



The State of the Ohio River 2023

A Report of the Ohio River Valley Water Sanitation Commission

A Message from the Executive Director

This year ORSANCO celebrates 75 years of dedication and partnership to improve the water quality in the Ohio River Basin, ensuring the Ohio River can be used for drinking, industrial supplies, recreational purposes, and can support a healthy and diverse aquatic habitat.



The Ohio River has made a remarkable recovery since ORSANCO's creation in 1948. There are certainly significant challenges that need to be addressed. However, as we celebrate ORSANCO's 75th anniversary, it is important to reflect upon the improvements achieved because of the passion and investment our staff, partners, and wonderful stakeholders have made towards improving the water quality of one of our region's most valuable resources.

ORSANCO's greatest strengths and successes can be attributed to its ability to collaborate and work efficiently with the Commission's numerous partners, committees, and stakeholders. ORSANCO is able to complete extensive water quality programs such as: comprehensive surface water quality characterization and assessment; spill monitoring and response, aquatic life and habitat monitoring and evaluation; bacterial determinations for contact recreation; and public information and educational outreach targeting underserved communities.

ORSANCO's collaboration with multiple state agencies, complex federal agencies across multiple regions, districts, divisions, water and wastewater utilities, industry, watershed organizations, local jurisdictions, and various other partners throughout the basin has been the key to facilitating significant improvement in the water quality of the Ohio River over the past 75 years.

ORSANCO has consistently delivered effective monitoring and assessment services through a variety of programs and continues to prioritize and manage resources to efficiently address the complex water quality needs of the Ohio River. This work helps to ensure the river continues to maintain its designated uses. ORSANCO's success relies heavily upon the resources and goodwill efforts of partners and collaborators. This has been demonstrated during significant emergency response efforts such as the East Palestine, Ohio train derailment chemical spill event earlier this year.

In the past 75 years, the river has undergone significant water quality improvements. However, there is more work to do and ORSANCO is ready. The sustained investment from our state, federal, utility, and other partners will continue to pay strong dividends to help ensure ORSANCO will be able to protect the Ohio River indefinitely. ORSANCO is very proud of the substantial progress we have experienced during this time. I am confident that ORSANCO will be uniquely positioned to address Ohio River challenges associated with bacteria, harmful algal blooms, legacy pollutants such as PCB's, dioxins, and mercury, as well as, emerging chemicals of concern such as PFAS chemicals in order to help ensure our future generations will be able to rely upon and enjoy this great river.

Sincerely,

A handwritten signature in blue ink, appearing to read "R. Harrison". The signature is fluid and cursive, written on a white background.

ORSANCO Executive Director
Richard Harrison

History of the Ohio River & ORSANCO

The Ohio River is one of the nation's great natural resources. The Ohio River not only provides drinking water for over five million people, but serves as a warm water habitat for aquatic life, provides numerous recreational opportunities, is used as a major transportation corridor, and is a source of water for the manufacturing and power industries.

Historic Pollution The Ohio River has played a critical role in the industrial growth of the United States by serving as a major transportation route and providing a plentiful source of water. An unfortunate side effect of this growth has been a significant pollution challenge. In 1924, states along the Ohio River reached agreements on the need to control the discharge of phenols from cooking operations which resulted in malodorous and bad tasting drinking water. In the 1930s, outbreaks of gastrointestinal illness occurred in cities that drew their drinking water from the Ohio River.

Formation of ORSANCO By 1934, the Cincinnati Chamber of Commerce recognized that the deplorable state of the Ohio River was unfavorable for economic growth and the effort to establish an interstate compact to control pollution in the river began. In 1948, legislatures of member states had approved the document and the formal signing of the Compact by Governors and appointment of Commissioners from the member states took place in Cincinnati on June 30th. The Ohio River Valley Water Sanitation Commission (ORSANCO) was created through the Compact to control and abate interstate water pollution in the Ohio River Basin. ORSANCO monitors and evaluates Ohio River water quality on behalf of its member states (Illinois, Indiana, Kentucky, Ohio, New York, Pennsylvania, Virginia, and West Virginia). ORSANCO helps facilitate the work of numerous stakeholders that include state and federal agencies, drinking water utilities, wastewater utilities, watershed organizations, industries, and other entities.

Predating the Clean Water Act by 24 years, ORSANCO's primary focus in its early stages was facilitating and championing the construction of sewage treatment plants. This allowed for the treatment of pollution that was directly discharged in the Ohio River Basin's waters. This situation essentially made the Ohio River largely an open sewer prior to ORSANCO's creation 75 years ago.

The Ohio River Today One of the most common questions people ask about the Ohio River is "How bad is the water?" Because of the industrial and agricultural nature of the Ohio River Valley, many people have the impression that the river suffers from poor water quality.

The Ohio River is one of the most diverse rivers in the country from an ecological perspective, and arguably one of the most resilient. Despite impacts from locks and dams, the river thrives; supporting over 160 species of fish and other wildlife. This includes a combination of prehistoric fish like Gar, Paddlefish, Bowfish, and Sturgeon, which are sensitive to pollution and very few rivers support these combined populations. Over the last 50 years, the Ohio River has seen a significant increase in species richness, including species sensitive to pollution such as Centrarchids (Sunfish, Bass, Crappie) and Catostomids (Suckers, Redhorse, Buffalo).

"The Ohio River is one of the most vibrant, resilient ecosystems in the country, as evidenced by its ability to support a rich assemblage of aquatic life, provide an abundant source of clean drinking water, and offer recreational opportunities, such as boating and fishing, for the surrounding communities, on top of serving as a major transportation corridor."

- Chris Lorentz, Professor of Biological Sciences
and Director of Biology Field Station,
Thomas More University

"We have seen remarkable improvements in the water quality of our Ohio River Basin interstate waters. ORSANCO's Compact remains as relevant today as it was when our member state governors entered into it 75 years ago. This is a testament to their incredible vision in forming ORSANCO."

- Richard Harrison,
ORSANCO Executive Director



Compact Signing June 30th, 1948

The Ohio River

The Ohio River flows approximately 981 miles, starting at the confluence of the Allegheny and the Monongahela Rivers in Pittsburgh, Pennsylvania, and ending in Cairo, Illinois, where it flows into the Mississippi River.

The Ohio River flows through or borders six states: Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia. The Ohio River drainage basin covers 205,000 square miles, encompassing parts of 15 states, and equals approximately 5 percent of the United States mainland.

The Ohio River received its English name from the Iroquois word, “O-Y-O” meaning “the great river.”

Today, the river serves as an important recreational, environmental, and cultural resource, as well as a critical route for commerce and industry.

The Ohio River and its tributaries run through diverse landscapes including; forests, agricultural and urban lands, and are home to over 160 species of fish, and over 100 species of mussels, including a number of threatened and endangered species. According to U.S. Army Corps of Engineers, there are an additional 625 species from other taxa within the 15 basin states that are federally listed as threatened or endangered.

The Ohio River Basin is home to more than 30 million people and the Ohio River is a primary source of drinking water for about 5 million people and serves as an abundant industrial water supply.

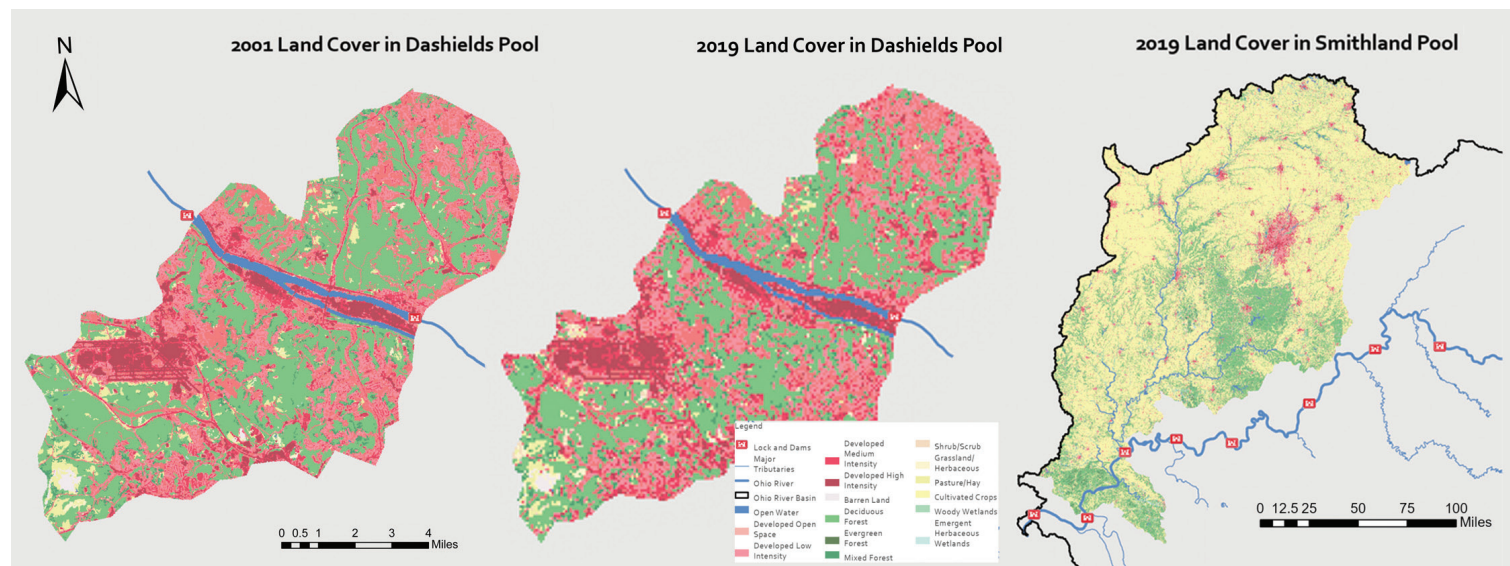
The 20 locks and dams on the Ohio River allow for navigation from Pittsburgh to Cairo. The average depth of the Ohio River is approximately 24 feet, allowing for more than 184 million tons of cargo to be transported annually.

The Ohio River is home to 38 coal-fired power plants, representing 20 percent of the nation’s coal-fired electricity generation capacity. The Ohio River also provides more than half a million jobs and generates billions of dollars in business activity.



The Ohio River Watershed

Land Use Changes



“Land use” describes the human use of land, including agricultural, residential, industrial, mining, and recreation uses. Land use changes happen often and on a variety of scales and they can have distinct and cumulative effects on air and water quality, watershed function, production of waste, extent and quality of wildlife habitat, human health, and climate.

Land Development Development can result in an increase in impervious surfaces, which are hard surfaces such as paved roads, parking lots, roofs, and highly compacted soils like sports fields. Thus an increase in impervious surfaces contributes to non-point source pollution by limiting the capacity of soils to filter and absorb runoff. Stormwater runoff is rain that falls on these hard surfaces and picks up any pollutants left behind such as dirt, oil, excess nutrients such as fertilizer or pet waste, and litter, flowing directly into nearby waterways.

The Ohio River is divided into 19 navigational pools. Over time, the Ohio River Basin has experienced changes within these pools including development of land, conversion of land to agricultural uses, and changes in forest composition. Highlighted above is Dashields Pool, which has undergone the greatest amount of increase in development (approximately 6.13%) since 2001.

Agricultural Uses Agricultural land uses can also affect the water quality of watersheds. Tillage practices, livestock grazing, and runoff can contribute sediment and nutrient pollution to the watershed. Excess nutrients can result in feeding algal blooms, which can become toxic

and known as “harmful algal blooms.” Smithland pool has the highest percentage of land devoted to agricultural usage including cultivated crops as well as pasture and hay fields (65.57%).

Climate Change Climatic warming may produce a shift in biogeographic species distribution northward, changing and reducing suitable habitat for cold-water fish species. Human water demands are expected to increase with a warmer climate which could exacerbate existing management challenges. Increasing demands for irrigation and industrial cooling water would conflict with increasing demands for municipal water supplies resulting from urban growth.

Precipitation and streamflow levels have increased over the past 50 years in the eastern part of the U.S., particularly in autumn and winter months. Additionally, loss of wetlands from agriculture and urban expansions are producing changes in characteristics of many drainage basins, including the Ohio. These include increases in maximum river discharges resulting from reduced storage capacity for flood waters and reductions in groundwater recharge and minimum discharges.

Increased hydrologic variability could pose large problems for the management of water resources in populated regions in terms of both quantity (ex: flood control and water allocations during droughts) and quality (ex: increases in sediment and contaminant loading during floods, reduction in assimilation, dilution, and capacity of effluents during droughts).

Aquatic Life

Biological Indices and Assessments

The channelization of the Ohio River in the early 19th century which allowed for industrial, agricultural, and urban development resulted in negative impacts to the river's aquatic ecosystem. The associated habitat fragmentation and degradation of water quality led to declining abundances and species loss. Through legislation such as the groundbreaking Clean Water Act of 1972, and collaborative efforts of ORSANCO and its partners, water quality improved allowing the Ohio River to regain some of its lost biodiversity. ORSANCO biologists work to ensure that the Ohio River continues to maintain a healthy aquatic community, which currently includes more than 160 fish and over 45 mussel species.



The primary means by which biologists determine the health of the aquatic community is through annual biological surveys and assessments. Beginning in 1993, ORSANCO developed and implemented a method to compare fish and environmental data sampled from the various navigational pools of the Ohio River. In 2003, ORSANCO developed the Ohio River Fish Index, which was subsequently modified in 2008 to become the mORFI_n (modified Ohio River Fish Index). In 2015, ORSANCO staff began employing the Ohio River Macroinvertebrate Index (ORMI_n) to assess another component of the Ohio River aquatic community. Macroinvertebrates include creatures like adult and larval insects, arthropods, worms, crustaceans, and other invertebrates. They spend all or most of their lives in the river and, being less mobile than fishes, are often more sensitive to changes in their environment. These two indices are collectively used to assess the relative health of the aquatic community of each Ohio River navigational pool.

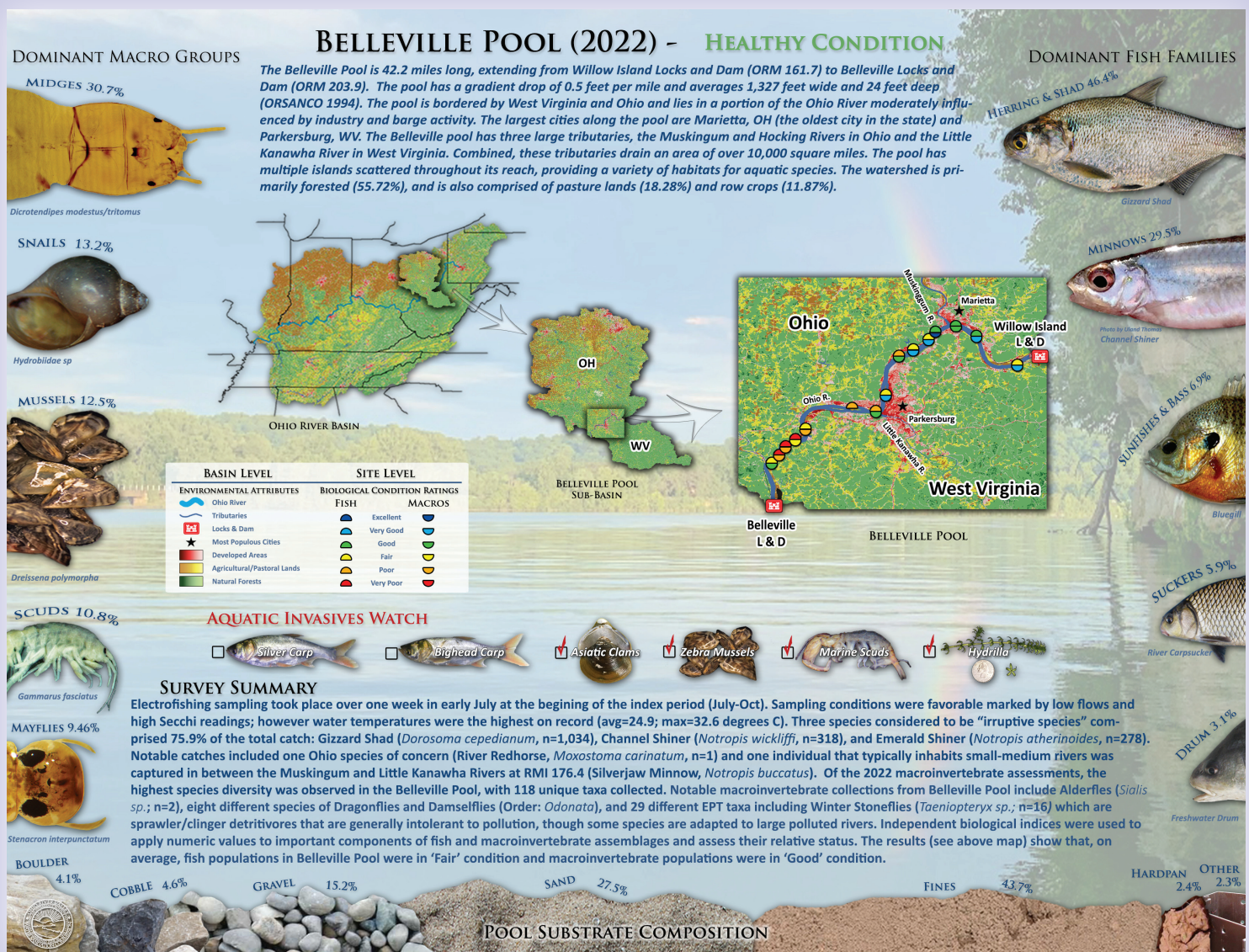
Each year ORSANCO biologists collect water, physical habitat, and biological data from multiple navigational pools. These data are primarily collected at 15 random sampling locations within each pool. Fish are captured, identified, measured, and inspected for any abnormalities prior to release. Macroinvertebrate samples are collected from those same locations and delivered to a contractual laboratory for identification and enumeration. From these data various aspects of each assemblage (e.g. diversity, abundance, and pollution tolerance) are assigned a numeric value. These scores are averaged across the 15 locations and compared against a criteria which represents a baseline healthy Ohio River community. The condition of each assemblage can be determined based on how each pool performs relative to this baseline criteria.





Annual Pool Reports

As with any tool, these indices require regular maintenance and sharpening in order to maintain functionality and maximize usefulness. In 2022, ORSANCO biologists completed the third assessment cycle of all 19 Ohio River pools which indicated healthy fish and macroinvertebrate assemblages river-wide. Using new insights gained during prior assessment cycles, biologists are currently refining and recalibrating these tools. As discussed in other sections of this report, ever-evolving issues like land use changes, contaminants, and invasive species can collectively impact aquatic communities. Regular index refinement, along with special studies to fill in pertinent data gaps, improve ORSANCO biologists' ability to detect any potential effects to Ohio River communities and improve the accuracy of our annual assessments. The accuracy of our annual assessments is paramount as they serve as the primary means to understand and convey the relative health of Ohio River aquatic communities to the public and our various partners. Furthermore, they are vital to informing potential management and restoration efforts and ensuring any diversity and functionality reclaimed through our collective efforts persists for years to come.



Recreation & Bacteria

Sections of the river are impaired with excess bacteria which can pose health risks for recreational users.

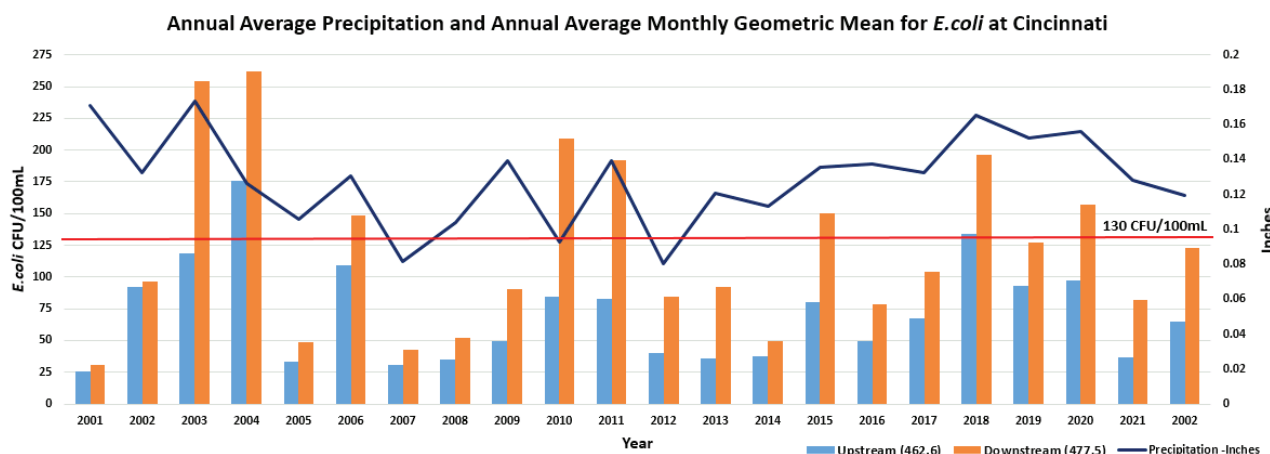
Presence of E. coli and fecal coliform bacteria indicate the potential presence of pathogens in the river. Both humans and animals can be sources of these bacteria. Impaired reaches of rivers and streams should have limited contact recreation.

Like everything else on the planet, including you, water is teeming with microorganisms. Certain bacteria are helpful, while others are detrimental. Animal's digestive tracts contain the bacteria *Escherichia coli* (*E. coli*), which can enter the environment and cause health problems and sickness if contacted by people.

Description and impacts Bacteria are common single-celled organisms and are a natural component of lakes, rivers, and streams. Most of these bacteria are harmless to humans; however, certain bacteria like *E. coli* have the potential to be harmful to human health. Common sources are human and animal feces. The Ohio River serves as a significant recreational resource, it is home to Paddlefest, the nation's largest paddling event, as well as the Great Ohio River Swim. To reduce the risk of people getting sick from exposure to pathogens while recreating,

ORSANCO monitors bacteria levels between April-October in six urban areas along the Ohio River.

Sources Major metropolitan areas often exceed the bacteria criterion for contact recreation. Nonpoint sources of bacteria pollution include human waste from septic systems, urban stormwater runoff, and animal waste including livestock, pets, and wildlife. Combined sewer overflows (CSOs) have been identified as significant sources of bacteria pollution near urban areas. The Ohio River currently has 49 Combined Sewer Overflow (CSO) communities, which represents roughly 10 percent of the total CSOs in the nation. A CSO collects rainwater runoff, industrial wastewater, and domestic sewage into one pipe. Under normal conditions, that water is treated and discharged.



This graph depicts the annual precipitation and annual average monthly geometric mean for *E. coli* during the contact recreation season at Cincinnati. Both upstream and downstream sites are shown along with precipitation. We can see how bacteria can fluctuate with precipitation and with both being an annual average, there is some room for variabilities (or irregularities).

When capacity is exceeded or infrastructure fails, untreated stormwater and wastewater are discharged into local rivers, streams, and creeks; particularly in times of snowmelt or heavy rainfall. In 1994, the Environmental Protection Agency (EPA) issued the CSO Control Policy through the National Pollutant Discharge Elimination System (NPDES) permitting program which helps CSO communities achieve the goals of the Clean Water Act (CWA) of 1972. All of the largest CSO communities are also under federal consent decrees to complete long-term control plans (LTCPs) to minimize overflows. The number of CSO overflows in Ohio River communities have decreased over the last 23 years.

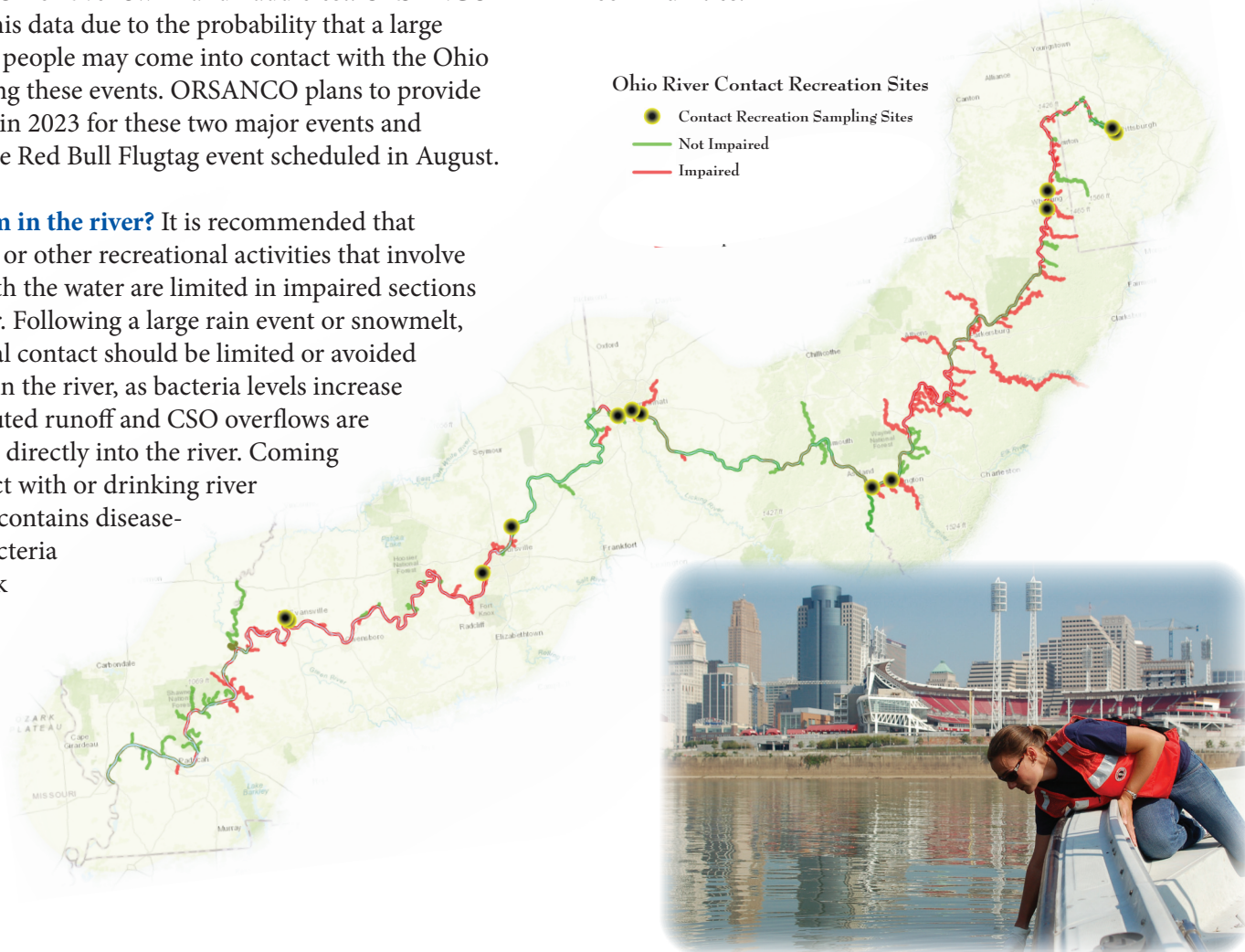
Status During the recreation season (April-October), ORSANCO monitors bacteria levels in six urban areas along the Ohio River including: Pittsburgh, Wheeling, Huntington, Cincinnati, Louisville, and Evansville. Samples are collected at both upstream and downstream locations and are analyzed for both fecal coliform and *E. coli* bacteria at the two West Virginia sites and analyzed for only *E. coli* only at the remaining sites. ORSANCO provided bacteria data in 2022 for two major river events on the Ohio River in the Cincinnati area: The Great Ohio River Swim and Paddlefest. ORSANCO provides this data due to the probability that a large number of people may come into contact with the Ohio River during these events. ORSANCO plans to provide data again in 2023 for these two major events and possibly the Red Bull Flugtag event scheduled in August.

Can I swim in the river? It is recommended that swimming or other recreational activities that involve contact with the water are limited in impaired sections of the river. Following a large rain event or snowmelt, recreational contact should be limited or avoided anywhere in the river, as bacteria levels increase when polluted runoff and CSO overflows are discharged directly into the river. Coming into contact with or drinking river water that contains disease-causing bacteria poses a risk


for animals as well as for people, so be mindful of letting your dog swim in the river during times of high bacteria pollution risk.

Looking Ahead ORSANCO submitted a proposal to the University of Cincinnati's Environmental Engineering Capstone Project in August 2022. This proposal was to produce an updated Ohio River Bacteria Trends Report and also create a predictive model for the Ohio River. ORSANCO was selected as one of the Capstone recipients by the Midwest Water Management Team. The Capstone project had two goals. One was to create a temporal trends assessment to determine if measurable improvements to fecal bacteria levels in the Ohio River have occurred over the past 20-30 years. The second was to evaluate relationships with variables such as streamflow and precipitation to create a predictive water quality model(s) to predict short-term Ohio River bacteria concentrations to better inform recreators.

The Midwest Management Team has only two semesters to finish this project, so the team is focusing on the Cincinnati area only. Once this project is finalized, it has the potential to be expanded to other Ohio River communities.



Bacteria Pollution Trends



ORSANCO's routine monitoring has found that the Ohio River is nearly seventy percent impaired with bacteria, however, during low flow conditions, bacteria levels are typically safe for recreational contact. Dedicated wastewater utilities led by their incredible professional staff have committed billions of dollars of work towards improvements, development, and implementation of long term control plans (LTCPs) to meet the requirements of the Clean Water Act required by our state regulatory partners.

ORSANCO collected and analyzed more than 6,000 fecal indicator bacteria samples over a fifteen year study period from 2001 to 2015 to see if any improvements in water quality resulted following the adoption of LTCPs and Consent Decrees (CDs) in Combined Sewer Overflow (CSO) communities. Since CSOs tend to discharge during snowmelt or heavy rainfall, downstream sample sites in CSO communities were observed to evaluate correlations between elevated fecal indicator bacteria and precipitation levels.

Results of the study showed that exceedances for fecal coliform and *E. coli* are variable over time, but are overall declining. The variability in values is attributed to fluctuations in precipitation and stream flow. Periods of high flow and precipitation had higher median values for fecal coliform and *E. coli*. On rare occasions, sites may be influenced by other sources and not representative of conditions beyond the CSO Communities. **When all factors are considered, there appears to be a significant decrease in bacteria loads in the Ohio River between 2001-2015.** This is likely due to several management practices including CSO and Sanitary Sewer Overflow (SSO) reduction, better agriculture maintenance, septic upgrades, and stormwater best management practices. Additionally, the collective dedication and investment of our stakeholders have also helped to contribute to the significant improvement in the Ohio River's water quality.

ORSANCO is currently completing a Bacteria Trends Assessment Report that will cover the years 2001 to 2020.



Water Quality Improvements

The Metropolitan Sewer District of Greater Cincinnati (MSD) represents an example of the positive impact wastewater improvements can have on water quality. MSD has reduced CSOs by 6 billion gallons annually since the start of its Wet Weather Program in 2009. Between 2009-2021, MSD completed 133 projects at a cost of \$1 billion to reduce or eliminate sewer overflows, including larger sewers, high-rate treatment facilities, smart sewers, and green infrastructure. The largest project, the Lick Run Greenway in the South Fairmount neighborhood of Cincinnati, has eliminated 800 million gallons a year of overflows into the Mill Creek, a tributary of the Ohio River. On the surface, the Lick Run Greenway looks like a park with a stream running through it, but it's a stormwater management project that controls CSOs. The Greenway uses a combination of real-time controls at the CSO outfall and new storm sewers and a surface stream to convey stormwater to the Mill Creek and keep it out of the sewer system.

As a result, the Mill Creek, once named the most endangered urban stream in America, is on its way toward recovery. MSD monitors water quality and aquatic habitat in the Mill Creek, Little Miami River, and Muddy Creek—all tributaries of the Ohio River. During a third round of sampling in Mill Creek in 2021, exceptional macroinvertebrate scores were recorded for the first time. In addition, MSD found 61 different fish species, with 7 new species including smallmouth redhorse. Species of fish that are sensitive to pollution are also being observed, such as striped shiner, silverjaw minnow, and orangethroat darter. MSD is continuing to reduce CSOs and improve local water quality as part of its Wet Weather Program.

Sanitation District No.1 of Northern Kentucky (SD1) has eliminated 592 million gallons of annual sewer overflow since the start of its wastewater mitigation program in 2005. Between 2005 and 2022, SD1 has completed over 50 projects at a cost of \$554 million to reduce or eliminate sewer overflows. Additionally, SD1 has recognized the significant impact of streambank erosion caused by storm water runoff and its damaging effect to public infrastructure, private property and instream water quality. SD1 continues to monitor local tributaries to the Ohio River to develop scientific-based solutions and policies. SD1 is committed to improving local water quality by reducing sewer overflows as part of its CleanH2040 initiative, as well as implementing innovative stormwater management practices and programs.

MSD and SD1 are just two examples of the dedicated efforts by our many wastewater utility partners that are working towards improvements to meet requirements of the Clean Water Act and contribute to a cleaner Ohio River.



Organics Detection System (ODS)

The ODS monitors the waters of the Ohio River for potential contaminants.

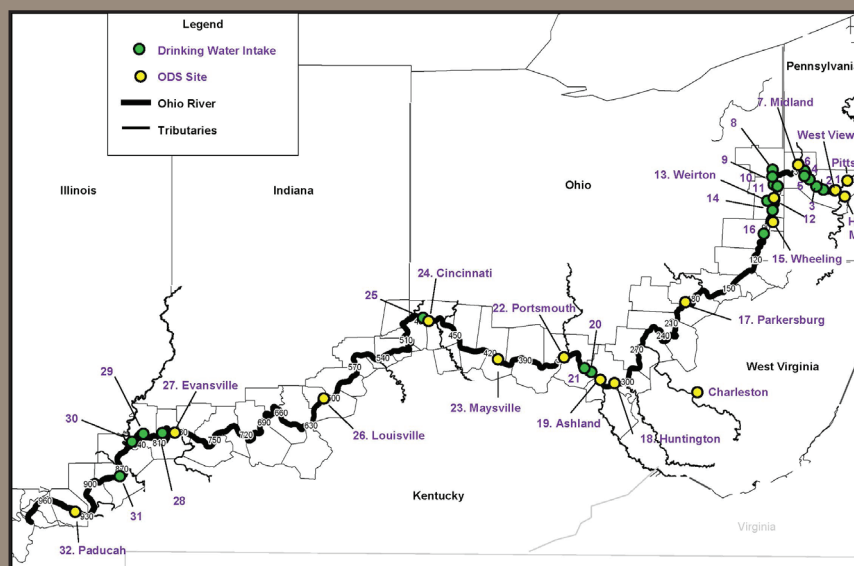
The Ohio River is highly industrialized with millions of gallons of chemicals stored, transported, or manufactured along its corridor. Because of the heavily commercialized nature of the river and its essential use in transportation, compliance monitoring by industry and utilities is unable to effectively capture the daily risk of spills and discharges. Daily monitoring is a necessity for early warning detection of potential contaminants. The need to address and monitor these chemicals is critical to protect the health and safety of the millions of people who rely upon the Ohio River and its tributaries for its designated uses, including the use of industrial water supply and drinking water.

ODS System ORSANCO's Organic Detection System (ODS) was created in 1978 after a release of carbon tetrachloride contaminated drinking water intakes that were using the Kanawha and Ohio Rivers as their source for drinking water. The release went undetected for over 200 miles over a period of seven days, and was only discovered inadvertently through analysis for an unrelated project. This incident identified the need for a monitoring system that would operate in addition to regulatory requirements to detect unreported discharges of chemicals that could compromise the source water quality for millions of consumers. ORSANCO, in cooperation with the Ohio River drinking water utilities and USEPA, developed a system that could detect and identify the presence of volatile organic compounds

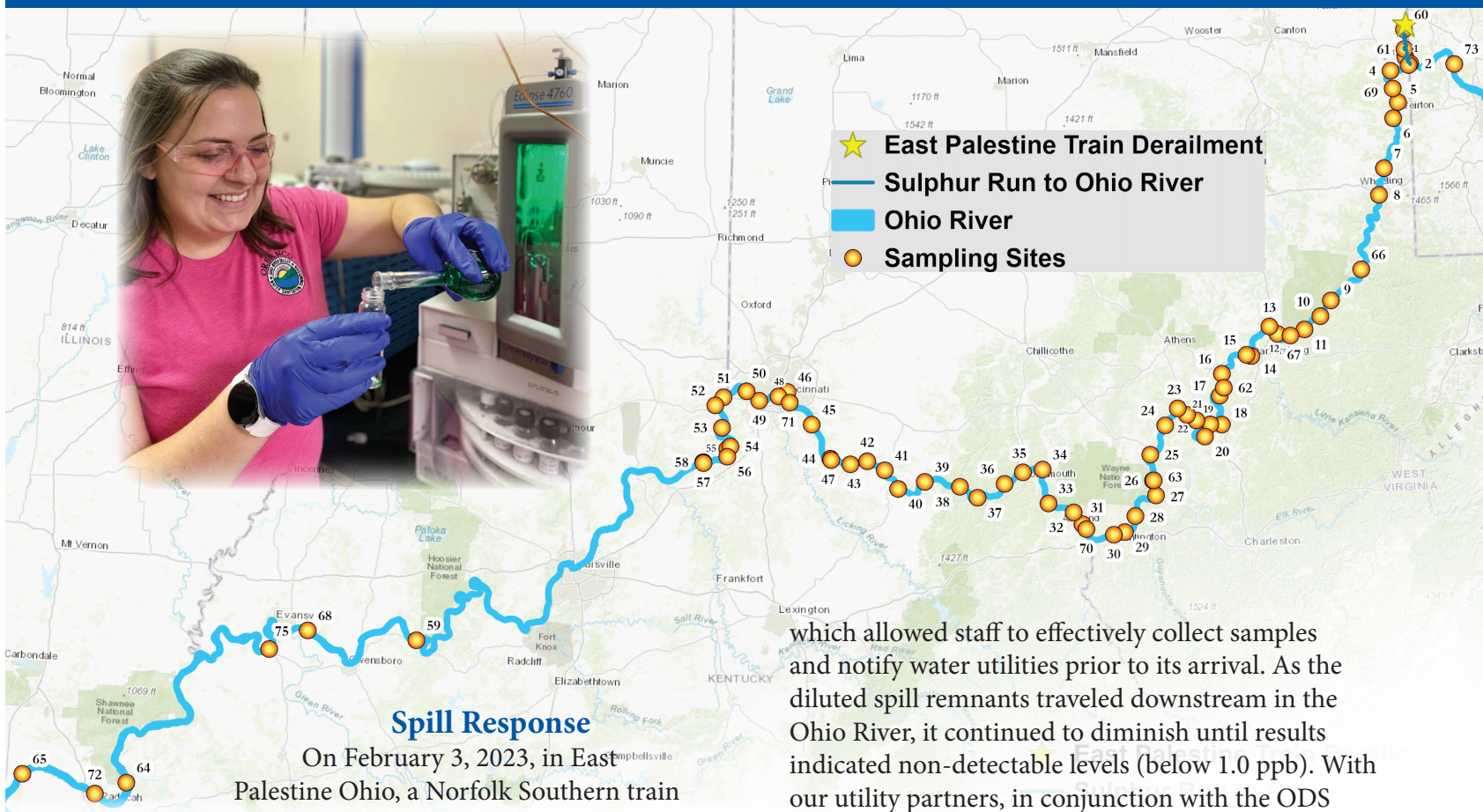
(VOCs), which are typically human-made chemicals that are used in the production of paints, pharmaceuticals, and petroleum based products. The ODS consists of 16 gas chromatographs (GCs) that are strategically positioned at drinking water utilities and industrial facilities along the 981 miles of the Ohio River to provide the greatest benefit to each of the water intakes drawing from the Ohio River and lower reaches of major tributaries.

The ODS uses purge and trap technology with gas chromatography to collect and analyze over 500,000 river samples annually for VOC analysis across its 16 stations to ppb (parts per billion) detection level analysis. This equipment not only detects the presence of a contaminant, but it simultaneously functions to **verify the absence** of harmful chemical pollutants which pose a threat to drinking water. Certain sites are equipped with mass spectrometry detectors, which are highly sophisticated and can conclusively identify an unknown contaminant. When detections occur, downstream utilities are notified of potential threats to a drinking water treatment system. The system is also used to provide information to state and federal response and drinking water agencies during a spill event to inform response efforts in a timely manner. Due to the multiple capabilities of the ODS network, it functions to provide daily routine monitoring in addition to emergency response applications.

Organics Detection System (ODS) Sites



ORSANCO provides the ODS sites with instrumentation, training, and instrument maintenance to keep the sites operational. Additionally, ODS host sites provide personnel and resources to help support the operational cost of this essential network. The ODS, through its instrumentation, cooperation, and communication network, provides protection to all water utilities and the five million citizens that rely on the Ohio River as their drinking water source. Many of the utilities are located in underserved communities with limited resources that are otherwise unable to assess for VOCs in the surface water.



Spill Response

On February 3, 2023, in East Palestine Ohio, a Norfolk Southern train derailed. The tanker cars were carrying several types of hazardous chemicals that were released into a tributary that drains into the Ohio River, including vinyl-chloride, n-Butyl Acrylate, 2-Ethyl-hexanol, and 2-Ethylhexyl-acrylate. Initial responders were on scene with containment structures in place downstream of the site to help prevent contaminants from traveling further. As a cautionary measure, ORSANCO requested the Weirton, West Virginia ODS station (first river site located downstream of the incident) to increase its sampling frequency to every two hours. Two and a half days later, the ODS first detected the presence of n-Butyl Acrylate at intake depth on the Ohio River 45 miles from the derailment. All utilities in the proximal area were immediately notified, and ORSANCO developed an internal sampling plan to track and profile the chemical plume.

Over the next several weeks, ORSANCO staff continued to work tirelessly in an effort to collect over 130 non-routine surface grab samples to track the diluted spill remnants. In partnership with Greater Cincinnati Water Works (GCWW), samples were analyzed, and data results were made publically available on ORSANCO's website.

ORSANCO utilized its Time of Travel model to track the chemical plume at key points along the river,

which allowed staff to effectively collect samples and notify water utilities prior to its arrival. As the diluted spill remnants traveled downstream in the Ohio River, it continued to diminish until results indicated non-detectable levels (below 1.0 ppb). With our utility partners, in conjunction with the ODS system, monitoring continued in case any additional releases occurred. The Agency of Toxic Substances and Disease Registry (ATSDR) established health guidance screening levels of 560ppb and 500ppb for n-Butyl acrylate and 2-ethylhexyl acrylate respectively, which quantities found in the Ohio River were significantly lower than those health guidance levels. But until that information became available, both ORSANCO's emergency spill response procedures and ODS network provided information to Ohio EPA and water utilities rapidly, which proved to be vital in making appropriate treatment decisions for the safety of their community.

The National Response Center (NRC) is the sole federal point of contact for reporting oil and chemical spills. As part of ORSANCO's Emergency Response Program, staff receive spill reports on a 24 hour basis from state and federal agencies, receiving up to 600 reports annually. ORSANCO relays information to the states and utilities whose water may be impacted.



Emerging Challenges

New issues in water quality continue to emerge as the population grows, demands on resources increase, and technologies evolve.

Excess nutrients lead to algal blooms. Fish in the river may contain elevated levels of contaminants. Invasive species are expanding their ranges.

Harmful Algal Blooms Nutrients and algae are a natural component of the Ohio River and are present throughout the year. During optimal conditions, when nutrients like phosphorus and nitrogen are in excess, some algae may rapidly proliferate causing a “bloom.” During a bloom, the algal concentration may go from a few thousand cells per milliliter (cells/ml) of water to hundreds of thousands or even millions of cells/ml. Algae blooms are most common in the summer, although they may occur at any time of the year. On the Ohio River, the conditions that allow these blooms to occur are typically low and slow flow, clear water, and warm water. Cyanobacteria can produce toxins which can be harmful if ingested. For this reason, an algal bloom which consists primarily of cyanobacteria is considered a Harmful Algal Bloom (HAB).

The first HAB identified on the Ohio River in 2008 impacted 30 miles of the river and lasted 10 days. In 2015, a HAB occurred which ended up covering over 600 miles of river and lasted over two months. This was unprecedented for a large river in the United States. Another HAB occurred in 2019 which covered 300 miles and lasted over a month. ORSANCO's research has identified specific flow patterns which have set the conditions that allow these blooms to occur. Climate change has likely allowed this alteration of the flow patterns which suggests that future large HAB events are likely and will be a challenge for users of the river, whether for recreation or drinking water use.

In order to address increasing likelihood of potential HABs, in partnership with USEPA and IDEM (Indiana Department of Environmental Management), ORSANCO has developed a HAB App, an online GIS-based tool, to predict the occurrence of harmful algal blooms on the Ohio River (HAB App). The tool uses flow data from the US Army Corps of Engineers gauges to compare the current flow to that experienced in 2015 and 2019 when HABs occurred. The tool displays the probability of a bloom occurring and persisting and shows relevant water quality data from eight locations on the river. A link to the HAB App can be found on our website so river users can stay informed.





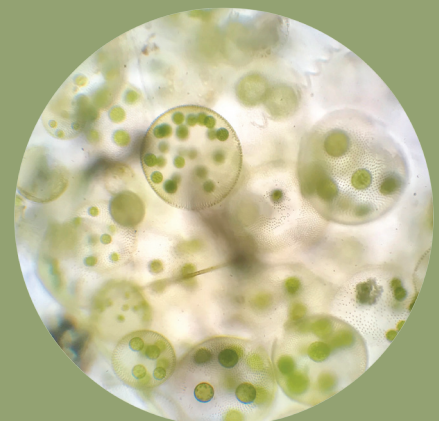
Contaminants in Fish Tissue There are a variety of contaminants that can bioaccumulate in the tissues of fish. Bioaccumulation is a process by which contaminant concentrations in animal tissues exceed the concentrations found in the surrounding environment. This occurs because contaminants are sequestered from the environment into the animal's tissues gradually, resulting in accrual over time. Many states issue species and location specific Fish Consumption Advisories (FCAs). These FCAs are designed to inform the general public of potentially harmful levels of contaminants that have been detected in the tissues of fishes from that specific area/waterway. ORSANCO routinely collects fish tissue samples river-wide for the purpose of monitoring contaminant levels and providing guidance to its member states when issuing FCAs. Legacy pollutants that result in FCAs typically include mercury, PCBs, dioxins, and chlordanes. Per-and polyfluoroalkyl substances (PFAS) have recently been included in the list of contaminants routinely monitored for in fish tissue analyses.

Invasive Species Invasive species have the potential to interfere with natural food webs and population dynamics. *Hydrilla verticillata* is one of several species of invasive Submerged Aquatic Vegetation (SAV) that is established and proliferating in the upper and middle sections of the Ohio River. This species grows in dense mats of vegetation that alter the available habitat. As a result, ORSANCO biologists are seeing changing fish communities in areas of the river where invasive SAV is heavily established.



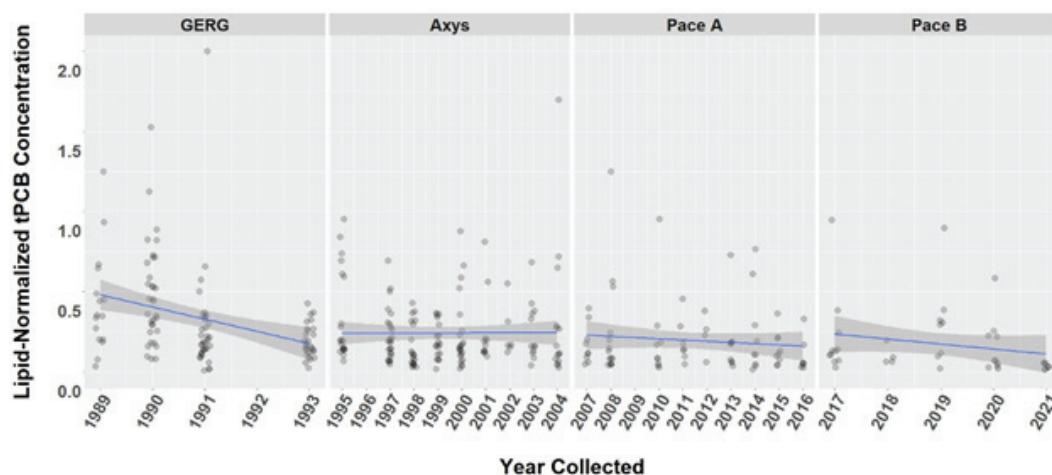
Invasive carp species are currently established and proliferating in primarily the lower half of the Ohio River. Despite extensive efforts by numerous state agencies, these species are slowly expanding their range. Invasive carp species

are only several of many invasive fish species that could have negative impacts on native Ohio River fish populations. ORSANCO routinely monitors fish and macroinvertebrate populations to ensure the Ohio River is capable of maintaining healthy aquatic communities.



Legacy & Forever Chemicals

Channel Catfish >35cm 1989-2021



PCB Trends in Fish Tissue Analysis

PFAS

Per- and Polyfluorinated Substances (PFAS) are widely used, long-lasting chemicals, components of which break down very slowly over time. These compounds can be found in water, air, soil, and living organisms at low levels everywhere in the world. In 2021, ORSANCO completed a baseline study of ambient levels of 28 PFAS compounds in Ohio River

PCBs

Polychlorinated biphenyls (PCBs) are a well-studied group of synthetic compounds that were commonly used for a variety of industrial purposes. PCBs are the primary driver of fish consumption advisories on the Ohio River, with the vast majority of those advisories being the lowest restriction of “One Meal per Week.” There is only a single species (Common Carp) from the upper river that is cautioned as “Do Not Eat.” Statistical analysis of PCB trends in fish tissue demonstrate a reduction of this contaminant and associated fish consumption advisory severity through time.

Dioxins

Dioxins refer to a group of toxic chemical compounds that are made up of polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and certain polychlorinated biphenyls (PCBs). Although environmental levels of dioxins have decreased in the last 30 years, they are extremely persistent compounds and break down slowly. The Ohio River Watershed Pollutant Reduction Program was initiated in 1995 and continued until 2010 and was designed to be pollutant-specific, including: bacteria, dioxin, PCBs, chlordane, atrazine, phosphorus, and nitrogen. This program made great strides in advancing the understanding of the presence of contaminants causing use impairments in the Ohio River and its tributaries.

surface water. This study was vital to understanding how PFAS could be monitored and detected in the Ohio River system. In March of 2023, USEPA took a key step to protect public health by proposing to establish legally enforceable levels for 6 PFAS known to occur in drinking water. Moving forward, ORSANCO’s 2023 river-wide broad scan survey will include 40 PFAS. Additionally, ORSANCO monitors for a suite of 35 PFAS in fish tissue.

Based on the Great Lakes Consortium recommended criteria for PFOS, none of ORSANCO’s fish composites collected to date would result in a more restrictive consumption advisory than currently listed for PCBs and Mercury contamination.

Issues concerning legacy and forever chemicals are not unique to the Ohio River. Their presence and effect on the aquatic ecosystem is something we have and will continue to monitor in the future.



Partnerships

ORSANCO staff achieves success working alongside a vast network of standing committees, advisory committees, ad-hoc committees, workgroups, watershed organizations, sub committees, and more! These committees and workgroups are a key component of ORSANCO's success and an excellent example of effective stakeholder involvement. There are more than 30 regular committees and workgroups, populated by nearly 300 individuals from our state agencies, water and wastewater utilities, watershed organizations, business and industry, USEPA, and other federal and state agencies.

As the Ohio River was recently designated the second most endangered river in the U.S., ORSANCO relies on its numerous partnerships to achieve our goals of protecting and improving water quality in the Ohio River and its tributaries. The incredible progress that has been made over the past 75 years is due to the hard work of all the ORSANCO partnerships and collaborations dedicated to the Clean Water Act objective in restoring the Ohio River and its 275,000 miles of rivers and streams within the Ohio River Basin.



We continue to closely collaborate with the Ohio River Basin Alliance (ORBA) as well as serving on their Steering Committee, leading the Ohio River Basin Discussion Series, and acting as their fiscal sponsor along with our Foundation. Together we are crafting a bold and visionary Ohio River Basin EcoSystem Restoration Plan to restore and protect the Ohio River and the streams, rivers, and wetlands that are connected

to it throughout a 14-state watershed where 30 million people reside. This plan will address threats to the region's drinking water, public health, and quality of life, such as sewage contamination, toxic pollution, mine waste, habitat destruction, invasive species, and flooding. The plan serves as a roadmap to restore water resources and prevent new pollution while prioritizing investment and supporting local economies in the communities most impacted by pollution and environmental harm. It is currently being developed by stakeholders from state and federal agencies, colleges and universities, utilities, businesses, and non-governmental organizations.

ORSANCO will join ORBA members in delivering the Ohio River Basin EcoSystem Restoration Plan to Congress this year. Together members will call on Congress to help provide well needed sustained and significant financial support for both the restoration plan and ORSANCO's technical equipment upgrades which are needed to protect the communities, environment, and livelihood throughout the Ohio River Basin.

ORSANCO is also closely involved with The Ohio River Way coalition and supports them in their mission to connect Ohio River communities with opportunities by building partnerships that promote safe and healthy outdoor recreation, education, and tourism. ORSANCO commits to further all partnership engagement as we move into the future to help protect the Ohio River Basin and to ensure water quality issues are prioritized.



Communication, Environmental Education, & Outreach

The communication and environmental education Programs at ORSANCO develop, coordinate, and disseminate public information, education, and outreach activities throughout the Ohio River Basin. ORSANCO informs the public regarding Commission activities and Ohio River water quality related information. The communication department works collaboratively with each member state and ORSANCO's partner network to provide a cohesive communication strategy that includes consistent messaging for its member states. The communication and environmental education staff work with each program to compile complex water quality information regarding a wide variety of topics and customize for public distribution via the ORSANCO website, various media channels, and print publications. The goal is to create strategies that deliver public information in a manner that improves perception of the Ohio River water quality and promote the protection of its vital uses.



FORE The ORSANCO Foundation for Ohio River Education (FORE) provides environmental education and outreach opportunities to people of all ages. FORE encourages stewardship and engages citizens in protecting the Ohio River as an essential resource for recreation, drinking water, and support of a healthy aquatic life through offering presentations, public events, and environmental education information and programs.

RiverREACH is a floating classroom program that connects schools in the Greater Cincinnati area to the Ohio River through exciting voyages of science and discovery. FORE is currently partnering with BB Riverboats to use the River Queen as a floating classroom and educational laboratory. While on board, students in grades 3-University test water quality using the same methods and equipment as scientists who monitor and protect the river. The newest extension of this program allows for high school and college students to conduct a similar curriculum from canoes on a lake or creek. These immersive experiences engage students in applied STEM (Science, Technology, Engineering, & Mathematics) disciplines through hands-on water quality monitoring, habitat assessments, and studies of aquatic organisms including fish and macroinvertebrates.

RiverWatchers is a citizen volunteer monitoring program for the Ohio River and selected tributaries throughout the Ohio River Basin that was originally founded in 1992 by ORSANCO. Since the program began, thousands of volunteers have collected samples to test for water quality. Participants are outfitted with chemical test kits and basic training of water quality beforehand to better evaluate the health of local waterways. Data collected during testing are sent to ORSANCO where they are evaluated and entered into a database. In 2023, a macroinvertebrate (aquatic insect) sampling kit was added to the program package that allows for collection and identification of specimens to be included in their overall assessment of waterways, as they are a good indicator for pollution.

FORE's mission includes a focus on environmental justice to improve access to environmental education opportunities for underrepresented communities. To accomplish this goal, FORE works with federal, state, and local agencies to ensure resources and environmental education programs serve the entire Ohio River Basin.

Between fall of 2021 and spring of 2023, FORE has reached over 5,000 individuals through 112 programs in Kentucky, Ohio, Indiana, Pennsylvania, and West Virginia.





Ohio River Sweep The shores of the Ohio River collect litter that is difficult to address for both the wildlife in and around the river, and for the people who rely on its resources. The Ohio River Sweep program provides an opportunity for public involvement in protecting water quality and reducing litter pollution. During the Ohio River Sweep season, volunteers remove litter and trash from along 3,000 miles of Ohio River shoreline and its tributaries. In order to adapt to Covid-19 regulations, the Ohio River Sweep program shifted from a one day event to a seasonal structure. Sweep season now runs from March 1 – October 31 and volunteers are able to schedule events and request supplies which are shipped directly to them. Last year, there were 127 clean up events, 5,554 volunteer participants, and 72.7 tons of trash collected.

Life Below the Waterline The 2,200 gallon mobile aquarium is operated and owned by ORSANCO and is one of only a dozen such aquariums in the United States. It serves as an educational display that highlights the fishes of the Ohio River Basin as well as the importance of water quality as a source of drinking water and to support a healthy aquatic ecosystem. The Ohio River Basin contains nearly half of the fish diversity of North America while providing drinking water and recreational opportunities to over 30 million people in its basin. The goal of this program is to highlight the significance of fish diversity in an Ohio River Basin citizen's backyard, change negative preconceptions about the quality of the Ohio River, and foster an appreciation for this often undervalued resource - one community at a time. All fishes for programs are collected by ORSANCO staff and returned following each exhibit. This year, ORSANCO relaunched the program and is hosting events for the first time in nearly 4 years! The environmental education and outreach staff are working closely with the biological staff to receive training on aquarium operations.



The Ohio River Basin supports 30 million people, covering more than 200,000 square miles. The streams, tributaries and main stem of the Ohio River connect communities across the region by providing opportunities for recreation, economic development, and a critical aquatic habitat for over 160 species of fish and other wildlife. The river is the backbone of the environment, the economy, the culture, and the history for the communities that live along its banks and throughout the region. ORSANCO and its incredible partners have devoted 75 years of effort with great successes and are dedicated to continuing to protect and promote the vital uses of our region's most valuable asset.



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