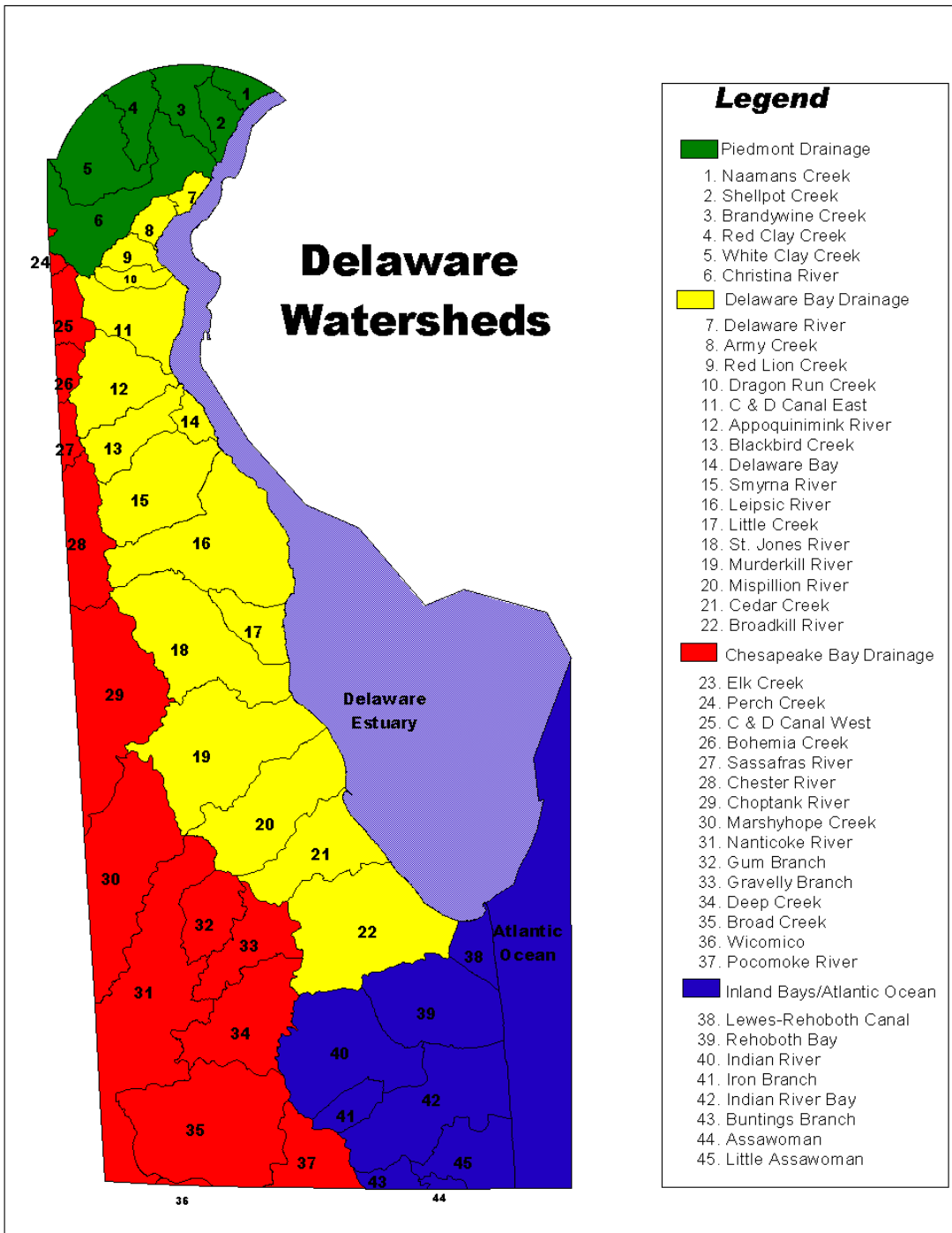


Figure 1 – State of Delaware Watersheds and Basins

The General Assessment Monitoring Network (GAMN)

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 139 monitoring stations (see 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 (see Tables 1, 3 and 4).

The data collected as part of this effort is entered into the EPA's STORET database. In addition, the data is 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 Department of Natural Resources and Environmental Control produces every 2 years. Furthermore, the data is 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 139 stations. These stations fall into 2 categories:

- a. C1 - Category 1 stations are high priority stations. Currently, GAMN contains 23 Category 1 sites. 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. In addition, annually 4 storm samples (1 per season) are collected at these sites.
- b. C2 - The remaining 116 stations are Category 2 stations and are monitored monthly for 2 years and bi-monthly for 3 years according to a 5-year rotating priority basins schedule.

Figure 2 shows the location of monitoring sites and C1 and C2 stations. During FY 2022, the Inland Bays and Upper Delaware Bay Drainage Basins are priority basins and all stations in these two basins are monitored monthly. Stations in the 3 remaining basins (Lower Delaware Bay, Piedmont, and Chesapeake Bay) are monitored 6 times per year (bi-monthly). Figure 3 shows Delaware's Priority Rotating Basins.

Data collected as part of this monitoring effort is archived in the US EPA's STORET data base. In addition, the data can be viewed or downloaded from the University of Delaware's Environmental Observatory System (DEOS) Water Quality Data Portal site at the following url: <http://demac.udel.edu/waterquality/>

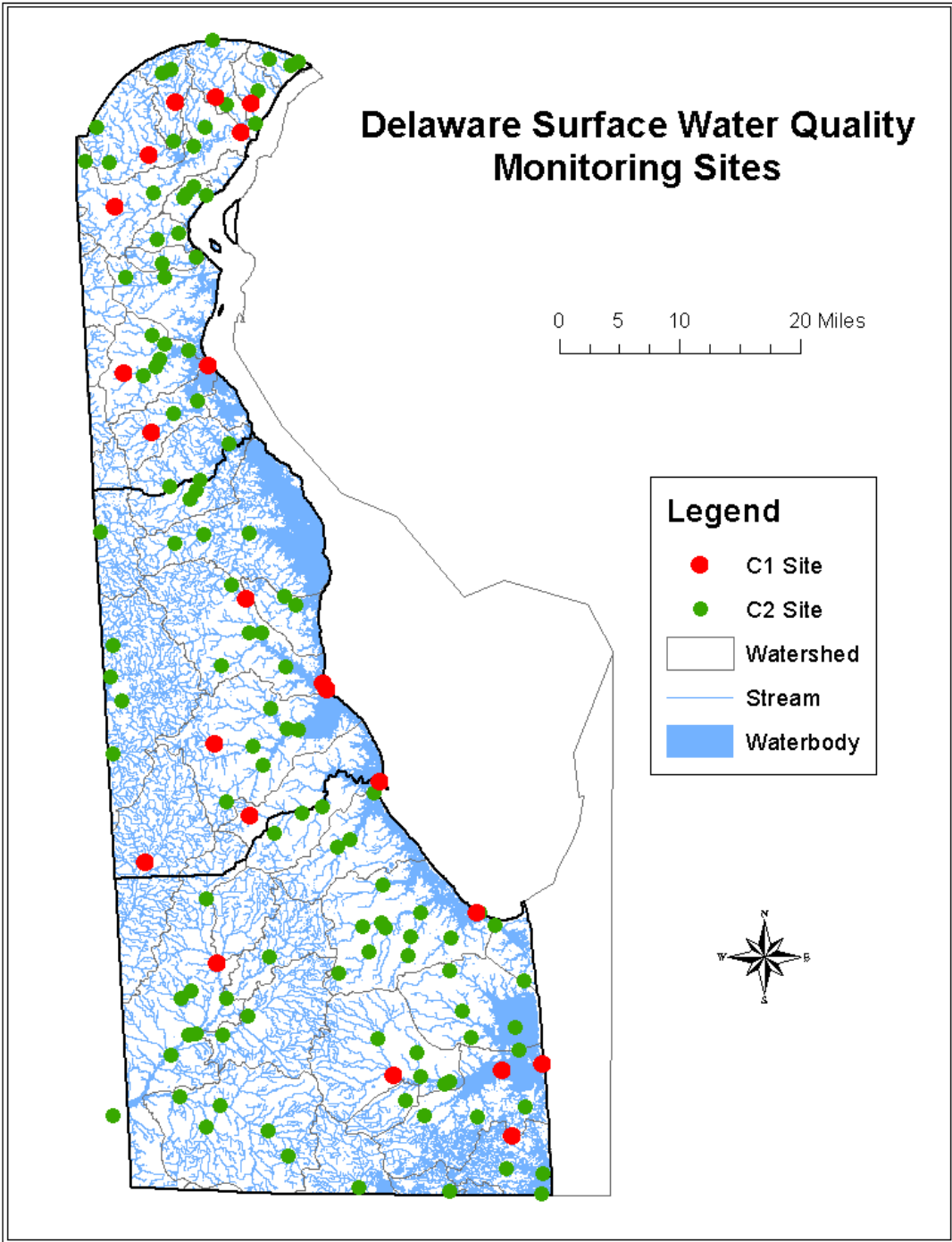


Figure 2 - Delaware's Surface Water Quality Monitoring Sites

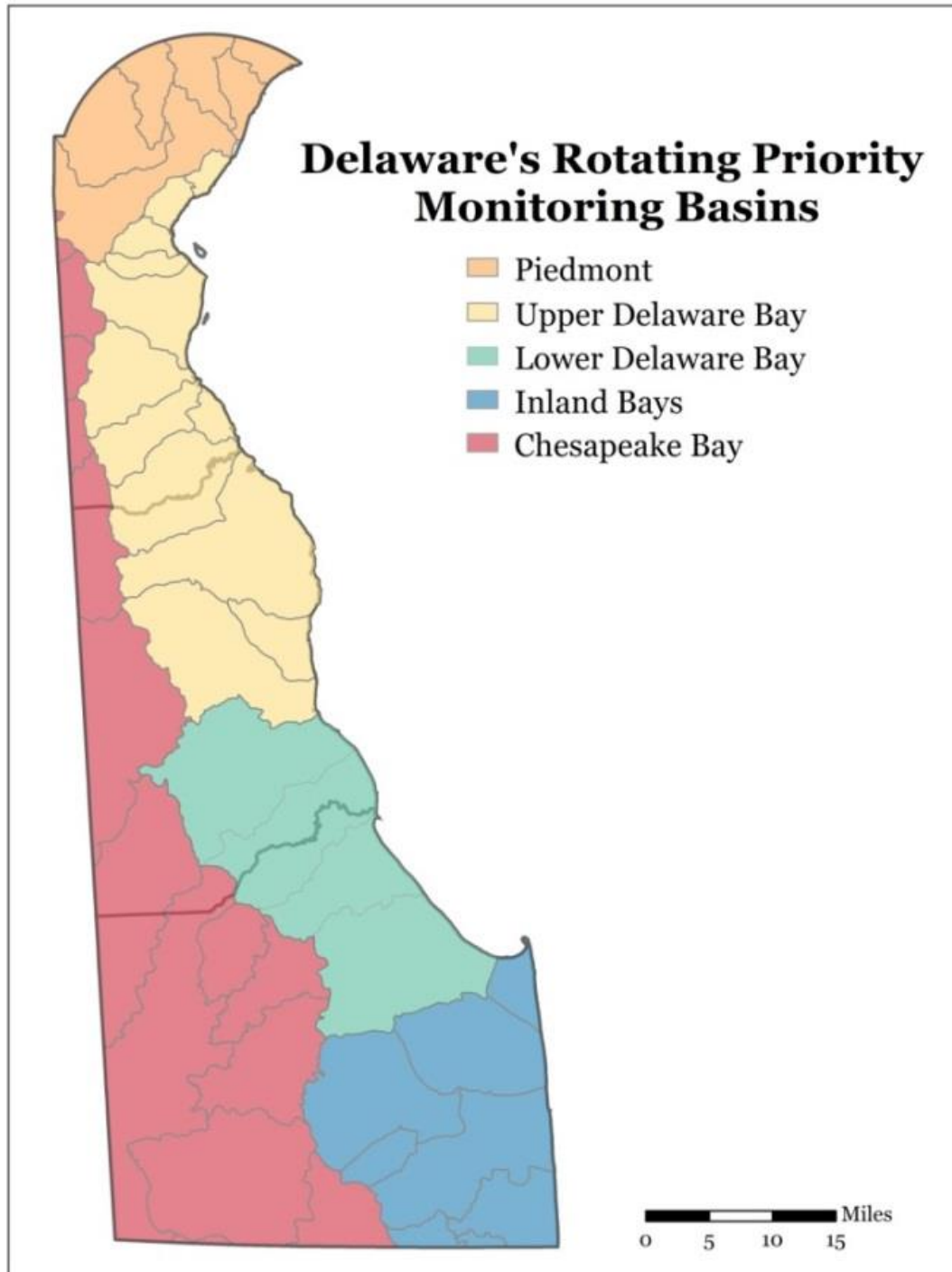


Figure 3 - Delaware's Rotating Priority Monitoring Basins

Chesapeake Bay Non-tidal Monitoring

Delaware DNREC is participating in a multi-State non-tidal monitoring Program conducted by the Chesapeake Bay Program and other jurisdictions including Maryland, Virginia, West Virginia, Pennsylvania, New York, and the District of Columbia. The Chesapeake Bay Non-tidal Monitoring Network has about 120 monitoring sites and the following two sites are in Delaware:

1. Nanticoke River near Bridgeville
2. Marshyhope Creek at Fishers Bridge Rd

Location of the Chesapeake Bay Non-tidal monitoring sites in Delaware is shown in Figure 4. Monitoring at the above two sites is conducted monthly using sample collection protocol developed by the Chesapeake Bay Program Non-tidal Monitoring Workgroup [1]. In addition to monthly sampling, 8 storm samples per year (2 per season) are collected at these sites.

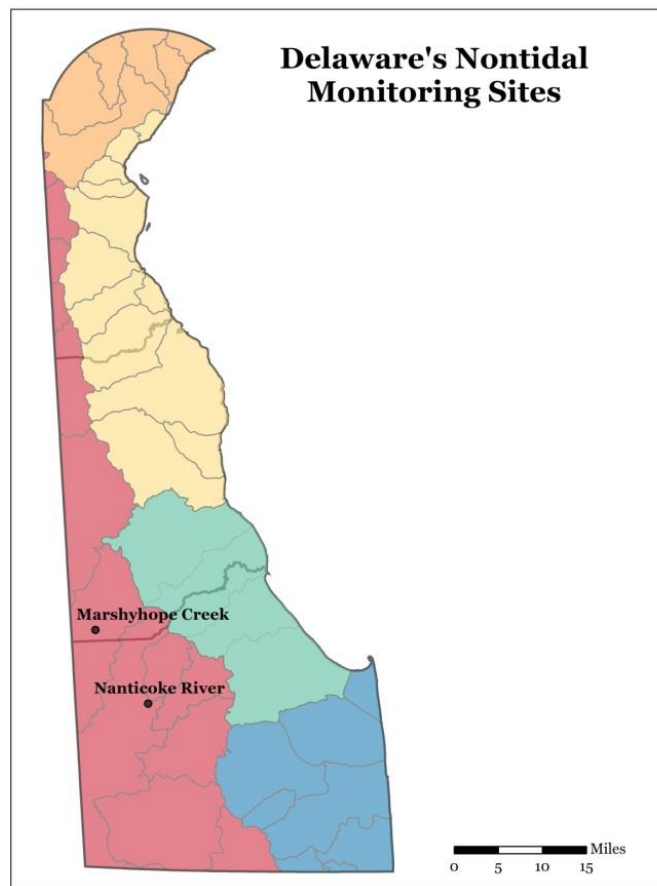


Figure 4 - Delaware's Non-tidal Monitoring Sites

Continuous Water Quality Monitoring

Delaware DNREC, in cooperation with the Delaware Geological Survey (DGS) and the United States Geological Survey (USGS), is maintaining a number of continuous Monitoring sites in the State. During FY 2022, six sites in Delaware are being monitored continuously. These sites include:

1. Brandywine Creek at Wilmington
2. Christina River at Newport
3. Appoquinimink River near Odessa
4. Millsboro Pond Outlet at Millsboro
5. Broadkill River near Milton
6. Massey Ditch at Massey Landing

Figure 5 shows the location of the above continuous monitoring sites. 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 (such as YSI sondes). All data are collected following USGS protocols and are stored in USGS National Water Information System (NWIS) databases, <http://waterdata.usgs.gov/de/nwis/current/?type=quality>

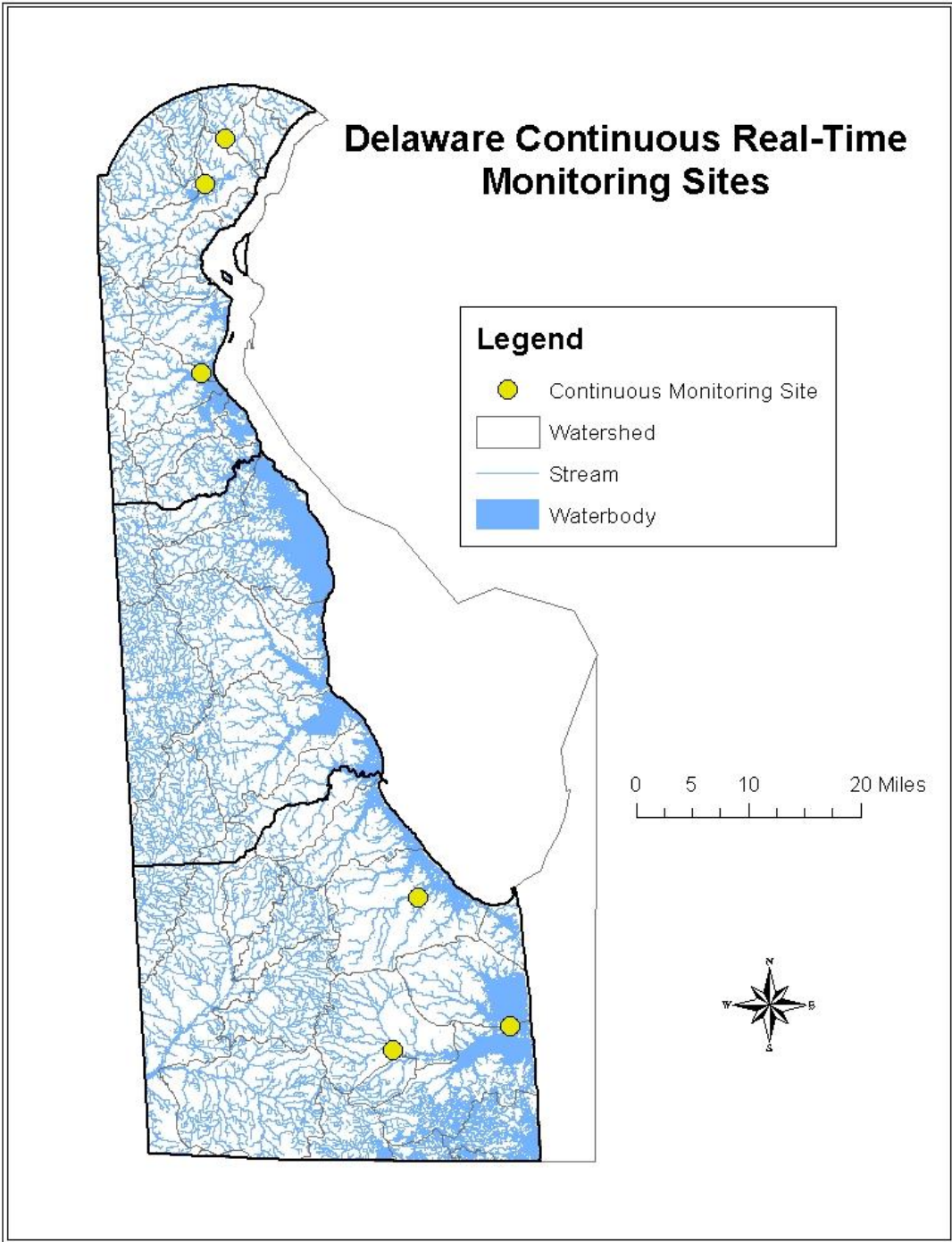


Figure 5 - Delaware's Continuous Monitoring Sites

Biological Assessment Monitoring

To assess habitat and biological integrity of Delaware's surface waters, Delaware DNREC conducts habitat and biological monitoring of its streams. Macroinvertebrate and habitat assessments are generally performed at perennial, non-tidal, wadable streams throughout the State of Delaware using a probabilistic design. Random sites are selected through the assistance by the Environmental Protection Agency (EPA) using an EMAP approach. Randomization of sites will allow for a statewide, unbiased probability-based estimate of stream conditions throughout the state. Data from this survey will be used for 305(b) analysis.

During FY 2022, Delaware DNREC is not conducting any new habitat/biological survey. Instead, it will review the results of surveys conducted over the past several years to evaluate the condition of habitat/biota and to identify any areas where data gap exist and where additional monitoring is needed. Future habitat/biological monitoring will be based on the findings of this data review and analysis.

Toxics in Biota Monitoring

The FY 2022 Toxics in Biota Monitoring program is being incorporated into the WATAR monitoring effort (see below).

Toxics in Sediment Monitoring

The FY 2022 Toxics in Sediment Monitoring program is being incorporated into the WATAR monitoring effort (see below).

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

In FY 2022, the WATAR team plans to focus its annual sampling efforts on fish tissue in the Christina Basin and Shellpot Creek. In addition, the team will attempt to collect fish tissue samples from Army Creek and the Appoquinimink River in FY 2022. Field sampling in FY 2021 was severely restricted due to COVID-19, and planned sampling was not able to be conducted. The data collected will inform/extend fish tissue trend assessments that were compiled and submitted to USEPA in 2018. The data will also be used to update fish advisories for the areas sampled. Additional surface water and/or sediment sampling will also be conducted in support of potential TMDL development for DxF TEQs and DDT and metabolites in the Red Clay Creek. For more detailed information on planned activities and field work, please refer to the WATAR 5-year workplan for 2018-2022 [2 and 5].

Field and Laboratory Procedures

Field procedures for sample collection activities are detailed in DNREC's Environmental Laboratory Services Quality Manual [3]. Method references, STORET codes and reporting levels for parameters listed in Table 2 are provided by the DNREC's Environmental Laboratory Section. 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 Project Plan prepared by the Watershed Assessment and Management Section, Division of Watershed Stewardship [4].

A duplicate water column sample will be collected and analyzed on 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 Environmental Laboratory Section's data report forms).

Table 1 - Station Locations, Descriptions, Parameters, and Sampling Frequency

BASIN	PROJECT	SITE DESCRIPTION	STORET	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Parameters
PIEDMONT	North Piedmont	Little Mill Creek @ DuPont Rd.	106281	C2	6			X	X
		Christina River near Conrail Bridge	106291	C1	12			X	X
		Brandywine Creek @ Foot Bridge in Brandywine Park	104011	C2	6			X	X
		Brandywine Creek @ New Bridge Rd. (Rd. 279)	104021	C1	12			X	X
		Red Clay Creek @ Lancaster Pike (Rt. 48)	103031	C1	12			X	X
		Red Clay Creek @ Barley Mill Rd. (Rd. 258A)	103041	C2	6			X	X
		Burroughs Run @ Creek Rd. (Rt. 82)	103061	C2	6			X	X
		Brandywine Creek @ Smith Bridge Rd. (Rd. 221)	104051	C2	6			X	X
		Christina River beneath Rt. 141 Bridge	106021	C2	6			X	X
		Red Clay Creek @ W. Newport Pike (Rt. 4)	103011	C2	6			X	X
		White Clay Creek @ Delaware Park Blvd.	105151	C1	12			X	X
		White Clay Creek @ McKees Lane	105171	C2	6			X	X
		Christina River @ Nottingham Rd. (Rt. 273)	106191	C2	6			X	X
		White Clay Creek @ Chambers Rock Rd. (Rd. 329)	105031	C2	6			X	X
		Christina River @ Sunset Lake Rd. (Rt. 72)	106141	C1	12			X	X
		Smalleys Dam Spillway @ Smalleys Dam Rd.	106031	C2	6			X	X
	Northeast Piedmont	Naaman Creek S. Branch @ Darley Rd. (Rd. 207)	101031	C2	6				
		Naaman Creek @ State Line near Hickman Rd.	101021	C2	6				
		Naaman Creek South Branch @ Marsh Rd. (Rt. 3)	101061	C2	6				
		Shellpot Creek @ Carr Rd.	102081	C2	6				
Shellpot Creek @ Market St. (Rt. 13 Bus.)		102051	C1	12					
Shellpot Creek @ Hay Rd. (Rd. 501)		102041	C2	6		X			
		Army Creek @ S. DuPont Hgwy. (Rt. 13)	114021	C2	12				

BASIN	PROJECT	SITE DESCRIPTION	STORET	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Parameters
UPPER DELAWARE BAY	North Delaware Bay	Army Creek @ Rt. 13 near Rt. 40	114051	C2	12				
		Trib Army Crk. @ Rt. 13 near Airport Ind. Park	114041	C2	12				
		Army Creek @ River Rd. (Rt. 9)	114011	C2	12				
		Red Lion Creek @ Rt. 9	107031	C2	12				
		Dragon Creek @ Wrangle Hill Rd. (Rt. 9)	111011	C2	12				
		C & D Canal @ DuPont Pkwy. (Rt. 13) N. side	108021	C2	12				
		Dragon Creek @ S. DuPont Hwy. (Rt. 13)	111031	C2	12				
		Red Lion Creek @ Bear Corbitt Rd. (Rt. 7)	107011	C2	12				
		Lums Pond @ Boat Ramp	108111	C2	12				
	Appoquinimink River	Drawyer Creek off Rt. 13 @ parking area	109071	C2	12			X	X
		Shallcross Lake @ Shallcross Lake Rd. (Rd. 420)	109191	C2	12			X	X
		Deep Creek Branch @ Summit Bridge Rd. (Rt. 71)	109251	C1	12			X	X
		Noxontown Pond @ Noxontown Rd. (Rd. 38)	109131	C2	12			X	X
		Appoquinimink River @ DuPont Pkwy. (Rt. 13)	109041	C2	12			X	X
		Appoquinimink River @ MOT Gut (west bank)	109171	C2	12			X	X
		Appoquinimink River @ Silver Run Rd. (Rt. 9) NE	109121	C2	12			X	X
		Appoquinimink River @ Mouth	109091	C1	12			X	X
	Delaware Bay Drainage	Little River @ Bayside Dr. (Rt. 9)	204031	C2	12				
		Little River @ N. Little Creek Rd. (Rt. 8)	204041	C2	12				
		Leipsic River @ Denny St. (Rt. 9)	202031	C2	12				
		Smyrna River @ Flemings Landing (Rt. 9)	201041	C2	12				
		Blackbird Creek @ Taylors Bridge Rd. (Rt. 9)	110041	C2	12				
		Blackbird Creek @ Blackbird Station Rd. (Rd. 463)	110011	C1	12				
		Blackbird Creek @ Blackbird Landing Rd. (Rd. 455)	110031	C2	12				
		Duck Creek @ Smyrna Landing Rd. (Rd. 485)	201051	C2	12				
		Mill Creek (Lake Como outfall) @ Rt. 13	201011	C2	12				
		Providence Creek @ Duck Creek Rd. (Rt. 15)	201161	C2	12				
		Mill Creek @ Carter Rd. (Rd. 137)	201021	C2	12				

BASIN	PROJECT	SITE DESCRIPTION	STORET	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Parameters
		Garrisons Lake @ DuPont Hwy. (Rt. 13)	202021	C2	12				
		Leipscic River @ Mt. Friendship Rd. (Rt. 15)	202201	C2	12				
		St. Jones River @ mouth, Bowers Beach	205011	C1	12				
	St. Jones River	St. Jones River @ Barkers Landing	205041	C2	12				
		St. Jones River @ East Lebanon Rd. (Rt. 10)	205091	C2	12				
		Derby Pond @ Boat Ramp (Rt. 13A)	205211	C2	12				
		Moores Lake @ S. State St. (Rd. 27)	205181	C2	12				
		Fork Branch @ State College Rd. (Rd. 69)	205151	C2	12				
		Silver Lake @ Spillway (Dover City Park)	205201	C2	12				
LOWER DELAWARE BAY	Murderkill River	Murderkill River @ Rt. 13	206011	C1	12			X	X
		Browns Branch @ Milford-Harrington Hwy. (Rt. 14)	206041	C2	6			X	X
		McColley Pond @ Canterbury Rd. (Rt. 15)	206361	C2	6			X	X
		Coursey Pond @ Canterbury Rd. (Rt. 15)	206451	C2	6			X	X
		Double Run @ Barratts Chapel Rd. (Rd. 371)	206561	C2	6			X	X
		Murderkill River @ Bowers Beach Wharf (mouth)	206101	C1	12			X	
		Murderkill River near levee @ MNWA (RM 3.25)	206141	C2	6			X	X
		Murderkill Rv. @ confl. of KCWWTF discharge ditch	206231	C2	6			X	X
		Murderkill River @ Bay Rd. (Rt. 1/113)	206091	C2	6			X	X
	South Delaware Bay	Beaverdam Branch @ Deep Grass Ln. (Rd. 384)	208231	C1	12				
		Abbotts Pond @ Abbots Pond Rd. (Rd. 620)	208181	C2	6				
		Silver Lake @ Maple Ave.	208211	C2	6				
		Mispillion River @ Rt. 1	208021	C2	6				
		Mispillion River @ Cedar Creek confluence	208061	C1	12				
		Cedar Creek @ Cedar Beach Rd. (Rt. 36)	301091	C2	6				
		Cedar Creek @ Coastal Hwy. (Rt. 1)	301031	C2	6				
		Swiggetts Pond @ Cedar Creek Rd. (Rt. 30)	301021	C2	6				
	Broadkill River	Savannah Ditch @ Savannah Drive (Rd. 246)	303011	C2	6				
		Ingram Branch @ Gravel Hill Rd. (Rd. 248)	303021	C2	6				

BASIN	PROJECT	SITE DESCRIPTION	STORET	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Parameters
		Beaverdam Creek @ Carpenter Rd. (Rd. 259)	303181	C2	6				
		Beaverdam Creek @ Cave Neck Rd. (Rd. 88)	303171	C2	6				
		Round Pole Branch @ Cave Neck Rd. (Rd. 88)	303311	C2	6				
		Broadkill River @ Union St (Rt. 5)	303031	C2	6				
		Pemberton Branch @ Gravel Hill Rd. (Rt. 30)	303341	C2	6				
		Red Mill Pond @ Rt. 1	303051	C2	6				
		Broadkill River 0.10 Miles From Mouth	303061	C1	12				
		Broadkill River @ Rt. 1 Bridge	303041	C2	6				
		Waples Pond @ Rt. 1	303331	C2	6				
INLAND BAYS	Inland Bays w/ Pocomoke & Delaware Bay	Indian River Inlet @ Coast Guard Station	306321	C1	12	X		X	
		Little Assawoman Bay Mid-Bay (Ocean Park Lane)	310071	C2	12	X		X	
		Little Assawoman Bay @ Rt. 54 (The Ditch)	310011	C2	12	X		X	
		Dirickson Creek @ Old Mill Bridge Rd. (Rd. 381)	310031	C2	12	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	12	X		X	X
		White Creek @ mouth of Assawoman Canal	312011	C2	12	X		X	
		Bundicks Branch @ Rt. 23	308371	C2	12	X		X	X
		Pocomoke River @ Bethel Rd. (Rd. 420)	313011	C2	12				
		Whartons Branch @ Rt. 20 (Dagsboro Rd.)	309041	C2	12	X		X	X
		Pepper Creek @ Rt. 26 (Main St.)	308091	C2	12	X		X	X
		Buntings Branch @ Rt. 54 (Polly Branch Rd.)	311041	C2	12	X		X	X
		Millsboro Pond @ Rt. 24	308071	C1	12	X		X	X
		Cow Bridge Branch @ Zoar Rd. (Rd. 48)	308281	C2	12	X		X	X
		Swan Creek @ Mount Joy Rd. (Rd. 297)	308341	C2	12	X		X	X
		Guinea Creek @ Banks Rd. (Rd. 298)	308051	C2	12	X		X	X
		Burton Pond @ Rt. 24	308031	C2	12	X		X	X
Indian River @ Buoy 49 (Swan Creek)	306181	C2	12	X		X			
Indian River @ Island Creek	306331	C2	12	X		X			

BASIN	PROJECT	SITE DESCRIPTION	STORET	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Parameters
		Island Creek upper third	306341	C2	12	X		X	
		Indian River Bay @ Buoy 20	306121	C1	12	X		X	
		Massey Ditch @ Buoy 17	306111	C2	12	X		X	
		Rehoboth Bay @ Buoy 7	306091	C2	12	X		X	
		Lewes & Rehoboth Canal @ Rt. 1	305011	C2	12	X		X	
		Lewes & Rehoboth Canal @ Rt. 9	305041	C2	12	X		X	
		Roosevelt Inlet, mouth	401011	C2	12				
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
		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
		Horse 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
	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				

BASIN	PROJECT	SITE DESCRIPTION	STORET	Category	Freq.	Arsenic (As)	Iron (Fe)	Copper, Lead and Zinc	BLM Parameters
Chesapeake Bay Nontidal	Chesapeake Bay Nontidal	White Marsh Br. @ Cedar Grove Church Rd. (Rd. 268)	207111	C2	6				
		Nanticoke River @ Rifle Range Rd. (Rd. 545)	304191	C1	12			X	X
	Chesapeake Bay Nontidal Storm	Marshyhope Creek @ Fishers Bridge Rd. (Rd. 258)	302031	C1	12			X	X
		Nanticoke River @ Rifle Range Rd. (Rd. 545)	304201	C1	8			X	X
		Marshyhope Creek @ Fishers Bridge Rd. (Rd. 258)	302031	C1	8			X	X
State-Wide Storm	State-Wide Storm	Shellpot Creek @ Market St. (Rt. 13 Bus.)	102051	C1	4				
		Brandywine Creek @ New Bridge Rd. (Rd. 279)	104021	C1	4			X	X
		Red Clay Creek @ Lancaster Pike (Rt. 48)	103031	C1	4			X	X
		White Clay Creek @ Delaware Park Blvd.	105151	C1	4			X	X
		Christina River @ Sunset Lake Rd. (Rt. 72)	106141	C1	4			X	X
		Deep Creek Branch @ Summit Bridge Rd. (Rt. 71)	109251	C1	4			X	X
		Blackbird Creek @ Blackbird Station Rd. (Rd. 463)	110011	C1	4				
		Murderkill River @ Rt. 13	206011	C1	4			X	X
		Millsboro Pond @ John Williams Hwy. (Rt. 24)	308071	C1	4	X		X	X
		Silver Lake @ Spillway (Dover City Park)	205201	C2	4				
		Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)	310121	C1	4				
		Beaverdam Branch @ Deep Grass Ln. (Rd. 384)	208231	C1	4				

Table 2 - Water Quality Parameters to be monitored at all stations - FY 2022

<i>Parameter</i>	<i>Method Reference¹</i>	<i>Reporting Level²</i>
<i>Water Column Nutrients</i>		
Ammonia Nitrogen	EPA 350.1, Rev. 2.0 (1993)	0.010 mg/l N
Nitrite+Nitrate Nitrogen	EPA 353.2, Rev. 2.0 (1993)	0.010 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)	0.005 mg/l P
Phosphorus, Total, Alkaline Persulfate	SM 4500-P J-2011	0.010 mg/l P
<i>Carbon and Organics</i>		
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
<i>Biochemical Oxygen Demand</i>		
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
<i>Field Measurements</i>		
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
<i>General</i>		
Alkalinity	SM 2320 B-2011	2.3 mg/l
Chloride	SM 4500-Cl ⁻ E-2011	3 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
<i>Bacteria</i>		
Enterococcus	Enterolert®	1 mpn/100 ml

- ¹ SM refers to Standard Methods.
- ² The Environmental Laboratory Section 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

<i>Dissolved Metals</i>	<i>Method Reference (EPA)</i>	<i>Reporting Level⁶</i>
Copper	EPA 200.8, Rev. 5.4 (1994)	1.0 ug/l
Lead	EPA 200.8, Rev. 5.4 (1994)	1.0 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)	1.0 ug/l

⁶High 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 Sampling for Copper (BLM Parameters)

<i>Dissolved Parameters</i>	<i>Method Reference (EPA)</i>	<i>Reporting Level</i>
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, Non-tidal Water Quality Monitoring. Annapolis, MD.
2. DNREC. 2017. Quality Assurance Project Plan - Collection and Analysis of Surface Water, Sediment and Fish Tissue Samples for Toxics in Delaware Watersheds that Flow to the Chesapeake Bay. Division of Watershed Stewardship, Delaware Department of Natural Resources and Environmental Control, Dover, DE.
3. DNREC. 2019. Quality Manual for DNREC Environmental Laboratory and Field Operations, Environmental Laboratory Section, Division of Water.
4. DNREC. 2019. Delaware Ambient Surface Water Quality Monitoring Program Quality Assurance Program Plan (QAPrP), Division of Watershed Stewardship, Watershed Assessment and Management Section.
5. DNREC. 2018. Watershed Approach to Toxics Assessment and Restoration 2018-2022. DNREC Division of Watershed Stewardship and Division of Waste and Hazardous Substances.