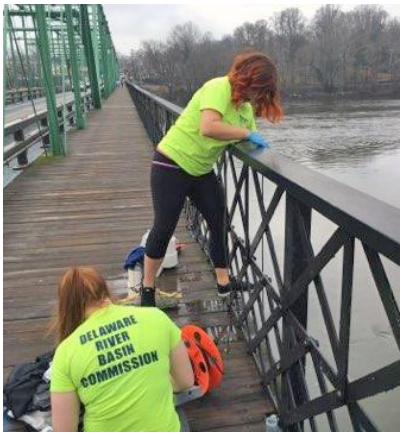
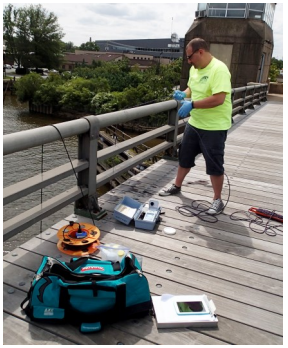
Water Quality Programs of the Delaware River Basin Commission





Delaware River Basin Commission

DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

Photos from top, left to right:

1. Former DRBC intern Vicki Trucksess (seated) and DRBC Water Resources Scientist Elaine Panuccio collect Delaware River samples at the Calhoun Street Bridge in Trenton, N.J. to be analyzed for nutrients. Photo by DRBC.
2. DRBC Sr. Geologist Bob Damiani collects a water sample from a Delaware River tidal tributary for nutrient analysis. Photo by DRBC.
3. (from left to right) Former DRBC Water Resource Planner Doug Rowland, former DRBC intern Andrew Garcia, and DRBC Water Resources Scientist Elaine Panuccio (underwater—snorkel) perform biomonitoring on the Delaware River. Photo by DRBC.
4. Retired DRBC Sr. Environmental Toxicologist Ron MacGillivray, Ph.D. (left), and retired Sr. Geologist Greg Cavallo, PG, collect a sediment sample from a tidal tributary to the Delaware River. Photo by DRBC.
5. Former DRBC interns Julia Ragazzo (left) and Megan Andreason (right) monitor the Delaware River from Kittatinny Visitor Center's beach near the Delaware Water Gap as part of DRBC's Scenic Rivers Monitoring Program. Photo by DRBC.
6. DRBC staff perform nutrient monitoring of the Delaware River from the Calhoun Street Bridge in Trenton, N.J. Photo by DRBC.
7. DRBC Sr. Water Resource Modeler Dr. Li Zheng (left) and Science & Water Quality Management Director Dr. Namsoo Suk collect surface water samples for nutrient analysis. Photo by DRBC.
8. DRBC Water Quality Assessment Manager John Yagecic, P.E. (front) and former DRBC intern Eric Wentz prep samples collected for radiochemistry analysis for the lab. Photo by DRBC.
9. DRBC Water Resources Scientist Elaine Panuccio holds the net used to collect macroinvertebrates (aquatic bugs) underwater during a biomonitoring sampling event on the Delaware River. Photo by DRBC.

Water Quality Programs of the Delaware River Basin Commission

Introduction

A Historical Perspective

Pollution in the Delaware River, particularly in the tidal reaches of its urban centers, began to be a recognized problem by the eighteenth century and continued to be a serious issue over the next 200 years. This was mostly due to rapid population growth and increased industrial activities, which used the river as an open sewer and dumping ground. Severe pollution was most evident by the prevalence of waterborne illnesses and in the sharp decline of migratory fish populations, such as the American shad and Atlantic sturgeon. Parts of the estuary were considered dead zones, almost or completely devoid of oxygen needed for the survival of aquatic life.

The 1937 *Philadelphia Record* editorial page cartoon depicts the time when the tidal Delaware was an open sewer, where pollution in some stretches robbed the river of all its oxygen needed to support fish and other aquatic life.

What Was Done?

In the late 1930s, these problematic conditions prompted the formation of the Interstate Commission on the Delaware River Basin, or INCODEL, by Delaware, New Jersey, New York and Pennsylvania. Cleaning up the severe water pollution in the Delaware Estuary was at the top of this advisory commission's priorities. The first set of interstate water quality standards was adopted through INCODEL, initiating the creation of new sewage treatment plants and also the completion of dredging the Schuylkill River and Delaware Estuary of coal silt, which was one of the nation's first non-point source pollution control programs.

Building on the experiences of INCODEL, the Delaware River Basin Commission (DRBC or Commission) was established in October 1961 when the Delaware River Basin Compact became law. The Commission was formed well before the 1970 creation of the Environmental Protection Agency, the 1972 passage of the federal law commonly known as the Clean Water Act, and the formation of many state environmental agencies. Like INCODEL, the Commission's members are the four basin states (Delaware, New Jersey, New York and Pennsylvania), but the DRBC includes a fifth representative, the federal government.

However, the DRBC is distinctly different than the advisory INCODEL, as it is a regional body with the force of law to manage the water resources of the Delaware River Basin without regard to political boundaries. The Compact's signing marked the first time that the federal government and a group of states joined as equal partners in a river basin planning, development and regulatory agency. The *ex officio* Commission members are the Basin state governors and the

Commander of the North Atlantic Division of the U.S. Army Corps of Engineers, who represents the federal government and all federal agencies.

(seated left to right) Governors Robert Meyner of New Jersey, Elbert Carvel of Delaware, and David Lawrence of Pennsylvania joined President John F. Kennedy at the White House on November 2, 1961, to participate in a ceremonial signing of the Delaware River Basin Compact.

The DRBC delved head-first into its water resources management role, initially focusing on cleaning up the tidal river's polluted waters. In 1967 it adopted comprehensive water quality standards, including bacterial standards for primary and secondary contact recreation (i.e., swimming and boating, respectively), and standards for dissolved oxygen. The standards were tied to an innovative waste load allocation program which factored in the waste assimilative capacity of the tidal Delaware River (the predecessor to today's "total maximum daily loads", or TMDLs). Regulations for implementing and enforcing the standards were also adopted.

The Clean Water Act of 1972 further assisted the implementation of water pollution control efforts in the basin by establishing technology-based and water quality-based standards and enforcement programs and creating the National Pollutant Discharge Elimination System (NPDES), which regulates point source discharges into surface waters via a permitting system. Funds for constructing municipal and wastewater treatment facilities were also provided by government partners. Later modifications to the Clean Water Act focused on the important issues of toxic pollutants and non-point source pollution.

> "Only the Delaware among the nation's river basins is moving into high gear in its program to combat water pollution."
>
> 1968—Stewart Udall, Secretary, U.S. Dept. of the Interior (1961–1969)

By the late 1980s, over one billion dollars had been spent on improving wastewater treatment facilities in the Delaware River Basin, which benefited communities along the river and strengthened fish populations. The DRBC began its Delaware Estuary Toxics Management Program in 1989 to develop methods to control the discharge of toxic pollution from wastewater treatment plants into the estuary. New rules were adopted in 1996 that added many toxic substances to what was originally regulated in wastewater treatment plant discharge. The DRBC's toxics criteria was most recently updated in 2010, and a revision to its water quality criteria for polychlorinated biphenyls (PCBs) was approved in December 2013.

In contrast to the conditions found in the more heavily developed estuary, monitoring demonstrated that water quality in the non-tidal Delaware was already better than standards. The DRBC in 1992 launched its Special Protection Waters (SPW) program, which set regulations in place to "keep the clean water clean" in the 121-mile stretch of the Delaware

River from Hancock, N.Y. to the Delaware Water Gap. In 2008, SPW designation was expanded to include the Lower Delaware Scenic and Recreational River, making the entire 197-mile non-tidal Delaware. This is believed to be the longest stretch of river in the nation with an anti-degradation policy program in place.

> "Water quality in the non-tidal portion of the Delaware River is perhaps the purest of all the large rivers in the mid-Atlantic and northeastern United States."
>
> 2012 – National Park Service, *Delaware River Basin Wild and Scenic River Values* (Sept. 2012)

How About Now?

Today, the clean-up of the Delaware is hailed as one of the world's top water quality improvement success stories. The river now supports year-round fish populations, as well as those returning to their natal waters to spawn. Bald eagles, which depend on fish as their primary food source, reside and nest throughout the basin from the river's headwaters to the bay. Pleasure craft marinas line waterfronts once visited only by commercial vessels, and river-based recreation is one of the region's top economic sources. Officially designated water trails exist for the non-tidal Delaware and a portion of the tidal river, as well as for the Lehigh and Schuylkill rivers, the two largest tributaries to the Delaware.

These improvements, as well as other DRBC accomplishments, over the past sixty years are rooted in the Delaware River Basin Compact's chief canon: that the waters and related resources of the basin are regional assets vested with local, state, and national interests that all share joint responsibility to maintain and protect. The DRBC stresses the importance of partnerships as a wise leveraging of public dollars and a way to work together towards this common goal.

However, this accomplishment does not mean that the work is over. While water quality is still in need of improvement in some sections of the river, it is better than standards in other stretches and needs to be maintained at these higher levels. As new technology enhances the DRBC's ability to detect, monitor, track and model pollution in the river, the Commission's policies, programs and abatement efforts must adapt and evolve in order to continually improve the Basin's water quality for future generations.

Learn more about the DRBC at https://www.nj.gov/drbc/about/.
Learn more about DRB water quality at https://www.nj.gov/drbc/programs/quality/.

The Foundations of DRBC's Water Quality Initiatives

Article 5 of the Delaware River Basin Compact defines the Commission's water quality mandates, which direct the DRBC to take the lead on water quality matters pertaining to the basin by adopting regulations:

> "…to control such future pollution and abate existing pollution, and to require such treatment of sewage, industrial or other waste within a time reasonable for the

construction of the necessary works, as may be required to protect the public health or to preserve the waters of the Basin for uses in accordance with the comprehensive plan." (Compact, §5.2)

The Commission's first Water Quality Regulations were adopted in March 1967 and are divided into two main sections: Article 3 - Water Quality Standards for the Delaware River Basin and Article 4 - Application of Standards. Standards were created for main stem water quality zones and also for the Basin in its entirety. The regulations, which have been updated and revised periodically, are a part of the Commission's Water Code and are an important mechanism by which Commission members work together to manage the water resources of the Basin. Basin states can utilize these standards either directly or if they are more stringent than state standards.

The Compact also provides that no project having a substantial effect on the water resources of the Basin shall be undertaken unless it shall have been first submitted to and approved by the Commission (Compact, §3.8). The Commission reviews projects that withdraw from or discharge to the Basin's waters over certain thresholds. In accordance with Section 3.8 of the Compact, the Commission is required to approve a project whenever it finds and determines that the project would not substantially impair or conflict with the Comprehensive Plan, i.e., not adversely impact the water resources of the Basin. The Commission provides by regulation for the procedure of submission, review, public input and consideration of projects and for its determinations pursuant to Section 3.8.

Learn more about the DRBC's authorities, regulations and guidance at https://www.nj.gov/drbc/about/regulations/.

DRBC Tenets for Integrated Water Resources Management

There are several self-evident truths about integrated water management that the Commission adheres to when managing the Basin's water resources, including its water quality. First, water does not respect political boundaries and should be managed on a holistic, watershed basis that takes into account surface water and groundwater and also stormwater and wastewater. Second, what happens on the land affects the water and what happens upstream affects downstream users. Third, water management is collaborative; all levels of government, including federal, state, interstate and municipal, as well as local stakeholders, must be engaged in the process. And, lastly, water management must be adaptive to changing conditions, new science and technology and the changing of regional priorities.

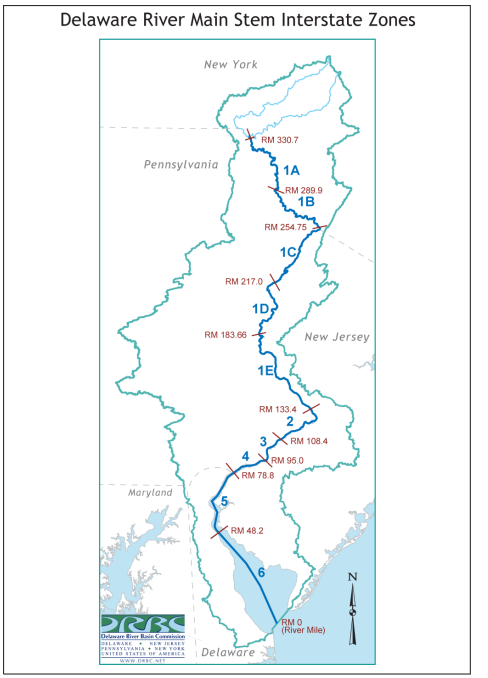
The Commission works with various federal, state and local agencies, non-profit organizations and other stakeholders. The Commission oversees various advisory committees and subcommittees that bring together all of these partners to share information on a variety of issues. Several, including the Monitoring Advisory and Coordination Committee, the Toxics Advisory Committee and the Water Quality Advisory Committee, focus specifically on addressing water quality topics. This coordination amongst its many varied stakeholders,

regardless of political boundaries or agendas, demonstrates the DRBC's ability to be a forum to address issues that affect the watershed as a whole.

The DRBC framework allows its five members to come together to jointly determine what is needed to best improve and protect the Basin's water resources and how to accomplish this in an integrated, non-duplicative and adaptive manner based on sound science. The nature of the DRBC's water quality management activities relies on this interstate coordination and cooperation. For instance, the agency maintains agreements with all four basin states regarding project review. Projects that lie within the Basin must comply with DRBC standards as well as state standards; whichever standard is stricter applies. All docket approvals and new or amended DRBC regulations are considered by the Commission after an open process that includes holding public hearings and inviting public comment. All Commission regulatory decisions are made at public meetings.

DRBC's Water Quality and Monitoring Programs: You Can't Manage What You Don't Measure

The Commission uses a multi-faceted strategy to water quality regulation that provides a rational approach to protecting and restoring water quality in the Basin. The waters of the Basin are protected for designated uses through established water quality criteria that specify what levels of individual parameters are appropriate to protect the uses for the different water quality zones of the river (see map on right). Criteria have been established to protect both human health and aquatic life. The DRBC's monitoring programs provide a mechanism to evaluate how those criteria are being met, and assessment of collected data provide the link to how well the designated uses are being protected.



In addition to monitoring to ensure compliance with established water quality standards, DRBC staff scientists monitor to maintain existing water quality in Special Protection Waters, where water quality is above standards. Monitoring is also undertaken to develop total maximum daily loads (TMDLs) and assimilative capacity determinations, to establish and calibrate water quality models, and to track the salt front for reservoir operations. Additionally, monitoring helps evaluate emerging threats to the water resources of the Delaware River Basin.

Every other year the DRBC compiles the Delaware River and Bay Water Quality Assessment Report for the U.S. EPA to assess the Delaware River and Bay's

support of various uses, such as aquatic life, drinking water, fish consumption and recreation, which are protected by the DRBC's Water Quality Regulations and the federal Clean Water Act. The next assessment report will be submitted to the U.S. EPA in 2024.

Learn more at https://www.nj.gov/drbc/programs/quality/.

Brief Summaries of DRBC Water Quality and Monitoring Programs

Special Protection Waters (SPW): Keeping the Clean Water Clean

The SPW program, initially adopted by the DRBC in 1992 and expanded in 1994 and 2008, is designed to prevent degradation in streams and rivers where existing water quality is better than the established water quality standards through stricter control of wastewater discharges and reporting requirements. Currently, the entire 197-mile non-tidal Delaware River from Hancock, N.Y. to Trenton, N.J. is considered Special Protection Waters, three-quarters of which is also included in the National Wild and Scenic Rivers System.

The shaded area in this map depicts the drainage area to SPW.

The program states that there will be no measurable change in existing water quality (EWQ) of SPW waters except towards natural conditions. This is accomplished by taking a watershed approach, looking at the drainage area of the designated waters and regulating both point and non-point source discharges. It allows new or expanded pollutant loadings as long as they do not measurably change the existing water quality and considers the cumulative impacts of these loadings, rather than just looking at them individually.

SPW regulations are unique in that they require monitoring to determine if measurable change is occurring at designated interstate and boundary control points where existing water quality has been defined. This monitoring program is conducted through an informal partnership between the National Park Service (NPS) and the DRBC called the Scenic Rivers Monitoring Program. Data collected are also used in computer models developed for priority tributaries, i.e. those that have a high number of existing discharges or are expected to have new growth and associated wastewater discharge needs. The models are used to predict possible changes to water quality and to establish discharge limits to prevent a measurable change.

The DRBC believes that these regulations establish an anti-degradation policy on the longest stretch of any river in the nation. Ensuring that the level of water quality in Special Protection Waters is not degrading over time is the ultimate goal of the program: to keep water quality

above existing standards, or, simply, to keep the clean water clean.

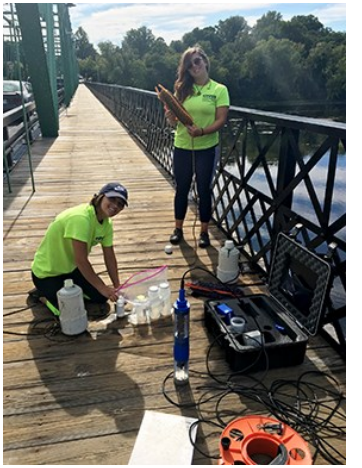
In 2016, the DRBC published the *Lower Delaware Water Quality Assessment*, which compared water quality data initially collected from 2000-2004 to the assessment period of 2009-2011. The report showed that for most water quality parameters at most locations, there were no measurable changes to EWQ in this 76-mile stretch of river from Portland, Pa. to Trenton, N.J. These results demonstrate that the DRBC's Special Protection Waters (SPW) program is working and plays an important role in managing water quality in the Delaware River Basin. A new reassessment period is underway (2023-2025).

Also in 2016, the DRBC released a technical document entitled *Existing Water Quality Atlas of the Delaware River Special Protection Waters*. This report compiles EWQ for 85 locations on the entire upper, middle and lower Delaware River SPW. The primary use of the Atlas will be to document site-specific water quality, allowing the Commission to monitor for measurable changes in the river and track SPW program effectiveness over time.

Learn more about SPW at https://www.nj.gov/drbc/programs/quality/spw.html.
Learn more about the Lower Delaware Water Quality Assessment at https://www.nj.gov/drbc/programs/quality/lower-delaware_EWQassessment2016.html.
Learn more about the SPW Water Quality Atlas at https://www.nj.gov/drbc/programs/quality/spw_ewq-atlas.html.

DRBC/NPS Special Protection Waters Monitoring

The DRBC and NPS partner in this effort to monitor and manage the water quality in the Special Protection Waters and National Wild and Scenic River segments of the Upper Delaware Scenic and Recreational River (UPDE), the Delaware Water Gap National Recreation Area (DEWA) and the Lower Delaware Scenic and Recreational River (LDEL). All of these river segments are considered to have exceptionally high scenic, recreational, ecological and/or water supply values.



DRBC staff collects water samples from the Lower Delaware for the SPW Monitoring Program.

NPS staff leads the monitoring programs in UPDE and DEWA, while Commission staff is in charge of the LDEL program. The goals are to assess compliance with EWQ targets and to determine whether EWQ is currently being maintained in SPW. Every three-five years, throughout the 197-mile non-tidal river, close to 60 sites are sampled between May and September and analyzed for nutrients, dissolved oxygen and other conventional pollutants, solids and bacteria. Samples are taken from the mainstem river and also at tributary confluences and are analyzed by academic institutions or state laboratories.

Learn more at https://www.nj.gov/drbc/programs/quality/spw.html.

DRBC Biological Monitoring Program

DRBC staff collects a macroinvertebrate sample as part of the DRBC's biomonitoring program.

The DRBC's biomonitoring program began in 2001 and includes the development and implementation of methodologies for assessing ecosystem health and biological water quality criteria to support evaluation of water quality in the non-tidal Delaware River. Every three-five years, typically during August and September, Commission staff collects samples at 25 riffle habitat sites from Hancock, N.Y. to just above the head of tide at Trenton, N.J. These sampling efforts include collection and identification of benthic macroinvertebrates (aquatic bugs); certain species are more sensitive to pollution and finding these are a good indicator of water quality. Benthic periphyton (alga) are also sampled and habitat characteristics are documented to provide a complete overview of the diversity and health of the aquatic life community.

The biomonitoring program also gathers information on other significant natural resources of the Delaware River Basin, such as fisheries, aquatic plants, mussels and invasive species (both aquatic and riparian plants and animals). In addition, staff supports the member states and the U.S. EPA in their regional biological monitoring surveys. Samples are analyzed by the Academy of Natural Sciences of Drexel University in Philadelphia, Pa.

Learn more at https://www.nj.gov/drbc/programs/quality/biomonitoring.html.

Special Project: Juvenile American Shad Monitoring

Volunteers sort and count the fish collected during the survey to determine the number of young-of-the-year American shad.

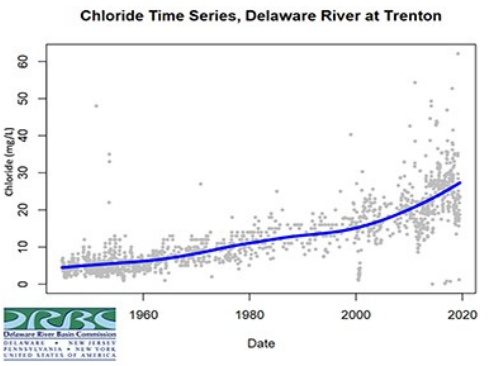
In addition to being active throughout the year sampling the Delaware River and analyzing data for its various water quality programs, the DRBC staff periodically assists with monitoring efforts led by partner agencies or Basin cooperatives. In this special project, the DRBC helps Basin state and federal fisheries biologists during the late summer and fall by providing manpower and expertise to count numbers of juvenile American shad in the non-tidal Delaware River. American shad, a member of the herring family, are anadromous fish, meaning they are born in fresh water, live for several years as adults in the ocean, and return to their natal waters (where they're born) to spawn (lay their eggs) in the spring. Juvenile American shad, called young-of-the-year (YOY), are those that are born in the spring and spend their first summer in the river. As the water temperatures cool, they travel south to overwinter in the warmer waters of the Delaware Estuary and Bay before heading out to the Atlantic Ocean.

To help determine how well the fishery is doing each year, YOY shad numbers are monitored in the non-tidal Delaware at various locations as they travel downriver towards the estuary. The shad are collected by seining, using a large net to catch the fish in the river. Other fish species are also caught, and the fisheries team must then sort and identify which are YOY shad so their numbers can be recorded.

Learn more at https://www.nj.gov/drbc/basin/living/american-shad.html

Special Study: Monitoring Chlorides in the Non-Tidal Delaware River Basin

Elevated chloride concentrations are a concern in the non-tidal Delaware River, which is protected under DRBC's Special Protection Waters (SPW) regulations. Over the past several years, instream monitoring of the non-tidal river has shown an upward trend in chloride concentrations. While concentrations are still below criteria for drinking water and aquatic life use, the DRBC is watching this trend closely.



From 2021-2023, the DRBC completed a study to monitor chlorides and TDS concentrations in the non-tidal Delaware River Basin. A mix of mainstem and tributary locations were chosen, for a total of 27 sites. Data were collected by continuous data loggers and also by staff at monthly site visits. The second phase of this project will include a track-down to identify areas of concern and a public outreach and education campaign.

Learn more at https://www.nj.gov/drbc/programs/quality/chlorides-monitoring.html

Special Projects: Lower Delaware River Mussel Studies

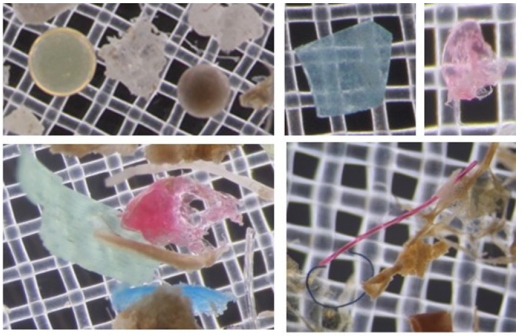
In the summer of 2013, to help fill the gap in understanding freshwater mussel occurrence and species distribution, the DRBC and the USGS partnered to conduct mussel surveys of the non-tidal lower Delaware River. The surveys began near the Portland-Columbia footbridge (river mile 208) and extended 75 miles downstream to the head of tide at Trenton, N.J. A final report was completed for the National Park Service in 2014.

In September 2019, the DRBC installed 24 mussel cages in the lower Delaware River across six locations, three upstream of the Lehigh River and three downstream of the Lehigh. Mussels were provided by the Partnership for the Delaware Estuary. The objectives of this pilot study were to 1) quantify growth and survival of freshwater mussels upstream and downstream of the Lehigh River and 2) evaluate the feasibility of installing mussel cages in a large, rocky river.

Learn more at https://www.nj.gov/drbc/basin/living/freshwater-mussels.html

Special Project: Microplastics Study

Plastic is perhaps the most prevalent type of debris found in our oceans, rivers and large lakes. Plastic debris comes in all shapes and sizes, but those that are less than five millimeters in length (or about the size of a sesame seed) are called "microplastics." These tiny particles easily pass through water filtration systems and end up in receiving waters. Over time, larger plastics degrade into microplastics, but microplastics also include manufactured items such as microbeads, synthetic microfibers and resin pellets.



As seen under the microscope: microplastics collected from the Delaware Bay by University of Delaware researchers. Photo courtesy of the University of Delaware.

Not much is known to date about microplastics and their impacts on human health and aquatic life. To date, a few microplastics studies have been conducted in the Delaware River Basin. Understanding the inputs of microplastics is a vital first step towards understanding the prevalence and potential problems posed by this contaminant.

In 2018, the DRBC received a grant from the Delaware Watershed Conservation Fund to monitor for microplastics and model loadings of microplastics in the upper Delaware River Estuary—from Trenton, N.J. to the C&D Canal. This reach of river is largely urbanized and is likely a major contributor to microplastics found in the estuary and bay.

A total of 15 sites (five mainstem river and 10 tributary sites) were sampled in spring and fall 2019, with additional samples collected in 2020 and 2021. Samples were collected via net, grab sample or Niskin sampler. Microplastics were found in each sample.

This project helped provide a better understanding of the type, concentration and distribution of microplastics in the upper Delaware River Estuary, laying the groundwork for future microplastics monitoring and cleanup efforts in the Basin and beyond.

Learn more at https://www.nj.gov/drbc/programs/quality/microplastics.html

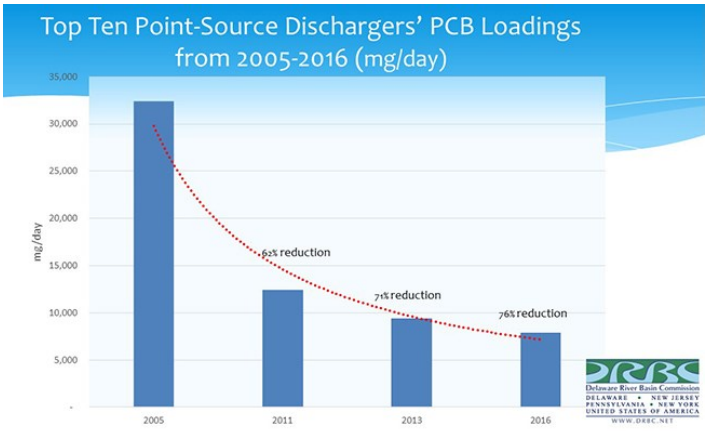
Monitoring for PCBs & Pollutant Minimization Plans

Polychlorinated biphenyls (PCBs) are a class of carcinogenic chemicals present in the waters of the Delaware Estuary at concentrations up to 1,000 times higher than the water quality criteria. Widely used in transformers, capacitors and other electrical equipment, the U.S. banned the manufacture of PCBs in 1976. Existing uses were permitted, however, and their chemical stability allows them to persist in the environment to this day. There are numerous sources of PCBs in the Delaware Estuary, which enter fish and other wildlife through absorption or ingestion and accumulate in their tissues at levels many times higher than in the surrounding water and sediment and at levels unsuitable for human consumption.

Because high levels of PCBs have resulted in state-issued fish consumption advisories for certain species caught in the Delaware Estuary, these waters were and continue to be listed as impaired, requiring the establishment of a PCB total maximum daily load (TMDL). A TMDL expresses the maximum amount of a pollutant that a water body can receive and still attain water quality standards.

At the request of the three estuary states and the U.S. EPA, the DRBC, working closely with its Toxics Advisory Committee and others, developed the technical basis for the Stage 1 PCB TMDLs for the Delaware Estuary (DRBC WQ Zones 2-6). The U.S. EPA established the Stage 1 PCB TMDLs for Zones 2-5 in 2003 and for Zone 6 in 2006. To support the implementation of the Stage 1 TMDLs, the DRBC monitors ambient waters, sediment and fish tissue to provide precise and defensible data on the PCB concentrations in the Delaware Estuary.

In addition to checking water, sediment, and fish for PCBs, the DRBC requires Pollution Minimization Plans (PMPs) to reduce or eliminate PCBs where they are known to exist. The PMP rule, adopted by the Commission in May 2005, establishes a non-numeric approach requiring the track down and reduction of point source and non-point source discharges of PCBs in the Delaware Estuary. The goal of this program is to work toward meeting water quality standards and to eliminate fish consumption advisories due to PCBs. PMPs require biennial PCB sampling and submission of an annual report summarizing PCB loading reduction efforts.



Recent reports show that the PMPs required by the DRBC are working. The top ten dischargers responsible for 90% of the point-source PCB loading have reduced their contributions 76% from 2005-2016. This improvement hopefully will be reflected as reduced amounts of PCBs found in fish tissue in future years.

In December 2013, the DRBC approved a revision to its human health water quality criteria for protection from carcinogenic effects of PCBs in Zones 2 - 6 of the Delaware Estuary. With the DRBC's adoption of revised PCB criteria, it is anticipated that the U.S. EPA will establish new TMDLs (Stage 2 TMDLs) corresponding to the updated criteria.

Learn more about PCBs and PMPs at https://www.nj.gov/drbc/programs/quality/pcb.html

Assessment of Metals in Estuarine Waters

The DRBC monitors metals, such as copper, zinc, nickel, chromium (VI) and mercury, in ambient water, sediment and tissues of aquatic life of the Delaware Estuary to ensure compliance with water quality criteria.

DRBC coordination with basin states and agencies is ongoing to ensure the use of the most appropriate methods and procedures for the conduct of monitoring studies in the Basin and to ensure the harmonization of water quality criteria and assessment methodologies for metals.

Learn more at https://www.nj.gov/drbc/programs/quality/monitoring-metals.html

DRBC staff collects a filtered sample during a July 2012 special copper survey in the Delaware Estuary.

Monitoring Toxicity in the Delaware Estuary

Monitoring toxicity is an essential component of programs designed to protect water quality and assess compliance with regulatory standards. Based on the DRBC's water quality regulations for the estuary to protect against short-term (i.e. acute) and long-term (i.e. chronic) effects on aquatic life from toxic pollutants, no adverse effects should be observed in toxicity tests with undiluted ambient water. As part of ongoing programs to control toxic substances in the Delaware Estuary, the DRBC conducts periodic monitoring of ambient water toxicity in the estuary and has requested monitoring of whole effluent toxicity by dischargers.

Learn more: https://www.nj.gov/drbc/programs/quality/ambient-tox.html

Special Study: Monitoring Bacteria in the Delaware Estuary around Philadelphia & Camden

Scientists monitor levels of fecal coliform, enterococcus and total coliform in surface water to see if harmful bacteria are present. Elevated concentrations can make humans sick if they come into contact with it.

The DRBC has adopted criteria for bacteria that is protective of recreation, which is one of the river's designated uses. In almost the entire mainstem river, the recreation designated use is primary, meaning the water is safe for close-contact water activities—e.g., swimming. Around Philadelphia and Camden, the designated use is secondary contact recreation—e.g., fishing and boating, activities where you wouldn't be immersed in the water.

In 2019, the DRBC initiated a multi-year study to see if bacteria levels around Philadelphia and Camden actually meet the stricter criteria for primary-contact recreation. The monitoring results indicate that water quality in this stretch of urban river does not meet the criteria for primary contact recreation. However, some sites could be closer to attaining criteria than others. Next steps, including additional monitoring, are underway.

Learn more: https://www.nj.gov/drbc/programs/quality/bacteria.html

Delaware Estuary Water Quality Monitoring Program

Initiated in 1967, *the Delaware Estuary Water Quality Monitoring Program is one of the longest running monitoring programs in the world.* Each year, the DRBC contracts with the Delaware Dept. of Natural Resources and Environmental Control to collect surface water samples in the center channel of the Delaware Estuary, from the head of tide at Trenton, N.J. to the mouth of the Delaware Bay. Samples are collected from March—October at 22 stations to manage water quality and ensure that criteria are being met. The goals of the program are to provide accurate, precise and defensible estimates of the surface water quality of the Delaware Estuary and to allow assessment of water quality criteria compliance. Sample analysis includes routine and bacterial parameters, nutrients, dissolved oxygen, heavy metals, chlorophyll-a, dissolved silica, emerging contaminants and volatile organics.

Bacterial sampling results are posted on the Commission's web site, and the other data are inputted into U.S. EPA's water quality portal, which is available to the public.

Learn more at https://www.nj.gov/drbc/programs/quality/boat-run.html

Contaminants of Emerging Concern

Contaminants of emerging concern (CECs) are chemicals present in substances or products used by humans that have been detected in surface waters and groundwater, potentially impacting water quality, aquatic species and drinking water sources.

DRBC's Dr. Ron MacGillivray collects surface water samples to analyze for PFCs, a contaminant of emerging concern.

CECs have been found to persist in the environment and have been detected in people and other living organisms. Many of these compounds are currently unregulated and not routinely monitored. Examples include PFAS (PFOA, PFOS), 1,4-Dioxane, brominated flame retardants (PBDEs), 6-PPDq, nanoparticles and pharmaceuticals and personal care products (PPCPs).

Although most of these compounds have been detected in surface waters at very low concentrations, there is concern about how CECs may impact drinking water and the river's ecology.

A number of efforts have been undertaken within the Delaware River Basin to identify, understand and prioritize CECs, including a three-year effort by the DRBC to investigate the presence and concentration of PPCPs, PFASs and PBDEs in the ambient waters of the tidal Delaware River. The Commission has an ongoing monitoring program for PFAS/PFC in the main stem Delaware River, examining surface water, fish tissue and sediment.

Learn more at https://www.nj.gov/drbc/programs/quality/cecs.html

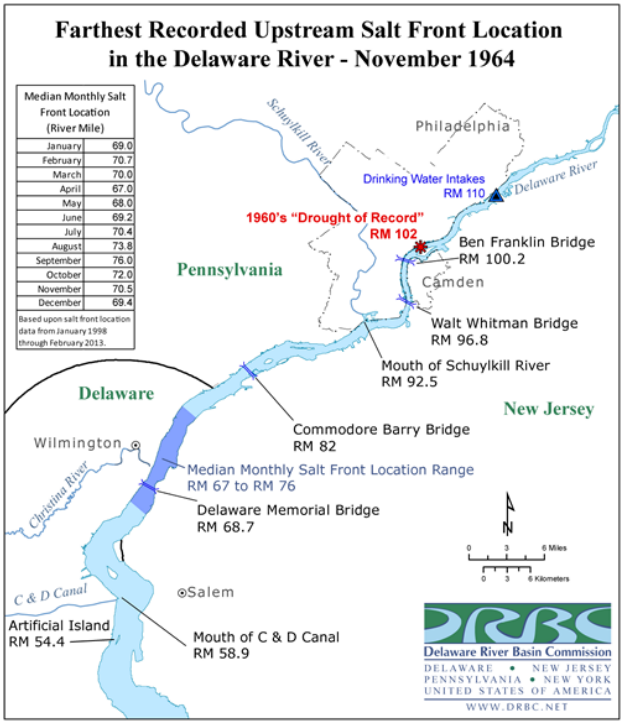
Fish Tissue Monitoring

Since 1990, the DRBC has periodically sampled tissues of resident fish species in the non-tidal and tidal portions of the main stem Delaware River. In the non-tidal portion, samples of smallmouth bass and white sucker are collected at four locations: Narrowsburg, N.Y. (river mile [RM] 290), Milford, Pa. (RM 246), Easton, Pa. (RM 183) and Lambertville, NJ (RM 149). In the tidal portion of the river, samples of channel catfish and white perch are collected at five locations: Crosswicks Creek (RM 128), Tacony-Palmyra Bridge (RM 107), Woodbury Creek (RM 91), Raccoon Creek (RM 80) and Salem River (RM 58). The samples are analyzed for PCBs, chlorinated pesticides, dioxins/furans, flame retardants, perfluorinated chemicals, mercury and other metals. These data are used to track the progress of the PCB TMDLs that were established by the U.S. EPA in 2003 and to identify chemical compounds that may pose a risk to human health through fish consumption. These data are also forwarded to state agencies for their use in establishing fish consumption advisories for fish caught in the Delaware River.

Learn more at https://www.nj.gov/drbc/programs/quality/fish-tissue.html

Monitoring the Salt Front

The DRBC has adopted criteria and monitors chlorides to ensure water quality remains suitable as a source of drinking water and protective of aquatic life. Additionally, the Commission's flow and drought management program focuses on controlling the upstream migration of salty water from the Delaware Bay during low-flow conditions. In addition to impacting treatment costs for public water suppliers, salty water increases corrosion control costs for other surface water users, for example, industry.



One important metric that is monitored is the seven-day average location of the salt front, the 250 mg/L chloride concentration based on drinking water quality standards. The salt front's location fluctuates in the Delaware River Estuary as streamflows increase or decrease in response to changing inflows, which either dilute or concentrate chlorides in the river.

Learn more at https://www.nj.gov/drbc/programs/quality/chlorides-monitoring.html

DRBC Modeling Efforts

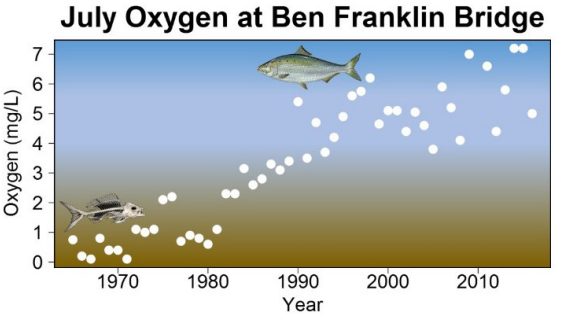
The DRBC develops and applies various models for Basin waters. Examples of models created and utilized by the DRBC staff include the following:

- A real-time flow and transport model, which is run nightly and tracks the movement of water in the tidal Delaware River. If a spill occurs, the most recent model run can be used along with a water quality model to predict where the pollutant will go and what the concentrations will be. This is especially important to protect drinking water intakes in the tidal Delaware River;
- Models to determine mixing zones for total dissolved solids, toxic pollutants and heat dissipation areas for regulated discharges;
- Assimilative capacity determinations for a water quality parameter of concern;
- TMDL development to support Basin states and the U.S. EPA; and
- No Measurable Change evaluations for dischargers in Special Protection Waters.
- Three-dimensional hydrodynamic model to evaluate the effects of sea level rise on salinity in the Delaware River Estuary.

Learn more at https://www.nj.gov/drbc/programs/quality/models.html

Dissolved Oxygen in the Delaware Estuary: Aquatic Life Designated Use Study

Most forms of aquatic life need dissolved oxygen (DO) to respire or "breathe," and it is important to maintain adequate levels for both migrating and native fish species, juveniles and adults. Oxygen enters water both by direct absorption from the atmosphere and as a by-product of photosynthesis by algae and aquatic plants.



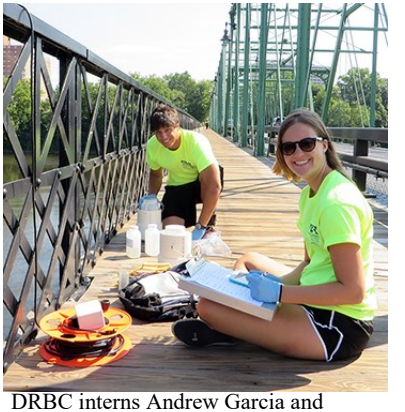
This graphic depicts how dissolved oxygen levels in the Delaware River at the Ben Franklin Bridge have improved dramatically since the late 1960s.

Warmer water generally contains less oxygen than colder water, so the amount of DO naturally varies seasonally and daily as water and air temperatures change. Salinity also affects DO; saltier water carries less oxygen than fresh water. Other things that can decrease the amount of dissolved oxygen in water include wastewater discharges (esp. ammonia), decaying leaves and algae, some chemical compounds and nutrient levels.

Although the worst of the dissolved oxygen problems have been addressed by the Commission over the past 50 years, DO conditions in the Delaware Estuary remain a concern even today. Automatic monitors track dissolved oxygen levels at four locations, and

although current conditions regularly meet the criteria, there are still mid-summer sags in areas near the Ben Franklin Bridge and Chester, Pa.

In 2017, the Commission unanimously approved a resolution to formally initiate a multi-year, technical effort called the Aquatic Life Designated Use Study to examine whether current criteria for DO need to be revised to be better protective of fish reproduction and juvenile fish populations. The study's focus area is a 38-mile stretch of the Delaware River from roughly the Tacony-Palmyra Bridge in Phila. to Wilmington, Del.



DRBC interns Andrew Garcia and Megan Andreason collect water samples, which will be analyzed for nutrients.

The study included a robust monitoring program, the development of a hydrodymanic and eutrophication model and additional research and reporting on DO needs of sensitive fish species, costs to upgrade key wastewater treatment plants and the evaluation of factors—including socioeconomic—affecting the attainment of improved DO criteria.

The DRBC led this groundbreaking effort through a collaborative process informed by an Expert Panel of scientists and engineers and in close consultation with its Water Quality Advisory Committee, a group representing state and federal co-regulators, NGO's, academic institutions, municipal and industrial dischargers and water purveyors.

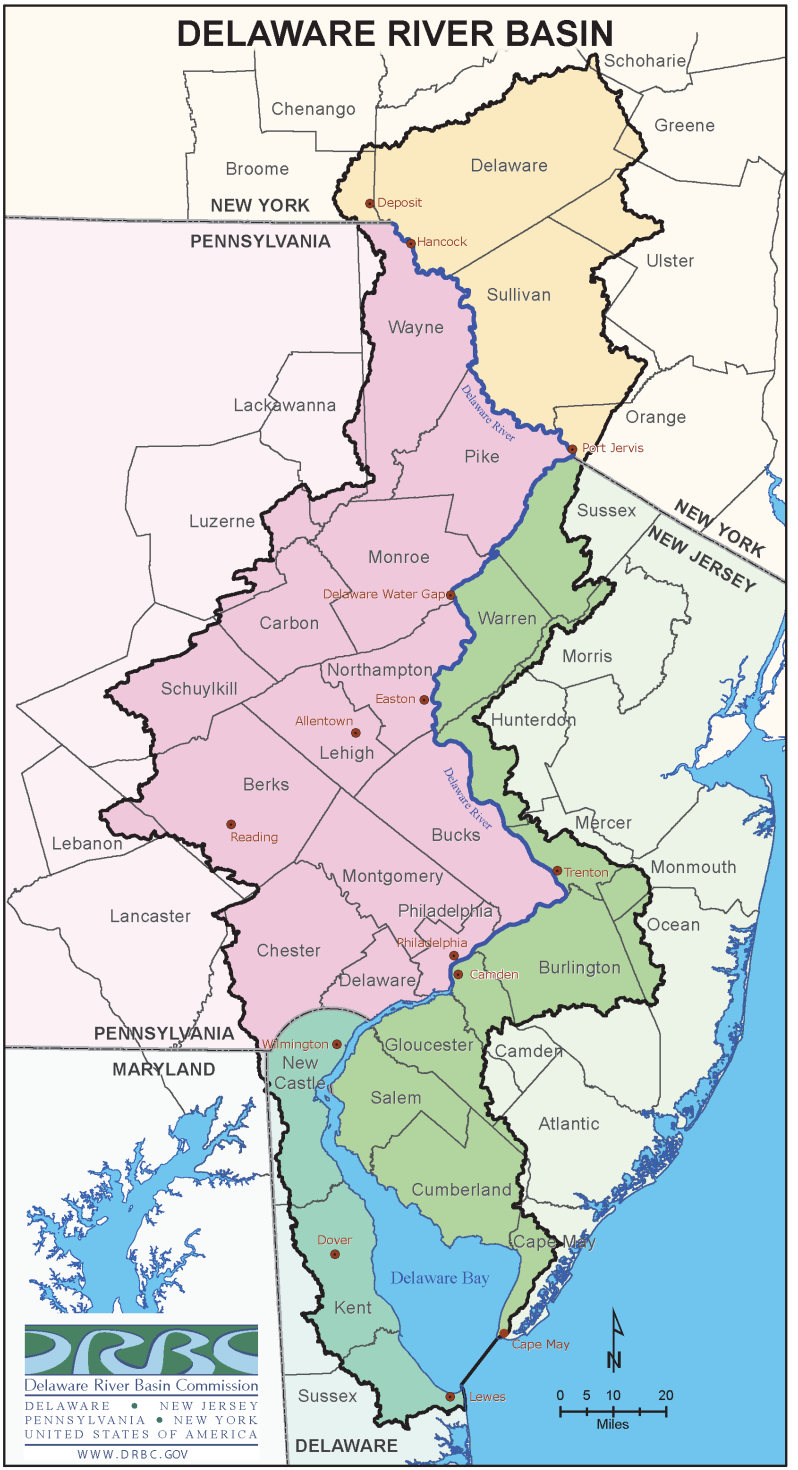
Work done by the DRBC to date supports the adoption of revised water quality criteria that protect fish propagation throughout the Estuary. The EPA is leading the rulemaking effort to update the criteria; the public comment period closed in February 2024.

The DRBC has been a part of the process leading up to EPA's rulemaking proposal and will continue to be involved, working with the EPA, our state environmental agencies and stakeholders to plan for the implementation of revised aquatic life use standards to improve water quality in the Delaware River Estuary.

The DRBC also is interested in how lower DO levels are connected to elevated nutrient levels (and the sources of those nutrients) in the Delaware Estuary; how DO varies at different depths (i.e., stratification) in the Delaware Estuary; and how climate change impacts of increasing temperature and sea level rise will affect estuary DO levels.

Learn more about the DRBC's Aquatic Life Designated Use Study: https://www.nj.gov/drbc/programs/quality/designated-use.html

Learn more about Dissolved Oxygen & Nutrients: https://www.nj.gov/drbc/programs/quality/DO_nutrients.html


DELAWARE RIVER BASIN
Schoharie
Chenango
Greene
Broome
Delaware
NEW YORK
Deposit
PENNSYLVANIA
Hancock
Ulster
Sullivan
Wayne
Lackawanna
Delaware River
Orange
Pike
Port Jervis
Luzerne
Sussex
NEW YORK
NEW JERSEY
Monroe
Delaware Water Gap
Carbon
Warren
Morris
Northampton
Schuylkill
Easton
Allentown
Hunterdon
Lehigh
Berks
Delaware River
Mercer
Reading
Bucks
Lebanon
Monmouth
Trenton
Montgomery
Philadelphia
Ocean
Lancaster
Philadelphia
Chester
Camden
Burlington
Delaware
PENNSYLVANIA
Wilmington
Gloucester
Camden
MARYLAND
New Castle
Salem
Atlantic
Cumberland
Dover
Cape May
Delaware Bay
Kent
Cape May
N
Sussex
Lewes
0 5 10 20
Miles
DELAWARE
Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA
WWW.DRBC.GOV

Managing, Protecting & Improving the Basin's Water Resources Since 1961

Delaware River Basin Commission
P.O. Box 7360
West Trenton, NJ 08628-0360
(609) 883-9500: office
(609) 883-9522: fax
www.drbc.gov

March 2024