U.S. Army Corps of Engineers, Huntington District
Water Management Section
Water Quality Team

Annual Water Quality Report

2024

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Executive Summary

U.S. Army Corps of Engineers policy necessitates the development and implementation of a holistic watershed monitoring plan designed to protect resources and execute an environmentally sound water quality management strategy for each project. The Water Quality Team, a component of the Water Management Section, is organized to use a multidisciplinary approach to assess various environmental issues associated with operation of our projects. The Team's mission objectives include 1) Assessing compliance with applicable state and federal water quality regulations, 2) Supporting Water Control, Project Operations, and Waterways Section, 3) Monitoring and identifying current trends in water quality conditions, and 4) Evaluating the effectiveness of the Water Control Plan. Understanding the physical, chemical, and biological processes occurring in our waterways allows the Huntington District to efficiently operate projects for their authorized purposes while conserving the environmental value of the resources.

LRH Water Quality Team Activities in 2024:

1) To assess compliance with applicable state and federal regulations, the Water Quality Team completed intensive water quality surveys at six projects in the Little Sandy, Muskingum, and Scioto River basins. Conducted on a five-year rotation at each lake project, intensive water quality surveys are often performed in conjunction with fish and benthic macroinvertebrate surveys. Water chemistry surveys were conducted six times each at Alum Creek, Deer Creek, Delaware, Grayson, Paint Creek, and Senecaville Lakes. Survey data were compared to sixteen water quality constituents that the Water Quality Team uses for long-term trend analysis and compliance determinations. Electrofishing surveys were conducted at 20 sites and benthic macroinvertebrate sampling was conducted for each site. In addition, the EPA's Rapid Bioassessment Protocol (RBP) was used to conduct visual-based habitat assessments at each site. Individual lake summaries can be found in Appendix C – LRH Lake Summaries.
    a) All exceedances of state water quality criteria resulted from inputs by degraded inflow streams whose headwaters were not regulated by the USACE.
    b) Elevated pollutant levels will be reported to the appropriate regulatory agencies to facilitate potential mitigation efforts by the state.
2) The Huntington District has observed increasing occurrences of harmful algal blooms (HABs) resulting in impacts to flood control projects. The Water Quality Team coordinates with multiple water quality agencies in the event of a HAB to determine potential impacts to project operations and public health. The Water Quality Team also works with Operations Division to host a training webinar for project staff as well as attends yearly HAB Task Force Meetings with state agencies. Harmful algal blooms occurred at Atwood, John W. Flannagan, and Tappan Lakes in 2024. These HABS did not result in any significant impacts or closures. Response efforts were handled primarily by the respective state agencies in accordance with established response plans and protocols.
3) In 2024, the Water Quality Team monitored maintenance dredging operations below R.C. Byrd Locks & Dam as required per 401 Water Quality Certification stipulations as well as compliance with the Clean Water Act, Endangered Species Act, and the Inland Testing Manual. Additionally, sediment was collected and analyzed from the Ohio River at Willow Island Locks and Racine Locks and the Kanawha River at London Locks, Marmet Locks, Winfield Locks, and Hurricane Creek Bar as per the rotating monitoring schedule. Results were presented to state and federal regulating agencies at the annual partnering meeting and future goals and objectives were discussed. Without the established cooperative and defensible monitoring program, the District could be required to utilize upland disposal at an additional annual cost of up to $1.2M due to endangered species at R.C. Byrd alone.
4) The Water Quality Team maintains, calibrates, and distributes equipment necessary to collect lake profiles and river data for use in daily operations. Temperature and dissolved oxygen measurements are collected through the water column and at control points to determine optimal withdrawal depths to maximize the effectiveness of selective withdrawal capabilities. These efforts allow the Water Quality Team to direct operations required to reach water quality targets established in the Water Control Manuals to protect downstream aquatic ecosystems.
5) The Water Quality team is assisting Operations in a 5-year feasibility study of installing floating wetlands at Paint Creek Lake's Little Pond, which involved conducting a bathymetry survey of the pond and participation on the

project's PDT. Floating wetlands are used to reduce nutrients within a body of water, such as retention ponds in urban areas, wastewater lagoons, and small riverine systems. The ability to place these floating wetlands within USACE lake projects that have seasonal elevation changes could be beneficial to help combat the persistent HAB presence that is found in some lakes in the District. Initial deployment of the floating wetlands is scheduled for Spring 2025.

6) The Water Quality Team assisted Operations, Office of Counsel, and Real Estate with an ongoing proposal by Delaware County for a sewage treatment plant to discharge directly into Alum Creek Lake. The Water Quality Team has been involved heavily with policy discussion, letter drafting, and meetings with the County to ensure policy compliance and protection of the lake's authorized project purposes.

7) The Water Quality Team completed a bathymetry survey of R.D. Bailey Lake in 2024 to update the storage curve used in the Corps Water Management System (CWMS) for daily water management modeling and operations. The Team intends to survey a minimum of one or two multipurpose projects per year until all storage curves are updated.

8) Two members of the Water Quality Team are involved in an ongoing national PDT to develop a USACE-wide water quality database. The database has basic functionality, and developers are continually working create new tools and attract new users. Due to shifting of priorities and workload, it is unknown at this time when development will be complete.

9) Consistent with our mission, in 2024 the Water Quality Team was called to respond to environmental issues and to provide guidance to other USACE offices and lake projects. More information can be found in the Situational/Reactionary Support section.

   a) The Water Quality Team, in collaboration with the Kentucky Department of Fish and Wildlife Resources (KDFWR), has been assessing whether Paintsville Lake can support threadfin shad. Threadfin shad were stocked in Paintsville Lake by a local fishing association to establish long-term forage for largemouth bass, however, winter survival was uncertain due to historically low lake temperatures. The Water Quality Team placed temperature loggers at various lake locations in December 2023. Data showed that areas near the outlet tower and mid-lake remained warmer, while upper branches dipped as low as 34°F. A February 2024 electrofishing survey confirmed winter survival of threadfin shad. Additional threadfin shad were stocked in April 2024. Further monitoring and stocking are planned for 2025 to support long-term population establishment.

   b) In late January 2024, an oil and brine spill occurred in Big Caney Creek, a tributary of Grayson Lake. Oil and brine entered the creek from a leaking tank on private property, prompting Kentucky Emergency Management to install absorbent booms and deploy cleanup contractors. On February 6, the Water Quality Team recorded specific conductance readings and observed residual oil around the stream. Sampling in April found no detectable levels of gas, diesel, or oil, and no additional sampling was required.

   c) In September 2024, the Water Quality Team assisted with the annual hydrilla survey at Alum Creek Lake. Since its discovery in 2021, hydrilla has spread throughout the lake, requiring herbicide treatments in recreational areas and posing risks to lake operations. The Team surveyed over five miles of the littoral zone, using GPS to document hydrilla coverage, record depths, identify plant species, and classify coverage levels.

   d) Hydrilla was first discovered at Tappan Lake in 2024 by the Muskingum Watershed Conservancy District (MWCD), marking the first known occurrence of the invasive plant in a Muskingum area lake. In response, MWCD began treatment and initiated surveys of all their lakes. The Water Quality Team supported this effort by surveying Clendening Lake on September 12 and 17, focusing on the littoral zone and using a throw rake to check macrophyte beds for hydrilla. While no hydrilla was found, the team documented several native and non-native species.

   e) Near the end of June 2024, a fish kill occurred at Bluestone Lake. The West Virginia Division of Natural Resources noted similar events have occurred annually around early July, though no definitive cause has been confirmed.

The working hypothesis is that the emergence of mayflies from the substrate quickly depletes a significant amount of dissolved oxygen. During a site visit on July 2, the Water Quality Team observed decomposing fish and numerous mayfly skins, confirming a recent hatch. The Team plans to deploy a lake buoy to continuously monitor dissolved oxygen during the peak fish kill period.

f) In October 2024, persistent drought raised concerns about reservoir storage at North Branch of Kokosing River Lake and potential impacts on the lake's fishery and downstream mussel habitat. The Water Quality Team conducted a bathymetric survey and found only negligible dead storage in front of the sluice gate, offering no refuge for fish if pool was lost. On October 28th, flow readings showed 2.1 cfs in the immediate tailwater, with downstream sections gaining an additional 5 cfs from a quarry system and 4 cfs from a tributary. In coordination with the Ohio Department of Natural Resources (ODNR), the team assessed mussel habitat and found suitable conditions and deep pools downstream of the dam, though no live mussels were observed. The lake eventually stabilized and USACE and ODNR agreed on future management considerations based on the findings.

10) The Team maintains regular partnerships with multiple outside organizations and State agencies including the Muskingum Watershed Conservancy District, Ohio Environmental Protection Agency, Kentucky Division of Water, and West Virginia Department of Environmental Protection. These partnerships reduce redundancy of work and facilitate monitoring and improvement efforts within watersheds across the District.

Water Quality Program Overview

Consistent with ER 1110-2-8154 the LRH Water Quality Program "provides one of the greatest opportunities for the USACE to demonstrate its commitment to environmental leadership, conservation, restoration, and stewardship" (Figure 1).

Water Quality *– The physical, chemical, biological, and radiological characteristics of surface and ground water affecting abiotic and biotic conditions and interrelationships.*

Figure 1. The USACE definition of water quality per ER 1110-2-8154.

Water quality is an authorized purpose at many LRH lakes, however, even if not an authorized project purpose, water quality is an integral consideration during all phases of a project's life. This commitment is supported by several authorities, regulations, and acts, all requiring compliance with applicable water quality and environmental standards set forth by federal, state, and interstate agencies (Figure 2). The guiding policies necessitate the development and implementation of a holistic watershed monitoring plan needed to protect resources and execute an environmentally sound water quality management strategy for each project. Establishing and maintaining a strong viable water quality program will ensure achievement of the water control plan objectives for congressionally authorized water resource projects and aid in evaluating project performance.

- Public Law 92-500 of the Federal Water Pollution Control Act; 18 October 1972
- Section 313 of the Clean Water Act (CWA) of 1979
- Executive Order 12088; 13 October 1978
- USACE ER 1110-2-8154; Water Quality and Environmental Management for Corps Civil Works Projects; 31 May 1995
- USACE EM 1110-2-3600; Management of Water Control Systems; 30 November 1987
- USACE ER 1110-2-8156; Preparation of Water Control Manuals; 31 Aug 95
- Endangered Species Act of 1973
- Water Quality Program Management Plan
- Federal Facilities Act of 1990
- LRH Water Management Program Plan
- USACE ER 1110-2-8154; Water Quality and Environmental Management for Corps Civil Works Projects; 2018

Figure 2. Policies and authorities that guide water quality operations.

Understanding the physical, chemical, and biological processes occurring in our waterways allows the Corps the opportunity to efficiently operate projects in ways that provide for sustainable human uses while conserving the environmental value of the resource. The ultimate responsibility to control water quantity and quality at all Corps projects rests with the Corps. Furthermore, a full commitment to environmental stewardship requires a comprehensive understanding of the interactions between the uses and users of the watershed and the impact of USACE activities on the aquatic and upland environment. Water quality data collection at inflow, lake, discharge, and tailwater stations is essential for:

1) Developing an understanding of cause-and-effect relationships that create unique water chemistry and sediment conditions at each project

2) Providing needed information for integrating environmental consideration into water management decisions

3) Supporting management of multiple competing project purposes and providing support for evaluating effects of the water control plan

Water quality data collection activities will be carried out to support **one or more** of the following objectives **as appropriate** for a given project or system of projects:
(1) Assess compliance with applicable Federal, State, and local water quality standards.
(2) Provide an adequate database for monitoring project conditions and facilitating coordination with Federal, State, and local agencies.
(3) Investigate special problems and design/implement modifications to improve water management procedures.
(4) Provide data to support reservoir regulation/management and address environmental problems.
(5) Provide water quality data required for real-time project regulation.
(6) Evaluate sediment and water quality interactions and their effects overall.
(7) Understand, protect, and restore aquatic and riparian ecosystems.
(8) Develop and maintain the awareness essential for sound stewardship of water resources.
(9) Monitor recreational areas and water supplies to ensure public safety and resource integrity.
(10) Ensure stormwater, erosion, and sediment control practices meet requirements.
(11) Collect water quality data to support studies, evaluations, and resource modeling.
(12) Consider spatial watershed relationships through seasonal or annual trends in water quality.
(13) Modify data collection requirements to meet evolving management requirements and regulations.
(14) Develop a sufficient data base to document external impacts or harm to water resource projects.
(15) Provide timely response to incidents that could impact project operations or resources.

Figure 3. Objectives that drive water quality data collection programs per ER 1110-2-8154.

Organization of the LRH Water Quality Team

The Water Quality Program is organized to use a multidisciplinary approach for addressing various environmental issues associated with operational goals and project purposes. Physics, chemistry, and biology are used for evaluating emerging concerns that may impede operation efficiency. It is important to understand the unique interactive effects among surface water, groundwater, terrestrial, and atmospheric systems at each project. Partnerships with State, Federal, and regional agencies, non-governmental organizations, and educational institutions are necessary to effectively understand environmental concerns (see Coordination with Other Agencies).

The Water Quality Team is part of the Water Management Section of the Geotechnical and Water Resources Engineering Branch. There were six personnel working on the Water Quality Team in 2024: Josh Daugherty (Aquatic Biologist), Nathaniel Fleshman (Aquatic Biologist), Andrew Johnson (Wildlife Biologist), Zachary Rozansky (Aquatic Biologist), Kamryn Tufts (Aquatic Biologist), and Thad Tuggle (Aquatic Biologist).

The Water Quality Operations Center is located at the R.C. Byrd Locks and Dam in Apple Grove, West Virginia, and is comprised of the following components: biological laboratory for analyses of macroinvertebrates, fish, and algae identification/enumeration; four workstations to use as needed; staging area for equipment calibration and repair; staging area for sample processing/storage; and a garage and carport for storage of boats, sampling equipment, and electronics. This facility serves as the staging area for all field work and often for group meetings. Additional workspace for Water Quality staff is located at the Huntington District Office.

Survey Implementation Strategy

A fixed-site sampling program has been implemented to monitor long-term water quality at each flood control project. These sites are visited on a predetermined schedule and extend throughout the calendar year to establish any temporal trends. Sites are carefully chosen to be the most representative of a lake's watershed and to provide the best overall assessment for that project. Extra sites and increased sampling effort may be necessary depending on environmental conditions and budgetary constraints. A more detailed sampling strategy is outlined in the Water Quality Section of the *Water Management Program Management Plan*. Current and future survey schedules are outlined in the most current *Water Quality Annual Operating Plan* (Appendix B).

Types of Surveys Implemented by the Water Quality Team

- Intensive surveys are designed to fully assess water quality parameters within a watershed. Such surveys are conducted on a five-year rotation at each lake/watershed and involve collecting water chemistry six or more times at each station as budget permits.
- Biological surveys such as fish community surveys and benthic macroinvertebrate surveys are typically performed in coincidence with intensive surveys. These are designed to support any observed physical or chemical water quality trends and are used to assess impacts of water quality to the biota. Biological data can be scored using indices that allow sites to be compared for evaluation of the ecological health. Biological surveys are conducted where budget and staffing permit.
- Dredge surveys are designed to monitor sediment transport/quality, water quality, and potential impacts of dredge operations to federally listed mussels and surrounding habitat. These surveys are completed for compliance with state 401 Water Quality Certifications.
- Project profiles are designed to monitor the progression of seasonal thermal and chemical stratification within lake projects. These types of surveys are conducted by project personnel and typically occur at projects with selective withdrawal capabilities. Data collected from this type of survey is used to manage the quality of dam releases.
- Acoustic Doppler surveys are completed at both Navigation and Flood Control projects. At Navigation projects, a SonTek M9 Acoustic Doppler is used to measure total river flow and to map the magnitude and direction of

currents below the dam. At Flood Control projects, the team maps the bathymetry of the lakes to estimate sedimentation rates and changes to reservoir storage curves. The technology is also used to map stilling basins, verify stream gage flow measurements, and perform dam/levee safety inspections.

- Special surveys refer to any additional surveys such as environmental flow (E-flow) surveys, bathymetric surveys, analyte-specific monitoring, and stream flow surveys that are not considered routine and are performed as needed in support of operations, emergency situations, needs of partner organizations, and other District programs.
- HAB (Harmful Algae Bloom) surveys are conducted in response to a visually observed algae bloom which could produce toxins that can be harmful to humans, wildlife, and pets/livestock. This survey type may include algae collection, toxin testing, water quality sampling, and visual inspections of the impacted areas. Coordination with state and federal agencies is crucial with HAB monitoring. Due to the Recreation mission at multipurpose projects, the District will assist the states with HAB responses where funding and scheduling allow.

Water Quality Mission Objectives

The Huntington District (LRH) covers approximately 45,000 square miles of drainage area that contain nine river basins flowing into a 311 mile stretch of the Ohio River. Water quality monitoring is implemented to fulfill four major objectives that drive the LRH water quality program: 1) assess compliance with state and federal water quality standards by monitoring current water quality conditions affected by a project's operation; 2) provide support to water control, project operations, and navigation for regulation and modifications; 3) monitor water quality conditions, establish baseline conditions, assess current water quality status, and identify any significant water quality trends; and 4) evaluate the effectiveness of the Water Control Plan.

1) Assess Compliance

Applicable state and federal compliance responsibilities are established by the following authorities:

> *"The Corps water quality management requirements derive from the Federal Water Pollution Control Act of 1948 and its amendments, including the Clean Water Act of 1977 and the Water Quality Act of 1987. The Clean Water Act of 1977 strongly affirms the Federal interest in water quality and recognizes, preserves, and protects the primary responsibility and rights of states 'to prevent, reduce, and eliminate pollution'. When permitted by Federal supremacy and when not specifically exempted by the President, Executive Order 12088 (Federal Compliance with Pollution Control Standards), 13 October 1978, provides that each Federal agency is responsible for compliance with applicable pollution control standards in the same manner as any non-Federal entity."* – **ER 1110-2-8154; Section 2-2. Authorities**

> *"The Corps commitment to environmental compliance and protection of estuaries, rivers, lakes, and other navigable waters arises from directives in many Federal statutes, Executive Orders, and the Corps environmental regulations. These regulations are designed to minimize pollution, maximize recreation, protect aesthetics, preserve natural resources, and promote the comprehensive planning and use of water bodies to enhance the public interest. Therefore, the Corps, in the design, construction, management, operation, and maintenance of its facilities, will exert leadership within existing authorities and appropriations in the nationwide effort to protect, enhance, and sustain the quality of the nation's water and land resources. Federal facilities must comply with all applicable Federal, state, and local requirements in the same manner and extent as other entities. The Corps water quality management responsibilities are responsive to the overall objectives established in the Clean Water Act (see Engineer Manual (EM) 1110-2-3600) to restore and maintain the chemical, physical, and biological integrity of the nation's waters and the laws, regulations, and Executive Orders…"* **– ER 1110-2-8154; Section 2-3. Policy**

Other compliance responsibilities are defined by, but not limited to:

- **Water Control Manuals**
- **PL 78-534 Flood Control Act of 1944 (recreation, surplus water)**
- **PL 85-624 Fish and Wildlife Coordination Act of 1958**
- **PL 85-500 Water Supply Act of 1958**

- **PL 91-190 National Environmental Policy Act of 1969**
- **PL 92-500 Federal Water Pollution Control Act of 1972**
- **PL 93-205 Endangered Species Act of 1973**
- **PL 95-217 Clean Water Act of 1977**
- **Executive Order 12088**
- **Executive Order 13148**
- **WV Title 47-2 Legislative Rules Requirements Governing Water Quality Standards**
- **KY 401 KAR 5:031 Surface Water Standards**
- **OH OAC Chapter 3745-1 Water Quality Standards**

Partnerships with state regulating agencies keep the Corps current with any criteria changes and newly listed 303d streams within the Huntington District jurisdiction that may affect data analysis and site monitoring.

2) Provide Support to Water Control, Project Operations, and Waterways Section

The Huntington District manages thirty-five flood control lakes in nine major watersheds. While flood damage reduction is the primary purpose of the lakes, there are other allied purposes which define more than ninety percent of their operation. Water quality is the driving issue for most of those allied purposes. Water management decisions must include valid water quality and biological assessments as part of the daily decision process. These real-time actions are necessary to help meet project purposes such as flood damage reduction, recreation, water supply, low flow augmentation, whitewater release, and fish and wildlife conservation. Specifics of the LRH water quality program can be found in the Water Quality Section of the W*ater Management Program Management Plan an*d the W*ater Quality Annual Operating Plan (*Appendix B).

Seventeen LRH lakes have some selective withdrawal capability. In the summer stratification season, operators can mix poor quality water (cold, little to no dissolved oxygen, high dissolved metals, etc.) from lower depths with better quality water (warm, high dissolved oxygen, low dissolved metals, etc.) from higher depths to achieve a release that supports aquatic life below the dams. To determine the quality and quantity of releases, lake operators are required to collect lake profiles at routine intervals. The Water Quality Team provides support in this area by supplying and maintaining the equipment necessary to perform these duties, and by managing the data that is collected by project operators. Water Quality staff use this data to direct lake project operations to meet water quality targets.

There are nine locks and dams on the Ohio and Kanawha rivers within the Huntington District. The USACE is mandated by Congress to maintain the navigation channel depth on these rivers. With the passage of the National Environmental Policy Act of 1970, the Corps started an environmental monitoring program to evaluate impacts associated with maintenance of the navigation channel. Sediment contaminants and plumes must be monitored prior to, during, and after dredging activities to protect any sensitive mussel species known to exist near dredging activities. Due to the abundance of riverine habitat immediately downstream of many locks and dams, high quality mussel beds tend to aggregate in these locations. Many of these beds are known to contain endangered species or provide the density and diversity of mussel beds known to support endangered mussels. State and Federally listed species of concern are regulated by the Endangered Species Act of 1973 and other local state authorities.

3) Monitor Current Water Quality Conditions and Identify Trends

A robust and defensible database is necessary to assess the constantly changing nature of our environment. While many watersheds are improving thanks to remediation efforts and more sustainable land management practices, many of the District's watersheds are continually in poor health, and some are even in decline. The Water Quality Team monitors the health of watersheds within LRH through the implementation of various water chemistry and

biological surveys upstream, downstream, and within LRH lake projects. Routine surveys allow the Water Quality Team to establish baseline conditions, assess current water quality status, and identify any significant water quality trends within LRH watersheds.

Many authorized project purposes, including recreation and fish and wildlife conservation, rely on the District assessing water quality consistent with applicable state and federal standards. The District currently tracks sixteen constituents for long-term trend analysis and compliance determinations. If a constituent exceeds the District threshold value, that data will be compared to historical data from the same site and within the watershed to determine if water quality has changed. If the District determines that the water quality of a site has been impacted, a plan will be developed to further analyze the new source of impairment. The District will determine if any project modifications could mitigate impairments to water quality. Additionally, the respective state will be notified of any exceedance of state water quality standards to address the source of impairment.

4) Evaluate the Effectiveness of the Water Control Plan

All Huntington District multi-purpose flood control projects are operated according to the guidelines set forth in their respective Water Control Manuals (WCMs). Water Control Plans are documents established within each project's WCM that detail a project's authorized purposes and requirements, how and when to operate said project to achieve its authorized purposes, and any constraints surrounding its operation. Routine monitoring conducted by the Water Quality Team per Mission Objective 3 (above) contributes to evaluating the effectiveness of a project's Water Control Plan, and monitoring results are included in WCM updates. Water Quality data are routinely utilized by the Water Management Team to adjust project operations to maintain the integrity of water resources surrounding Corps facilities.

Other sections of the WCMs contain information regarding land use and other watershed characteristics that are subject to temporal changes. Many water quality constituents are indicators of land use change and analyzing these data may reveal and support any updates necessary to the WCMs. The District will determine if any project modifications could mitigate impairments to water quality found via Mission Objective 3 (above). Any changes to the manuals will be completed following reporting of intensive survey data.

Water Quality Data Management

The USACE is in the process of developing a Corps-wide enterprise data base solution that will house all water quality data generated by USACE districts. The LRH Water Quality Team will be migrating data to this new data base once it is complete. Until recently the Team utilized a software service called Aquarius Samples (AQS) to manage water quality data. AQS is a cloud-based data management service hosted by Aquatic Informatics, Inc. that provides access to chemical, physical, and biological data from any device with an internet connection. The service proved satisfactory and was in use from 2017 to 2022. However, the developers of AQS fell out of compliance with FedRamp cyber security requirements, hindering further use by USACE agencies and necessitating the switch to the enterprise solution currently in development.

Time series temperature and dissolved oxygen data are maintained in the Corps Water Management System (CWMS) database for use in daily operations. Lake profile data are currently managed in Excel spreadsheets and posted online for public availability. The fully functional module will provide a more consolidated and permanent solution than separate spreadsheets. Time series lake buoy data has been collected and will be managed in the CWMS database.

The Water Resources Development Act (WRDA) of 2014 required that all USACE water quality data be made accessible to the public. Initial efforts to satisfy these requirements involved uploading water chemistry data to the USEPA STORET Water Quality Exchange (WQX) system. The District currently relies on Freedom of Information Act requests and the USACE's Access to Water public website (water.usace.army.mil) to maintain compliance.

Real-Time Data Collection

Real-time data are needed for many aspects of water control and quality assessment. Precipitation modeling, forecasting, water management/control, and water quality monitoring are the main uses of the real-time data. Most of the data are accessible online and are provided by a vast national network of gaging stations maintained cooperatively by USACE, U.S. Geological Survey (USGS), and the National Weather Service (NWS). Locations and associated data of active gaging stations can be found at http://waterdata.usgs.gov/nwis/rt.

Multiparameter sondes offer another source of real-time data and are used in applications where continuous measurement of multiple physical parameters is needed such as water temperature, dissolved oxygen, conductivity, turbidity, and pH. For instance, a sonde is deployed in the Winfield Pool of the Kanawha River during summer months to monitor temperature and dissolved oxygen levels to determine flow augmentation requirements (see Support for Other USACE Elements).

Water Quality Activities in 2024

Water Quality Compliance and Long-Term Trend Analyses

The District currently tracks sixteen water quality constituents for long-term trend analysis and compliance determinations, which facilitates decision making and operation of projects for their congressionally authorized purposes. These sixteen constituents make up a broad spectrum of water quality analytes that can be indicators of poor land use practices, agriculture, silviculture, poor sewerage, resource extraction, etc. The District has developed threshold values for each constituent to screen for potential water quality problems in a watershed (Table 1). Oftentimes, these threshold values are based on the most stringent appropriate state and/or USEPA water quality criteria. Where no criteria exist for a constituent, the District has developed threshold levels using historical data from all District projects as well as best professional judgment. Henceforth, USACE threshold levels will be referred to as the "LRH screening value". If a constituent in a sample exceeds the LRH screening value, that data will be compared to historical data from the same site and within the watershed to determine if water quality has changed. If the District determines that the water quality of a site has been impacted, a plan will be developed to further analyze the new source of impairment. Additionally, the native state will be notified of any exceedance of state water quality standards to address the source of impairment. In this report the District will not be reporting exceedances below surface depths of lakes. The importance of each constituent is described below:

Aluminum – Aluminum is a metal that occurs naturally and in great abundance in the Earth's geology. Elevated aluminum levels in water can indicate watershed impairments from poor land use practices, increased suspended sediments, and resource extraction. A LRH screening value of 750 µg/l is consistent with the West Virginia and USEPA water quality standard for total aluminum. Any results that did not exceed the minimum detection limit (MDL) for aluminum were removed for trend and boxplot analysis. This is appropriate due to the consistent detection of aluminum and the rarity of samples that are below detection.

Ammonia – Ammonia is a nitrogen compound that is present in surface and ground waters from both natural and man-made sources. Naturally occurring sources of ammonia include waste products from wildlife, decomposition of animal and plant matter, and nitrogen fixation from certain species of bacteria. Man-made sources include point source discharges from wastewater treatment plants, discharges from the manufacture and application of fertilizers, runoff from livestock operations, and atmospheric deposition from burning fossil fuels (indirectly). Although ammonia typically will quickly oxidize into other usable compounds (nitrite, nitrate, etc.), high concentrations of ammonia can be toxic to aquatic life and an indicator of improper waste discharge such as a failing septic system. State criteria for ammonia vary between states, therefore LRH will use the native state's method for

determining exceedances. The ammonia criteria is often dependent upon the pH and water temperature at the time of sampling.

Bromide – Bromide is a naturally occurring ion of the element bromine. In response to increased horizontal fracturing for natural gas extraction adjacent to our flood control projects, the District is concerned about elevated bromide levels. Historically, the District has seen bromide levels below detection limits at our sample sites. In recent years the method detection limit (MDL) has lowered, and therefore more detections of bromide have been found across the district. While any detection of bromide at a site could indicate a new impairment in the watershed, the District is setting its LRH Screening value to 0.25 mg/L. The EPA suggests naturally occurring bromide concentrations could range upwards of 0.5 mg/L in freshwater, however waters in the Huntington District are generally at lower amounts. Due to the overall lack of consistent bromide data, all data is being used for analysis including results that are below the minimum detection level.

Chloride – Chloride is a naturally occurring ion of the element chlorine. Increased chloride levels in water can be attributed to natural gas extraction, mineral extraction, and poor land use practices. The LRH Screening value of 860 mg/l for chloride is consistent with West Virginia, Virginia, and the USEPA criteria. Any results that are below the minimum detection limit have been removed for trend and boxplot analysis purposes. Chloride is consistently detected above minimum limits in surface waters across the District, therefore it is appropriate to remove those data below detection.

Dissolved Oxygen – Dissolved oxygen (DO) is influenced by many factors including temperature, nutrient concentrations, and physical aeration of the water body. In order to support healthy aquatic life, adequate DO levels of 5 mg/l (warm water) and 6 mg/l (cold water) must be maintained. The LRH Screening values are consistent with Kentucky water quality standards. Due to consistent and expected low dissolved oxygen levels in lakes during summer stratification, only the surface measurements will be considered for trend analysis.

Iron – Similar to aluminum, iron is abundant in the geology of the District. Elevated iron levels in water can indicate watershed impairments from poor land use practices, increased suspended sediments, and resource extraction. The LRH Screening value of 1,000 µg/l is consistent with the Kentucky standard for chronic iron exposure. Any results that are below the minimum detection limit have been removed for trend and boxplot analysis purposes. Iron is consistently detected above minimum limits in surface waters across the District, therefore it is appropriate to remove those data below detection.

Kjeldahl Nitrogen – Total Kjeldahl nitrogen (TKN) is a measurement of organically bound nitrogen plus ammonia. TKN is monitored to determine impacts from waste disposal such as from wastewater treatment plants, untreated sewage, agricultural operations, or animal feed lots. TKN also tends to increase as lakes age and accumulate organic material. The LRH Screening value of 0.5 mg/l for TKN was determined using historical data from across the District. Any results that did not exceed the minimum detection limit for TKN were removed for trend and boxplot analysis. This is appropriate due to the consistent detection of TKN and the rarity of samples that are below detection. In recent years the minimum detection limit for TKN has increased, leading to an increase in perceived “non-detects” in analytical results.

Manganese – Manganese is a naturally occurring metal that is generally present at low levels in the Earth’s geology. Increased manganese levels in water are usually associated with mineral extraction or other land disturbance. The LRH Screening value of 1,000 µg/l is based on historical data from within the District. Values exceeding this threshold would indicate a new impairment in the watershed. Any results that did not exceed the minimum detection limit for manganese were removed for trend and boxplot analysis. This is appropriate due to the consistent detection of manganese and the rarity of

samples that are below detection. Manganese is also consistently elevated at the bottom of stratified lakes under anoxic conditions, therefore those values are not included in trend analyses.

Mercury – Mercury is a toxic metal that is found in the Earth's crust, usually in a compound form. Atmospheric deposition of mercury is the largest contributor of this constituent to District waters, primarily from coal fired power plants. The District threshold value of 1.4 µg/l is consistent with the standards developed for Kentucky and Virginia. It is difficult to measure trends with mercury data due to the abundance of samples that do not exceed the MDL. As a result, trend analysis for mercury uses all available results and expressions of an MDL.

pH –A pH value is a measurement of the concentration of hydrogen ions in a substance. In terms of water quality, pH is more commonly thought of as a measurement of how acidic or basic a water body is and can be used to gauge aquatic health. Normal pH values for healthy surface waters range between the District threshold values of 6.5 to 9.0, which is a range generally needed to sustain aquatic life. This threshold value is consistent with the water quality standard of Ohio. Deviations outside of this range can indicate a potential problem in a watershed such as acid mine drainage, improper waste disposal, or nuisance algal blooms.

Phosphorus – Phosphorus is a naturally occurring element that usually occurs in compound form. Phosphorus, along with nitrogen, is considered an essential nutrient for aquatic life at the right concentrations. Elevated phosphorus levels are usually associated with agricultural land uses from fertilizer applications. Increased phosphorus levels have been linked to increased potential for harmful algal blooms. The LRH Screening values for warm lakes (0.04 mg/l) and cold lakes (0.03 mg/l) are consistent with the standards for West Virginia. A less stringent 0.05 mg/l is used for streams in the District. For data and trend analysis purposes all results below MDL will be set to zero.

Selenium – Selenium is an element necessary to life, but can be toxic at elevated amounts. Elevated selenium levels are most often associated with mineral extraction in the District. The LRH Screening value of 5 µg/l is consistent with West Virginia and Virginia water quality standards. It is difficult to measure trends with selenium data due to the abundance of samples that do not exceed the MDL. As a result, trend analysis for selenium uses all available results and expressions of an MDL.

Strontium – Elevated strontium levels are often associated with horizontal fracturing for natural gas extraction. Elevated levels are also often seen in areas where agriculture is the primary land use and strontium isotopes are known to be a tracer component in fertilizers. The LRH Screening value of 200 µg/l for strontium was developed using historical data from within the District's watersheds. Any results that did not exceed the minimum detection limit for strontium were removed for trend and boxplot analysis. This is appropriate due to the consistent detection of strontium and the lack of samples that are below detection.

Sulfate – Sulfate is naturally occurring and usually compounded with other metals and minerals. Elevated sulfate levels are most often associated with mineral extraction and other chronic land disturbances. The LRH Screening value of 200 mg/l for sulfate was developed using historical data from within the District's watersheds. Any results that did not exceed the minimum detection limit for sulfate were removed for trend and boxplot analysis. This is appropriate due to the consistent detection of sulfate and the lack of samples that are below detection.

Specific Conductance – Specific conductance measures the electrical conductivity in a body of water and is directly influenced by the concentration of dissolved constituents within that water. It is a good "catch-all" indicator because the parameter is driven by many different types of water quality constituents. In general, elevated conductivity is associated with human activity. Any land change or instability can result in increased conductance in the watershed because increased dissolved materials

generally cause an increase in electrical conductivity in a body of water. The LRH Screening value of 500 µS/cm is a rule of thumb value that is often associated with some form of biological impairment.

Trophic State Index (TSI) – North American Lake Management Society defines trophic state as the total weight of living biological material or average productivity in a lake at a specific location and time. A TSI score is a measure of eutrophication in a waterbody and is correlated with nutrient loading, algal growth, water clarity, and dissolved oxygen levels. Three categories of eutrophication describe increasingly nutrient-rich and productive conditions: oligotrophic, mesotrophic, and eutrophic. The Huntington District estimates the trophic states using values for chlorophyll-a, total phosphorus, and Secchi depth.

Table 1. Water quality constituents/analytes observed for long-term trend analysis of state criteria and/or District levels of concern.

Analyte	LRH Screening Value	West Virginia	Kentucky	Ohio	Virginia
Aluminum	750 ug/l	750 ug/l	None	None	None
Ammonia	0.5 mg/L	Temp/pH dependent	0.05 mg/L (unionized)	Temp/pH dependent	Temp/pH dependent
Bromide	0.25 mg/L	None	None	None	None
Chloride	860 mg/l	860 mg/l	1,200 mg/l	None	860 mg/l
Dissolved Oxygen	5.0 mg/l warm 6.0 mg/l cold	5 mg/l	5.0 mg/l warm 6.0 mg/l cold	4.0 mg/l warm 6.0 mg/l cold	4.0 mg/l
Iron	1,000 ug/l	1,500 ug/l	4,000 ug/l	None	None
Kjeldahl Nitrogen	0.50 mg/l	None	None	None	None
Manganese	1,000 ug/l	None	None	None	None
Mercury	1.4 ug/l	2.4 ug/l	1.4 ug/l	1.7 ug/l	1.4 ug/l
pH	<6.0 or >9.0	<6.0 or >9.0	<6.0 or >9.0	<6.5 or >9.0	<6.0 or >9.0
Phosphorus	0.04 mg/l warm lake 0.03 mg/l cold lake 0.05 mg/l stream	0.04 mg/l warm lake 0.03 mg/l cold lake	None	None	0.02 mg/l JWF 0.04 mg/l NFP
Selenium	5 ug/l	5 ug/l	5 ug/l	5 ug/l	20 ug/l
Specific Conductance	500 uS/cm	None	None	None	None
Strontium	200 ug/l	None	None	None	None
Sulfate	200 mg/l	None	None	None	None

Intensive Surveys

Water Chemistry Surveys

Intensive surveys were completed at six projects in 2024 per the five-year rotating sampling schedule. Intensive survey data were used to report analyte concentrations of concern, compliance monitoring, suggestions for operational changes impacting water quality, and to assess fulfillment of authorized project purposes. Sampling locations were chosen based on historical site data, 303d listings of impaired waters, known or potential land disturbances, proximity to the lake, and spatial distribution within the watershed. Station information and 303d listings are available in Appendix A. Each location was sampled for a predetermined water quality suite consisting of physical parameters, solids, nutrients, major ions, metals, alkalinity, acidity, and hardness. These constituents are

commonly used to gauge ecosystem health and their thresholds (Table 1) are considered supportive of aquatic life use criteria proposed by state and federal regulatory agencies. Inflow and outflow sites were sampled during four seasonal flow periods: winter, spring, summer intermediate, and summer low flow. Lake stations were sampled four times at multiple depths during summer stratification. Benthic macroinvertebrate and fish community data were collected where budget, staffing, and site conditions allowed.

A seasonal approach has been implemented for intensive surveys to capture the natural variance in constituent levels that occurs during different flow periods (Figure 4). The "Summer Intermediate-Low Flow" season (Jun-Oct) is the most stable flow period for both water volume and water quality. Consistent monthly sampling during this period allows the team to detect true water quality changes in the lake and watershed because the water chemistry is subject to fewer natural fluctuations. During other seasons, flows and water chemistry can be extremely variable, making it more difficult to determine true water quality trends or identify watershed disturbances. As a result, water chemistry sampling is less likely to detect smaller changes to a watershed but can bracket the range of "normal" conditions for those water bodies.

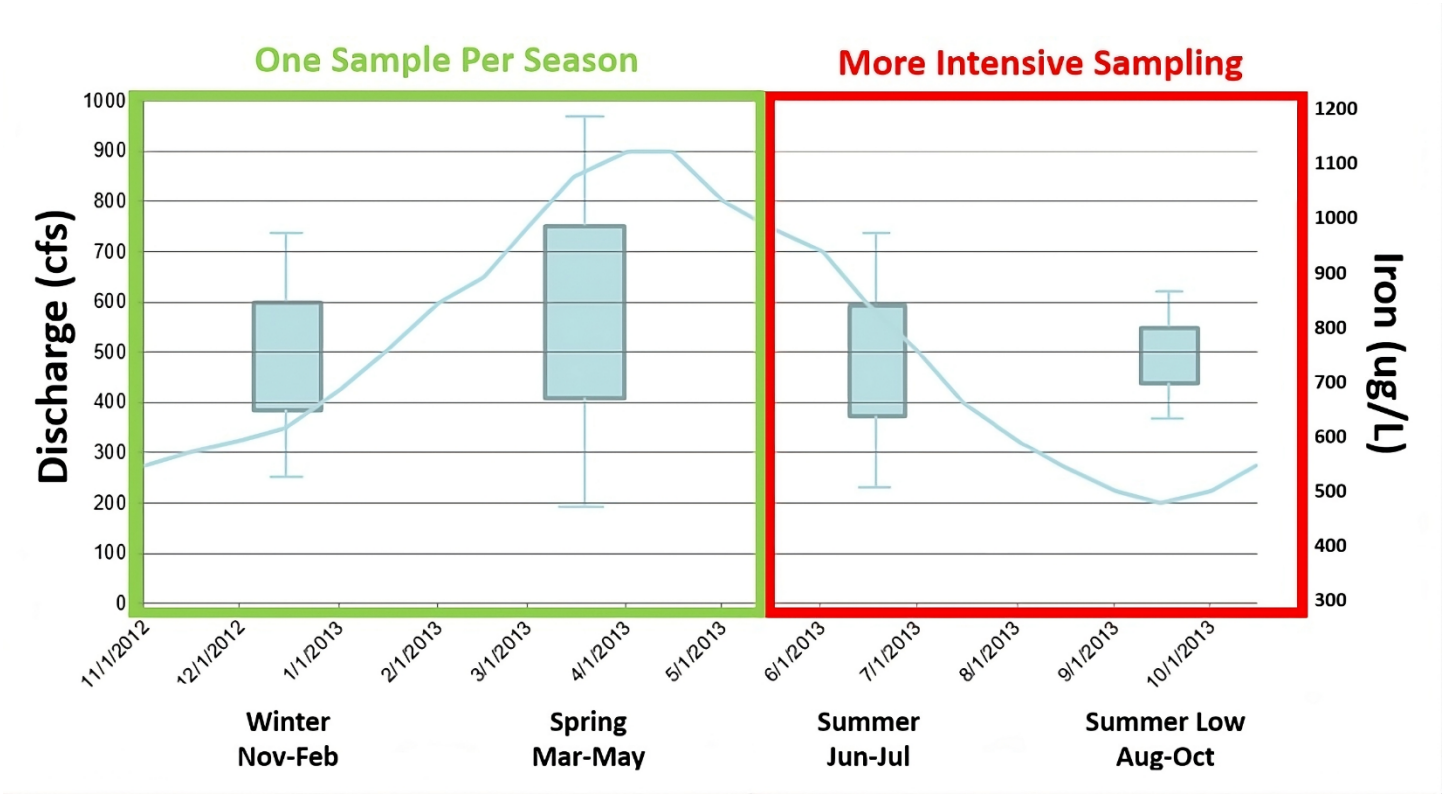

Figure 4. Demonstrates the flow and water quality variability that accompany different seasons of the year.

The Water Quality Team monitors watersheds for common parameters and indicators that are part of typical water monitoring programs. Analytes or parameters may be added or removed depending upon land use and known disturbances within the projects' watersheds. Below is a list of analytes currently monitored within LRH:

Hot Peroxide Acidity, Total Alkalinity, Aluminum, Ammonia as N, Antimony, Arsenic, Barium, Beryllium, Bicarbonate, Boron, Bromide, Cadmium, Calcium, Chloride, Chlorophyll, Chromium, Cobalt, Copper, Iron, Total Hardness, Total Kjeldahl Nitrogen, Lead, Magnesium, Manganese, Mercury, Nickel, Nitrite + Nitrate as N, Oxygen Saturation, Oxygen Concentration, Total Phosphorus, pH, Potassium, Total Dissolved Solids, Total Suspended Solids, Total Solids, Secchi depth, Selenium, Silver, Sodium, Specific Conductance, Strontium, Sulfate, Temperature, Thallium, Tin, Titanium, Turbidity, Vanadium, Zinc

The Water Quality Team completed intensive water quality surveys at six projects in the Little Sandy, Scioto, and Muskingum River basins. Surveys were conducted six times each at Grayson, Alum Creek, Deer Creek, Delaware, Paint Creek, and Senecaville Lakes. The sections below summarize the most recent information that was collected in 2024. More detailed information for these and other projects can be found in Appendix C. Additional information will be added as the projects are sampled and the information becomes available.

Alum Creek: Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include iron, dissolved oxygen, phosphorus, strontium, specific conductance, aluminum, and total Kjeldahl nitrogen. Chloride, sulfate, and specific conductance appear to be on a downward trend. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

Deer Creek: Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including dissolved oxygen, iron, phosphorus, strontium, specific conductance, aluminum, and total Kjeldahl nitrogen. In 2025, District Water Quality Team will be assessing the potential benefits of a riser to the existing low flow gate. A riser similar to one constructed at Sutton Lake, could provide water quality benefits to both the tailwater and the lake. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. The Deer Creek inflow scored a 47 on the Ohio IBI (Rating = Good) and a 1.66 on the Shannon Index. The Deer Creek Lake outflow scored a 36 on the Ohio IBI (Rating = good), and a 0.49 on the Shannon Index.

Delaware: Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including strontium, aluminum, specific conductance, phosphorus, ammonia, and total Kjeldahl nitrogen. Some nutrient levels in the lake and outflow were above or in the upper historical ranges, whereas levels in the inflow streams were within historical ranges. Concentrations of sulfate and chloride appear to be on a downward trend, which is reflected in a slight downward trend in specific conductance. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. Fish and macroinvertebrate surveys scored “Fair” in all areas.

Grayson: Water quality analysis revealed high inputs of nitrogen, phosphorus, and strontium into the lake from the one of the primary inflows, Paint Creek (1PCS0002). The outflow contained high levels of nitrogen, phosphorus, and strontium, indicating that the lake is not acting as a buffer to the above sources. Trend analysis revealed a downward trend in sulfate. All other parameters of interest appear stable in the watershed.

Paint Creek: All water quality concerns revealed in the most recent intensive surveys at Paint Creek Lake have been previously documented in the WCM with no new concerns surfacing. Active agricultural land use is most likely contributing the nutrients to the watershed through runoff of farm fields and overuse of fertilizers.

Senecaville: Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including iron, aluminum, strontium, manganese, specific conductivity, dissolved oxygen, phosphorus, and total Kjeldahl nitrogen. Constituents were within or below historical ranges. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

Fish Surveys

Electrofishing surveys were conducted at 20 sites in 2024 as part of the intensive sampling schedule. Survey methods included backpack electrofishing and tote barge electrofishing. Upon completion of surveys, fish that could be positively identified in the field were then counted and batch weighed and released back to the stream. Fish that were small and/or difficult to identify were fixed in formalin, taken to the Water Quality Operations Center, transferred into ethanol, and later identified.

The metrics used in the Kentucky and Ohio Index of Biotic Integrity (IBI) are Number of Native Species, Darter Species, Sunfish Species, Sucker Species, Intolerant Species, Percent Tolerant, Percent Omnivores, Percent Insectivores, Percent Top Carnivores, Percent Simple Lithophils, Percent DELT Anomalies, and Number of Fish.

During the 2024 electrofishing surveys, 8,073 individual fish were identified, and the data were entered into IBI calculators for Kentucky and Ohio. Among the Ohio sites sampled, Rattlesnake Creek, an inflow to Paint Creek Lake, received the highest IBI score with a rating of 52 categorized as Excellent. In contrast, the South Fork of Seneca Creek, an inflow to Senecaville Lake, received the lowest score of 22 categorized as Poor.

In Kentucky, all sampled sites were located at Grayson Lake. Middle Fork of Little Sandy, an inflow to Grayson Lake, was the highest-rated stream achieving an IBI score of 74 (Excellent). The Little Sandy River, however, received the lowest score among Kentucky sites with a rating of 47 (Fair).

Across all sampled sites in 2024, a total of 69 different species were collected (Table 2). Notably, 21 species were found at only one site. Bluegill (Lepomis macrochirus) was the most widespread species, present at all 20 sites sampled. Table 4 provides a complete list of species observed and the number of sites where each species was found. Detailed results for each sampling location are included in Appendix C – Lake Summary Pages.

Table 2. Fish species collected in 2024 and number of occurrences.

Common Name	Number of Sites Present	Common Name	Number of Sites Present	Common Name	Number of Sites Present
bluegill	20	silverjaw minnow	7	spotted sucker	2
bluntnose minnow	19	smallmouth bass	6	stonecat	2
central stoneroller	18	silver shiner	5	black bullhead	1
logperch	18	yellow perch	5	black redhorse	1
green sunfish	17	black crappie	4	blackstripe topminnow	1
largemouth bass	17	common carp	4	bluebreast darter	1
johnny darter	16	least brook lamprey	4	dusky darter	1
creek chub	14	orangespotted sunfish	4	fathead minnow	1
white sucker	14	sunfish hybrid	4	freshwater drum	1
fantail darter	13	white crappie	4	golden shiner	1
golden redhorse	12	brindled madtom	3	goldfish	1
northern hogsucker	12	brook silverside	3	grass pickerel	1
greenside darter	11	emerald shiner	3	northern brook lamprey	1
longear sunfish	11	mosquitofish	3	pumpkinseed	1
rainbow darter	11	mottled sculpin	3	redear sunfish	1
striped shiner	11	quillback	3	river chub	1
yellow bullhead	11	trout-perch	3	silver redhorse	1
spotfin shiner	9	warmouth	3	smallmouth buffalo	1
channel catfish	8	blacknose dace	2	smallmouth redhorse	1
rock bass	8	blackside darter	2	steelcolor shiner	1
sand shiner	8	flathead catfish	2	suckermouth minnow	1
banded darter	7	saugeye	2	western blacknose dace	1
gizzard shad	7	spotted bass	2	white bass	1

Benthic Macroinvertebrate and Habitat Surveys

Benthic macroinvertebrate sampling and scoring were conducted following the appropriate state protocols for each site. In Ohio, samples were collected using Hester-Dendy macroinvertebrate samplers, and site scores were calculated using the Invertebrate Community Index (ICI). The ICI evaluates 10 variables, each of which can receive a score of 6, 4, 2, or 0, based on comparisons with undisturbed reference sites, resulting in a total possible score ranging from 0 to 60. For Kentucky, sampling and scoring followed the protocols outlined in the Macroinvertebrate Bioassessment Index (MBI), which uses seven metrics to calculate site scores. Each metric is scored from 0 to 100 percent based on statewide reference data, and the MBI is derived as the average of these equally weighted metrics, resulting in possible scores ranging from 0 to 100.

In addition, the EPA's Rapid Bioassessment Protocol (RBP) was used to conduct visual-based habitat assessments at each site. RBP scores range from 0 to 200. Detailed macroinvertebrate and habitat assessment results for each site are provided in Appendix C – Lake Summary Pages.

Deer Creek Outflow Surveys

Background

Routine intensive sampling was conducted at Deer Creek in 2024 as part of the ongoing 5-year rotation survey, which includes assessments of fish, macroinvertebrates, habitat, and water chemistry. Comparative analysis of the 2024 survey results with the previous 2019 survey revealed notable changes in the biological community at the outflow site.

During the summer, Deer Creek typically operates with a low flow gate located at 786 ft which places it at a depth of approximately 7 meters below the surface at summer pool. Although it is sometimes the best option for operations, this results in discharges of warmer, anoxic water during the summer months. To mitigate low dissolved oxygen (DO) levels, a sluice gate aerator can be installed and has become a good alternative method for summer operations. In July 2024, switching from the low flow gate to the sluice aerator released higher-than-normal manganese concentrations, which blackened the tailwaters. Reduced DO levels and dead fish were also observed. Outflows were increased and operations were reverted to the low flow gate to improve downstream conditions.

Biological Survey Results

Both the inflow and outflow sites showed increased macroinvertebrate index scores (ICI) between 2019 and 2024. The outflow site increased from 12 (poor) to 22 (fair). Metrics indicated a decline in tolerant organisms, primarily chironomidae (midges), and an increase in cheumatopsyche caddisflies, which are net-spinning caddisflies that are less tolerant of poor water quality than chironomidae. These shifts contributed to the overall increase in the outflow ICI score.

Fish Index of Biotic Integrity (IBI) scores at the outflow declined from 36 (good) to 32 (fair), with species richness dropping from 34 species in 2019 to 17 species in 2024. No suckers or intolerant species were collected in 2024. Of the 21 species collected in 2019 but not in 2024, 9 were classified as intolerant or moderately intolerant. Additional information from ODNR includes data from a 2024 creel survey that indicated negative impacts on fishing success. However, the survey concluded in late July, potentially missing further impacts later in the season. Sonde readings during the survey period showed very low dissolved oxygen (DO) levels, and dead gizzard shad were observed.

Potential Influencing Factors

In 2019, the reservoir experienced two major storm events that more than replaced the entire lake volume, reducing residence time. In contrast, 2024 had significantly lower inflows, with 106 days below 10 cfs from 2019 to 2024, compared to only 13 days below 10 cfs from 2014 to 2019. Overall, the period from 2019 to 2024 was drier than the preceding five years. The current selective withdrawal system is inadequate for addressing low DO issues, which may have exacerbated drought-related impacts. The timing of the surveys may have influenced the results, as early summer stratification conditions could provide better downstream conditions than late summer. Timing should be considered when comparing surveys from different years and may be studied in future assessments

Future Plans

Although the exact drivers of the biological changes at Deer Creek remain unclear, the 2024 survey provided valuable insight into changing fish community health and macroinvertebrate conditions. Continued monitoring and surveys are planned to improve downstream habitat quality and address persistent DO issues.

In 2025, the Water Quality Team will deploy multiple Hester-Dendy samplers in the tailwater to determine the change in macroinvertebrate populations throughout the summer. Fish surveys are planned to evaluate the importance of timing when assessing the impacts of the Deer Creek Lake discharge. Additionally, a lake profiling buoy and downstream DO monitors will be deployed to evaluate real-time stratification and allow the team to compare the conditions at the low flow gate and sluice gates prior to operation.

Harmful Algae Bloom (HAB) Response

Consistent with national trends, the Huntington District has observed increasing occurrences of HABs resulting in impacts to operations at our flood control projects. Toxins that are known to cause human and animal health problems can be released from the blooms, often leading to closures of public areas at Corps projects. HABs occur under many different environmental conditions and are nearly impossible to predict. The prevalence of HABs at both our projects and other water bodies has required our state partners to establish response strategies to protect the water users.

All states within LRH have developed HAB monitoring and/or response plans. Currently, states are taking the leading role in HAB monitoring, sampling, and response while LRH has adopted a supporting role. The LRH Water Quality Team has made itself available as necessary for any sampling, sign-posting, or monitoring efforts that cannot be accomplished by state or local authorities in the event of a HAB on a USACE lake. The Water Quality Team also attends yearly HAB Task Force Meetings with the States of Ohio, West Virginia, Virginia, and Kentucky.

As states take the lead in HAB response they have requested that the Corps continue to monitor and report potential HABs. The Water Quality Team coordinated with Operations Division to host a HAB webinar to train flood control project staff and navigation project staff on HAB identification, response, and reporting. Project managers were advised to report any out of the ordinary water conditions to the Water Quality Team so that it can be evaluated and directed to the appropriate agency.

Harmful algal blooms occurred at Atwood Lake (Ohio), John W. Flannagan Lake (Virginia), and Tappan Lake (Ohio) in 2024. There were no significant impacts or closures as a result of these HABs. Response efforts were handled primarily by the respective state agencies in accordance with established response plans and protocols.

Support for Other USACE Elements

Critical Habitat and Threatened/Endangered Species

One significant change to environmental conditions in the District over the last twelve years has been the listing of additional Federally protected species and associated Critical Habitat. Prior to 2013, there was no aquatic Critical Habitat listed within the District's boundaries. That year, the rabbitsfoot mussel (*Theliderma cylindrica*) was listed along with Critical Habitat that extended both above and below Mohawk Dam. Additionally, the diamond darter (*Crystallaria cincotta*) was listed at that time with Critical Habitat in the Elk River downstream of Sutton Lake. Since 2013, additional aquatic species and Critical Habitat have been listed within the District including the candy darter (*Etheostoma osburni*), the Guyandotte crayfish (*Cambarus veteranus*), the Big Sandy crayfish (*Cambarus callainus*, Figure 5), the longsolid mussel (*Fusconaia subrotunda*) and the round hickorynut mussel (*Obovaria subrotunda*).

Figure 5. Big Sandy Crayfish. Credit: Guenter Schuster

Currently, the flood control projects impacted by Critical Habitat in the District include Sutton Lake tailwater (round hickorynut mussel, longsolid mussel, and diamond darter), Summersville Lake tailwater (candy darter), Burnsville Lake tailwater (longsolid mussel and round hickorynut mussel), R.D. Bailey Lake flood storage pool (Guyandotte crayfish), North Fork of Pound Lake tailwater (Big Sandy crayfish), J.W. Flannagan Lake flood storage pool and tailwater (Big Sandy crayfish), Fishtrap Lake tailwater (Big Sandy crayfish), Dewey Lake tailwater (Big Sandy crayfish), Mohawk tailwater (rabbitsfoot mussel), and Mohicanville tailwater (rabbitsfoot mussel).

The presence of Critical Habitat upstream and downstream of multipurpose flood control projects requires extra analysis and effort when our projects need to operate outside of the Water Control Plan. Maintenance of our navigation channel in association with locks and dams along the Kanawha River also requires additional analysis and coordination. The efforts of the Water Quality Team to mitigate impacts to Federally protected species and Critical Habitat can be seen in multiple subsections of the Support for Other USACE Elements section.

Dredge Mission at R.C. Byrd Locks and Dam in 2024

Figure 6. The WIZARD measures conditions in the actual substrate and the water column.

Due to significant sedimentation below the R.C. Byrd Lock and Dam (RCB), presence of endangered mussels, and the importance of the RCB navigation mission, dredging at RCB requires continued scrutiny to best meet objectives. The District has continually shown an ability to avoid and/or minimize impacts to these mussel beds during dredging operations through an evolution of monitoring capabilities. Additionally, the District has employed the use of steering currents (Figure 7) from the RCB dam to direct dredge disposal plumes away from endangered mussels. Dam operators create steering currents by opening and closing a combination of gates to control the direction and magnitude of flow through the dam. Sedimentation and dissolved oxygen levels are intensely monitored downstream of the dredge disposal area and adjacent to valuable mussel beds. The team uses a monitoring platform that provides real-time data transmissions to the District with the most current environmental conditions surrounding the mussel beds. No other USACE District has deployed such an innovative and advanced monitoring platform or operated for steering currents during dredging operations. These innovations have garnered praise from our partners in the state and federal resource agencies.

Figure 7. Velocity vectors demonstrating the effectiveness of steering currents employed below R.C. Byrd Dam.

Slightly less than normal maintenance dredging occurred at R.C. Byrd in 2024. A total of 70,000 cubic yards of material was dredged during 17 days of operations in October and November. Flows were slightly lower than normal and ranged from approximately 6kcfs to 24kcfs. Dump scows were used for all RC Byrd dredging. This type of dredge operation is great for minimizing impacts associated with dredge material disposal. The combination of mechanical dredge, dump scows, and steering current

flows (Figure 7) allowed the dredging operations to continue without impact to the mussel beds. 9 Figure 7 shows the WIZARD monitoring platform that monitors our mussel beds for impacts from dredge disposal. The WIZARD is a real-time platform measuring sedimentation, dissolved oxygen, and turbidity. Turbidity results were unavailable in 2024 due to issues with the buoy. The WIZARD was deployed in October prior to dredging and remained in the water for further analysis. Data showed that there was likely no accumulation of sediments over the mussel beds as a result of dredge operations (Figure 8). As a result of this monitoring, good flow and stage levels, and steering currents, no changes were required during dredging operations at R.C. Byrd in 2024.

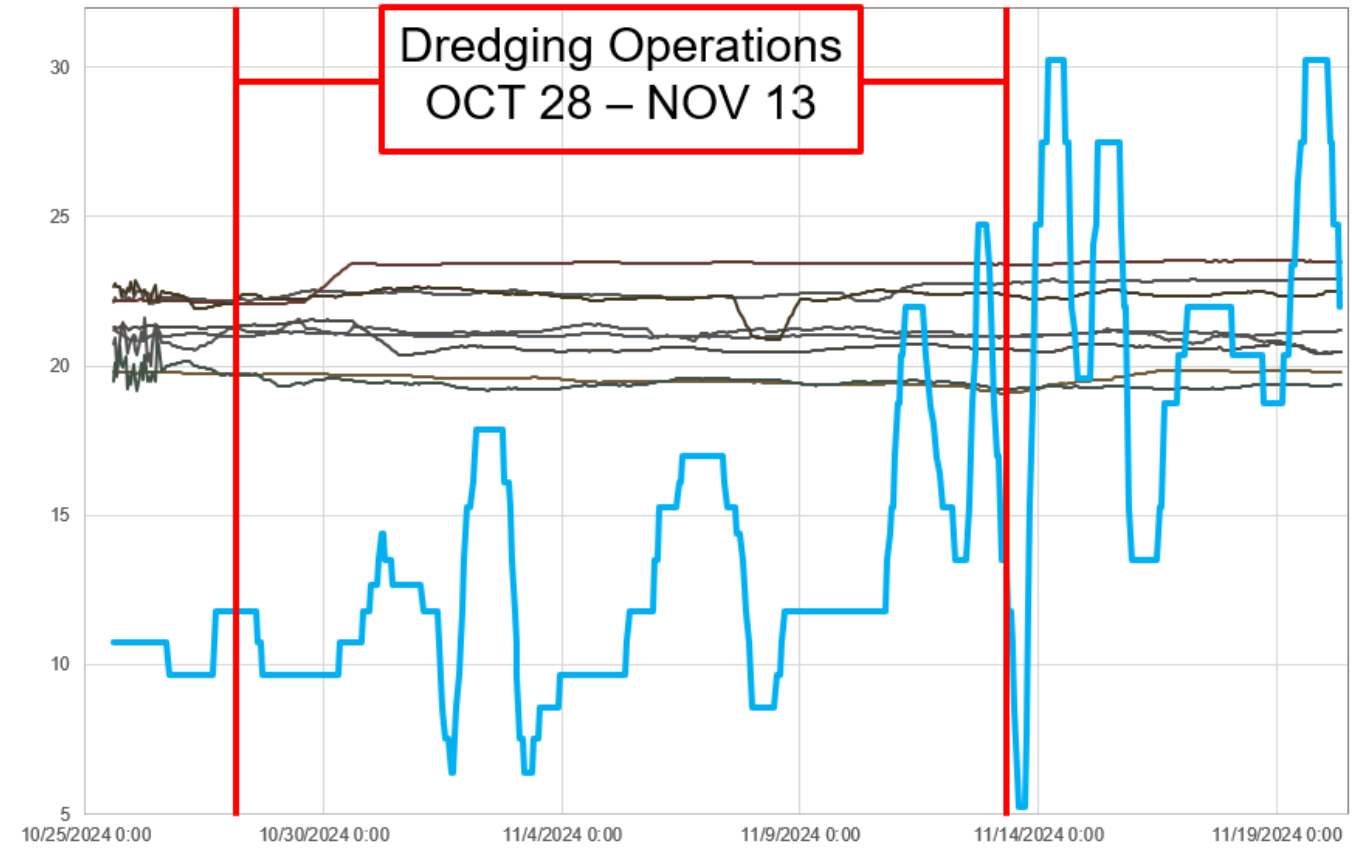

Figure 8. 2024 WIZARD transducer results (black, cm) and flows (blue, kcfs) for RC Byrd dredge monitoring.

Dredge Mission Sediment Analysis

To maintain proper 401 Water Quality certification, the Huntington District is required to sample sediment and raw water from dredging and receiving locations at least once every three years. The LRH Water Quality Team conducts these sampling efforts on behalf of the Waterways Section on a three-year rotating schedule. Locations comprised of more than 20% silt and clay (fines) require in-depth elutriate analyses, whereas locations comprised of less than 20% fine sediment require only particle size analyses to confirm less than 20% fines. Elutriate analyses include metals, nutrients, solids, pesticides, polychlorinated biphenyls (PCBs), chlorinated herbicides, semi-volatile organic compounds, volatile organic compounds, oil & grease, sieve analysis, and some individual specific analytes. Additional elutriate sampling will be performed when locations historically less than 20% fine sediment suddenly yield results greater than 20% fine sediment. Table 3 provides a summary of the locations where sampling was conducted in 2024 and lists any constituents that exceeded state criteria or an EPA recommendation. For more detailed information, see the current Maintenance Dredging Program Mitigation Reports (Appendix B).

The Willow Island Locks and Dam Lower Approach area was sampled in 2024 as part of the routine sediment monitoring program. Elutriate analyses were conducted at the dredge and disposal locations as well as particle size analyses at the dredge location. Elutriate analyses yielded typical results within historical ranges, including high concentrations of

aluminum, arsenic, copper, iron, lead, manganese, and zinc. Because they exceeded a West Virginia or EPA water quality criteria, mixing zone models were generated for these constituents and were reported to the appropriate regulatory agencies. There were no detections of organic constituents above reporting limits.

The Racine Locks and Dam Upper Approach dredging and disposal sites were sampled in 2024 to obtain 401 certifications from the State of Ohio. Elutriate and background water samples were collected per normal routines at the dredging and disposal sites above the dam, which were tested for the normal suite of analytes. However, the Ohio EPA also requested additional sediment sample collection at the dredging site as well as a reference site outside of the dredging area to be analyzed for metals and polycyclic aromatic hydrocarbons. Results were typical for the area and were within historical ranges, showing elevated metals like aluminum, copper, iron, and manganese in the elutriate samples. Because they exceeded an Ohio or EPA water quality criteria, mixing zone models were generated for these constituents and were reported to the appropriate regulatory agencies. There were no detections of organic constituents above reporting limits.

The Racine Locks and Dam Lower Approach area was sampled in 2024 as part of the routine sediment monitoring program as well. Elutriate analyses were conducted at the dredge and disposal locations as well as particle size analyses at the dredge location. Elutriate analyses yielded typical results within historical ranges, including high concentrations of aluminum, copper, iron, and manganese. Because they exceeded a West Virginia or EPA water quality criteria, mixing zone models were generated for these constituents and were reported to the appropriate regulatory agencies. There were no detections of organic constituents above reporting limits.

Dredging locations on the Kanawha River at London Locks, Marmet Locks, Winfield Locks, and Hurricane Creek Bar were sampled in 2024 as part of routine sediment monitoring. These locations are typically less than 20% fine sediment, therefore only particle size analysis was conducted. Analysis results were within historical ranges at these locations, so further elutriate testing will not be conducted per stipulations of the Inland Testing Manual and 401 Water Quality certifications.

Table 3. Summary of locations sampled for the Maintenance Dredging Program in 2024 and constituents that exceeded state criteria or EPA recommendation.

River	Dredge Location	Analysis Type	Constituents that Exceeded One or More State Criteria or EPA Recommendations
Ohio	Willow Island Locks Lower Approach	Elutriate, particle size	Aluminum, arsenic, copper, iron, lead, manganese, zinc
Ohio	Racine Locks Upper Approach	Elutriate, particle size	aluminum, copper, iron
Ohio	Racine Locks Upper Reference Site	Sediment	n/a
Ohio	Racine Locks Lower Approach	Elutriate, particle size	aluminum, copper, iron, manganese
Kanawha	London Locks	Particle size only	n/a
Kanawha	Marmet Locks	Particle size only	n/a
Kanawha	Winfield Locks	Particle size only	n/a
Kanawha	Hurricane Creek Bar	Particle size only	n/a

Mussel Surveys for Navigation Channel Maintenance Program

To maintain compliance with the Endangered Species Act, the Water Quality Team develops and reviews mussel surveys for USACE dredging projects. These surveys are conducted on a five-year rotation at most projects and include semi-quantitative sampling. Additional quantitative surveys are conducted at R.C. Byrd every five years and reconnaissance surveys are conducted as needed. Due to the need for additional disposal options on the Kanawha River, additional reconnaissance and surveys are being completed in the area downstream of the Pocatalico River.

Mussel surveys were developed for the Navigation Channel Maintenance Program to assist in the minimization and avoidance of impacts to mussel resources adjacent to dredging operations. In 2024, semi-quantitative mussel surveys were completed downstream of Racine, and Meldahl Locks and Dam, as well as at Old Lock 31 and Lower Bonanza Bar. These surveys were developed for comparison of previous semi-quantitative surveys and to aid the District in the avoidance and minimization of impacts to mussel resources during maintenance dredging activities at these locations. A survey was also completed in the Winfield pool of the Kanawha River to find additional disposal capacity for upper Kanawha River maintenance projects. Task orders were awarded to Lewis Environmental Consulting on the regional IDIQ contract.

The Lower Bonanza Bar survey showed an increase in the mussel population at the site (Figure 9). This included recruitment of mussels in the certified disposal area. No federally listed mussels were collected during this survey.

The Racine survey effort was an identical resurvey of the 2015 efforts. In general, the distribution of mussels was similar between the 2015 and 2024 surveys.

The Meldahl survey showed increasing densities of mussels along the left descending bank downstream of the dam. The 2024 survey area was smaller than the 2019 survey due to habitat degradation that was documented in previous surveys. It is assumed that new flow patterns due to hydropower operation resulted in changes to the river bottom habitat towards the river channel.

The Old Lock 31 survey showed similar results to the 2019 survey.

The Kanawha River survey completed the semi-quantitative assessments of a proposed disposal location in the Winfield pool. The purpose of this study is to determine a potential alternative disposal site within the middle Kanawha River that would be appropriate for placement of London and Marmet dredge material. The 2024 surveys show a potential disposal area that could result in aquatic habitat benefits through the introduction and stabilization of coarse substrate material in that section of the Kanawha River. The results of the entire study will be incorporated into a biological assessment to determine the future usability of the site. In addition to the biological assessment, the District will continue to work with the WVDNR, WVDEP, and the USFWS to get the required water quality certification for the site.

Figure 9. Mussel resources have expanded at Lower Bonanza Bar (2019 and 2023 are shown). Red areas show mussel beds. Pink areas show low density areas of mussels. The transects and the disposal area (blue checked box) are also shown.

Annual Dredge Partnering Meeting

The Water Quality Team had significant participation in the Annual Partnering Meeting for the District's Dredging mission. The 2024 meeting was held in person in Elkins, WV, and virtually. This meeting provides the District the opportunity to discuss the previous year's dredging, the proposed dredging, the results of any mussel surveys, the 401 Water Quality Certifications, and the mussel concerns surrounding our dredge and disposal areas. Representatives from the WVDNR, USFWS, WVDEP, OEPA, ODNR, KDFWR, KYDOW, and other USACE Districts are invited to participate. Due to our environmental compliance work for the Waterways Section, the Water Quality Team was able to fill the role of District experts for the LRH dredging program.

Water Control Operations

At projects with multi-level intake structures, gates within the structures are opened or closed to satisfy a downstream water quality target (e.g., temperature and/or dissolved oxygen concentration). The degree of success is dependent upon the design of these selective withdrawal structures and the quality of data used to determine water temperatures within lake strata.

To manage dam releases, water quality lake profile data are needed. These data are collected by lake project personnel according to schedules developed by Water Quality staff. Prior to "profiling season" all equipment used to collect water quality lake profile data is quality checked, maintained, and calibrated to District standards by the Water Quality Team. After each lake profile was completed, the data were transmitted to the District, reviewed, and posted for use in daily operations. Calibrated profiling equipment is distributed to selective withdrawal projects.

The Huntington District lake operation strategy is as follows:

1) Store as much cold water in the lakes as possible.

2) Regulate downstream temperatures based on trends of current conditions in conjunction with guide curves to better match current weather patterns.

3) Incorporate ecological sustainability into the overall strategy when possible.

4) *Use deep intakes to make releases after lakes have mixed in the fall and until they re-stratify the following spring.*

5) Evaluate e-flow releases to improve downstream habitat.

The Water Quality team supported these goals by providing accurate water quality profiles of the lakes as well as supportive data from the outflow and the projects' significant inflows.

In addition, the Water Management Section is continuing to merge the concept of sustainable water resource management into its operation of flood control projects as it aligns with the USACE's Environmental Operating Principles. Based on these principles, the section continues its efforts to measure effects of its projects on the environment and to explore alternate ways of managing releases to improve environmental conditions and achieve project purposes. With more multi-level intake structures than any other USACE District, Huntington has a leading role in achieving sustainable solutions when operating flood control projects.

As stated above, project staff collect lake profile data. The data are used by the Water Quality Team and Water Management Section to make daily operations determining the quality of the release water. The data are also posted to the District Water Management website (www.lrh-wc.usace.army.mil/wm/) in summary plots (Figure 10). The most current temperature and dissolved oxygen profiles along with pool information, water condition, gate operation, and historical average conditions are displayed on the website plots.

Beginning in early September, the Water Resources Engineering Section evaluates hydro-meteorological conditions, water quality conditions, and recreational factors to determine when winter drawdown should start. The winter drawdown schedule takes not only water quality into consideration, but also other competing projects purposes such as white water, recreation, and fish and wildlife conservation.

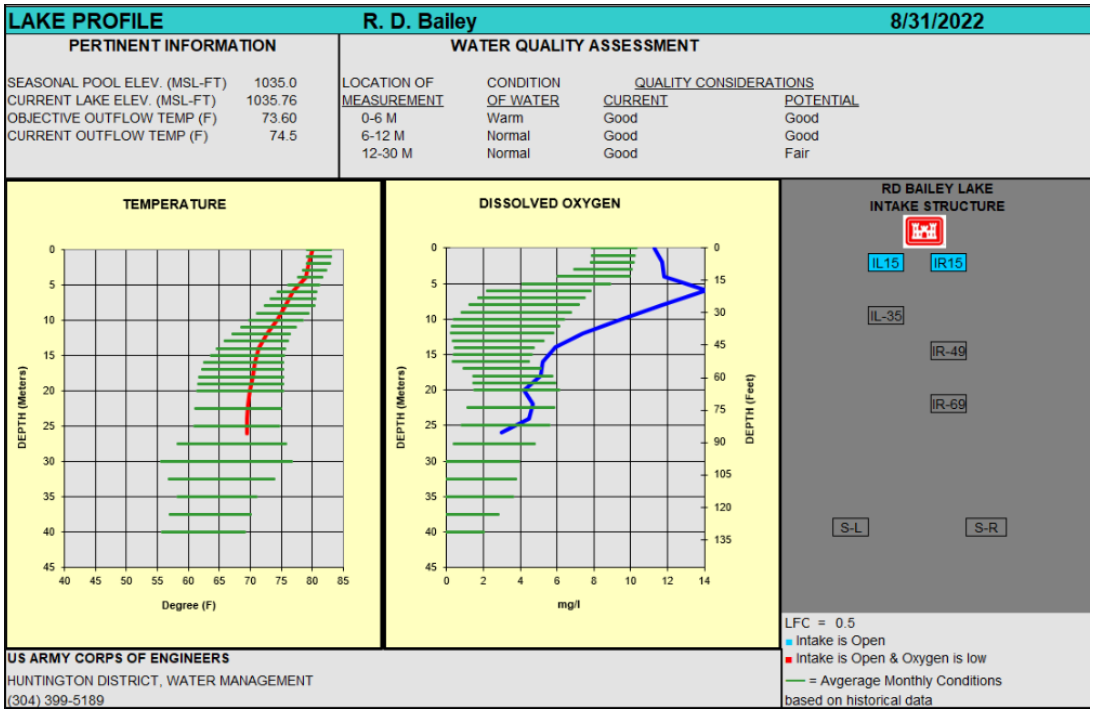

Figure 10. An example of the informational plots featured on the District Water Management public website. The plots are an output of the LRH lake profiling program.

In coordination with the lake profiles, real-time flow measurements below a project are also sometimes necessary to "calibrate" gate settings to meet low flow guidelines established by the Water Control Manual. The Water Quality Team is often employed for this task, using either an Acoustic Doppler Current Profiler (ADCP) or a traditional hand-held flow meter.

Kanawha River Augmentation

A YSI multiparameter sonde is deployed annually upstream of the Winfield Locks and Dam for the determination of augmentation needs on the Kanawha River. This probe is maintained throughout the critical summer water quality period. Depending on temperature and dissolved oxygen levels at Winfield, additional flows can be released from Sutton and Summersville lakes to meet water quality targets developed in coordination with the West Virginia Department of Environmental Protection. Weather and flow conditions during 2024 resulted in conditions that required augmentation to maintain adequate oxygen levels and temperatures. The dissolved oxygen at Winfield fell below 5 mg/L during the critical flow periods of July to October. Flows also fell below augmentation targets during this time. As a result, Sutton and Summersville Lakes were required to augment flows for Charleston.

Floating Wetlands

The LRH Water Quality team is assisting Operations in implementing floating wetlands at Paint Creek Lake's Little Pond. This five-year feasibility study will investigate the cost of multiple floating wetland designs, nutrient reduction in the water body, and the durability of floating wetlands on USACE projects. Floating wetlands have been used in various locations around the world to help reduce nutrients within the body of water they are residing in. Most applications of floating wetlands are found in retention ponds around urban areas that have high nutrient inputs, but they are also found in wastewater lagoons and small riverine systems. The ability to place these floating wetlands within USACE lake projects that have seasonal elevation changes could be beneficial to help combat the persistent HAB presence that is found in lakes.

In November 2023, the Water Quality Team completed a bathymetry survey of Little Pond at Paint Creek Lake to develop a depth-contour. This depth contour gave the PDT an idea of what the substrate looks like of Little Pond and informed where the floating wetlands will be placed. The Water Quality Team continues to assist the PDT as technical advisors on monitoring, nutrient uptake, and HABs. Construction and initial deployment of the floating wetlands is scheduled for Spring 2025.

Alum Creek Lake Sewage Discharge Proposal

For approximately nine years, Delaware County has proposed a sewage treatment plant adjacent to Alum Creek Lake and has requested permission to discharge the treated sewage directly into Alum Creek. The Water Quality Team has assisted Operations, Office of Counsel, and Real Estate with ongoing coordination, policy compliance, and protection of the lake's authorized project purposes of flood control, recreation, water quality, and fish and wildlife conservation. The Water Quality Team has been involved heavily with policy discussion, letter drafting, and meetings with the County.

Bathymetric Surveys

The Water Quality Team completed a bathymetric survey of R.D. Bailey Lake in 2024 to update the storage curve used in the Corps Water Management System (CWMS) for daily water management modeling and operations (Figure 11). Bathymetry measurements were collected using a SonTek M9 Acoustic Doppler Current Profiler (ADCP) and a YSI EcoMapper AUV (autonomous underwater vehicle) and used to generate TIN (triangular irregular network) models in HYPACK (Figure 12). Additionally, the TIN data was used to generate a depth raster of the lake (Figure 13).

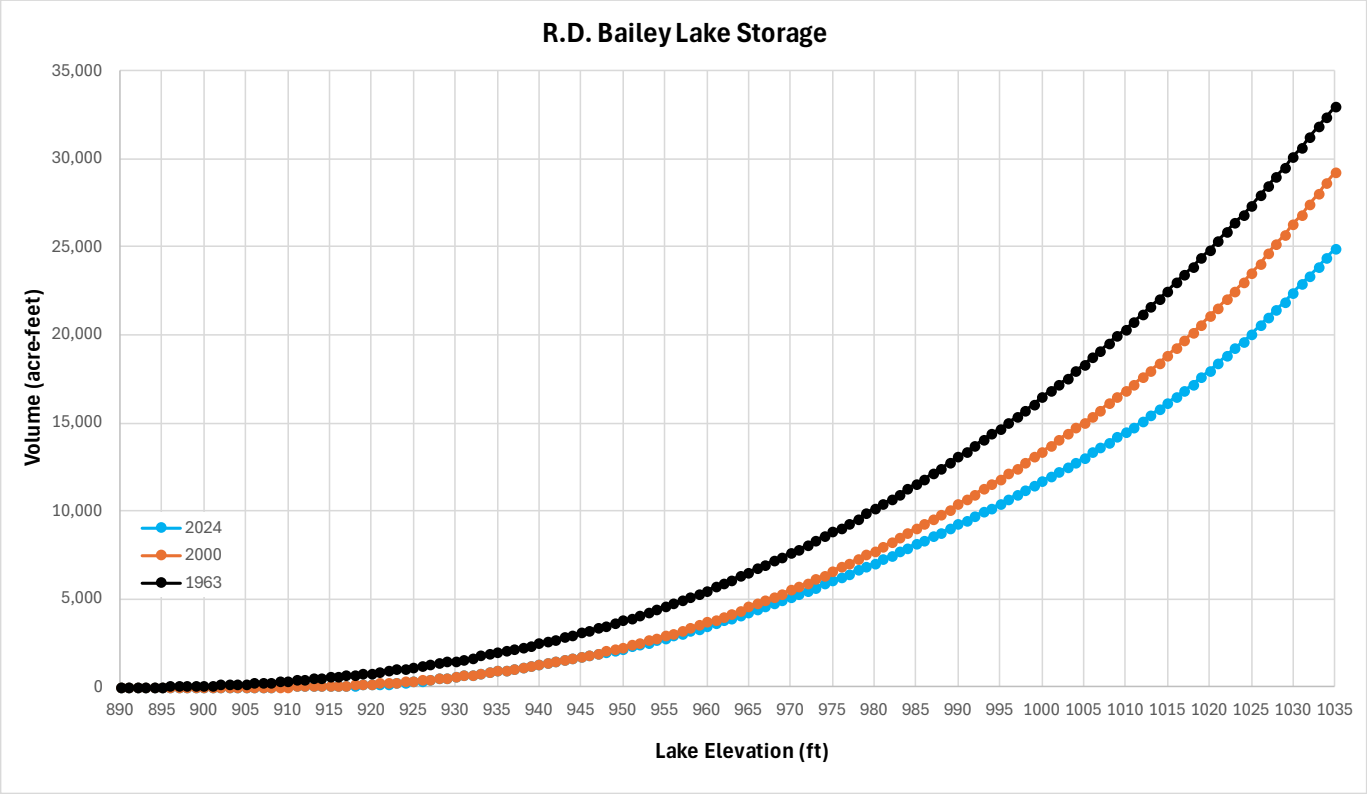

Figure 11. 2024 R.D. Bailey Lake storage curve. Lake elevation 1035 ft (orange) denotes summer pool elevation and 1012 ft (blue) denotes winter pool elevation.

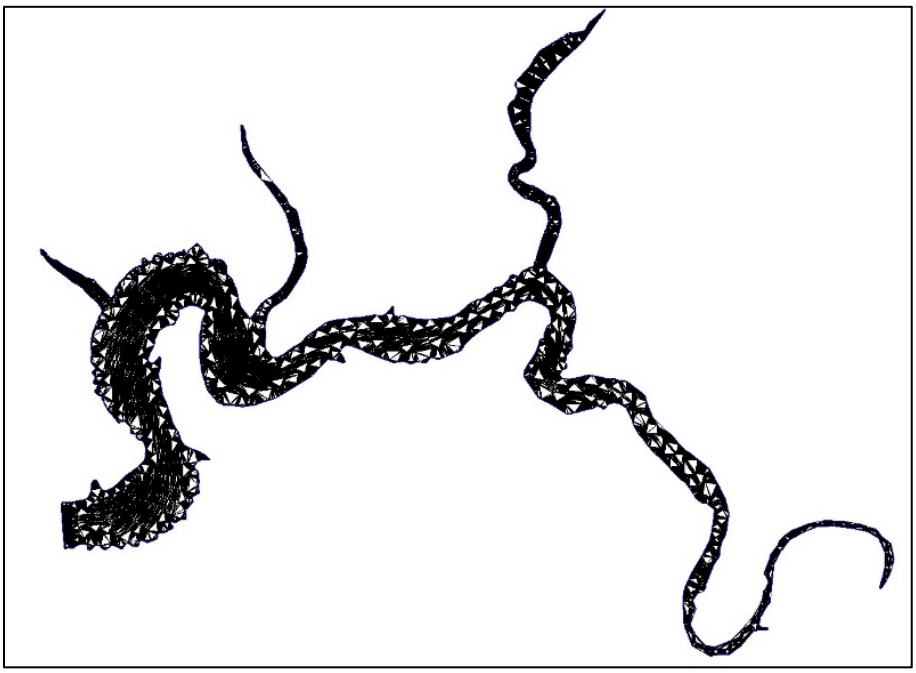

Figure 12. 2024 R.D. Bailey Lake bathymetry survey TIN model.

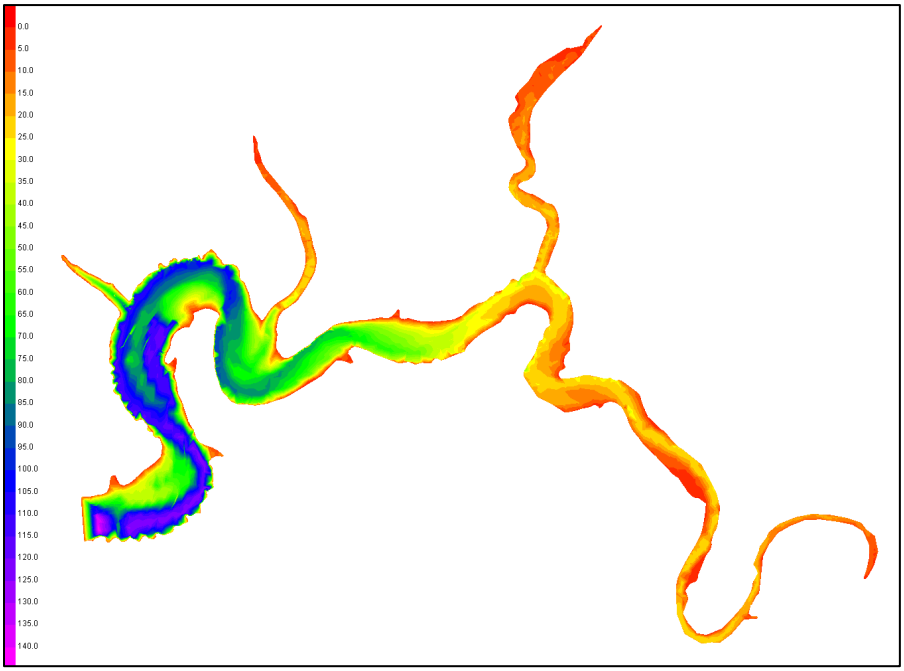

Figure 13. 2024 R.D. Bailey Lake bathymetry survey depth raster. Depths in feet.

Water Quality Enterprise Database PDT

Since 2019 Water Quality staff have been members of a PDT to develop a Corps-wide water quality database. This enterprise application is expected to replace outdated water quality databases across the Corps of Engineers as well as provide a solution for those Districts lacking in data management capabilities. Members from multiple districts were represented including Baltimore, Huntington, Louisville, Nashville, New England, Pittsburgh, and LRD Headquarters. The PDT was tasked with development of a database that combined the tools and functionality of existing data management

solutions such as Dasler and Aquarius Samples with tailored, unique features that would help support the USACE Water Quality mission.

Current development has been transferred to CRREL, but PDT members will still have a stake in future work to complete the application. After preliminary investigations and discussions with CRREL personnel, it has been determined that most of the existing framework for the application will not be usable due to it being developed with outdated language and methods. CRREL staff have also indicated that the application will have low priority due to existing workloads and funding, and work will not begin until FY2026 at the earliest. The application is not usable at this time and Districts are currently looking into other temporary data management options to sustain the mission until the database is complete, which includes some transitioning back to Dasler.

Situational/Reactionary Support

The list below describes instances where the Water Quality Team provided situational/reactionary support or guidance to other organizations in 2024.

Assessing Conditions at Paintsville Lake for Maintaining Populations of Threadfin Shad

The Water Quality Team has been collaborating with the Kentucky Department of Fish and Wildlife Resources (KDFWR) to assess whether the temperature conditions in Paintsville Lake can support threadfin shad. Originating from rivers throughout the southern United States and Central America, threadfin shad are small pelagic fish that are often stocked to provide forage for largemouth bass. In April 2023, a local fishing association stocked 50,000 threadfin shad in Paintsville Lake with the goal of establishing a long-term population. During the summer of 2023, KDFWR observed evidence of prolonged threadfin shad reproduction through larval trawl sampling. It was unknown if threadfin shad could survive the cold winter temperatures at Paintsville Lake.

Research has shown that threadfin shad become stressed at temperatures around 45°F and can die off at 42°F. At Paintsville Lake, temperatures frequently fall below 40°F as recorded at the outflow gage, suggesting it was unlikely for threadfin shad to survive. To supplement temperature data from the outflow gage, the Water Quality Team placed temperature loggers in Paintsville Lake in December 2023 (Figure 14). These loggers were hung on buoys at the outlet tower, mid-lake, and at the top of the lake to identify potential areas that could provide thermal refuge for the shad.

In February 2024, the team assisted KDFWR with electrofishing to determine whether threadfin shad survived their first winter in the lake. Few adult threadfin shad were collected from the mid-lake section, revealing that some had survived. No threadfin shad were collected from the upper branches of the lake. Data from the logger at the tower showed temperatures above 40°F the entire winter, with a low temperature reaching 40.6°F (Figure 15). The temperatures at mid-lake were similar, with a low reaching 39.8°F (Figure 15). The upper branches of the lake both showed temperatures below 40°F for a few weeks, with the low temperature of the northern and southern branches reaching 34.0°F and 37.8°F respectively (Figure 15).

An additional 50,000 threadfin shad were stocked in Paintsville Lake in April 2024. Throughout the summer and early fall of 2024, larval trawl sampling revealed that the shad spawned earlier in the season and did not experience the prolonged spawning period observed in 2023. A follow-up electrofishing survey by KDFWR in the fall of 2024 showed an increase in threadfin shad numbers compared to the spring.

Additional population surveys are planned for 2025, and the local fishing association intends to stock another batch of threadfin shad in Paintsville Lake in the spring. The Water Quality Team will retrieve temperature data from the loggers and redeploy them for another season to continue monitoring the temperature conditions.

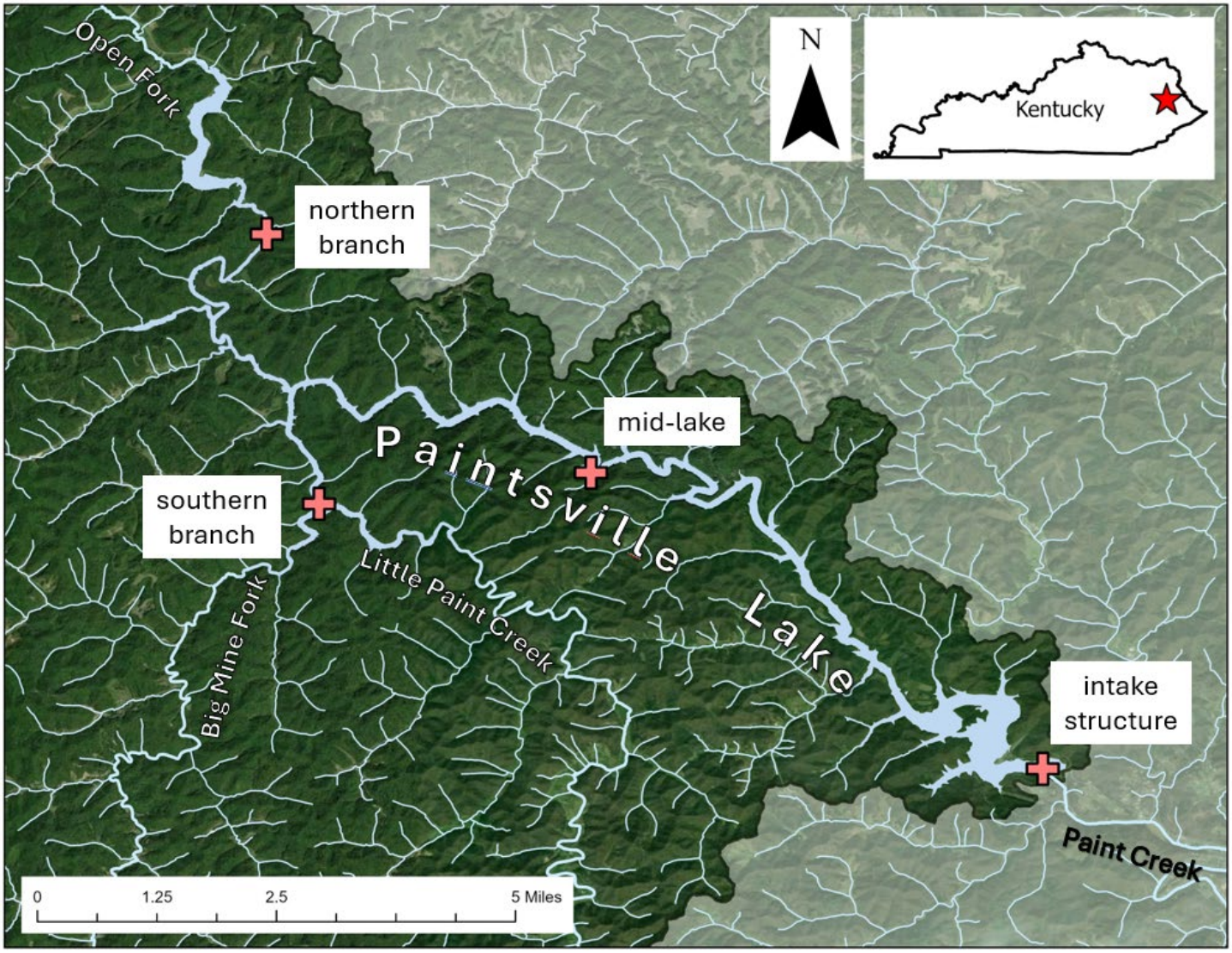

Figure 14. A map of Paintsville Lake, Kentucky, showing the locations of HOBO temperature loggers, which were placed at the intake structure, mid-lake, the southern branch, and the northern branch.

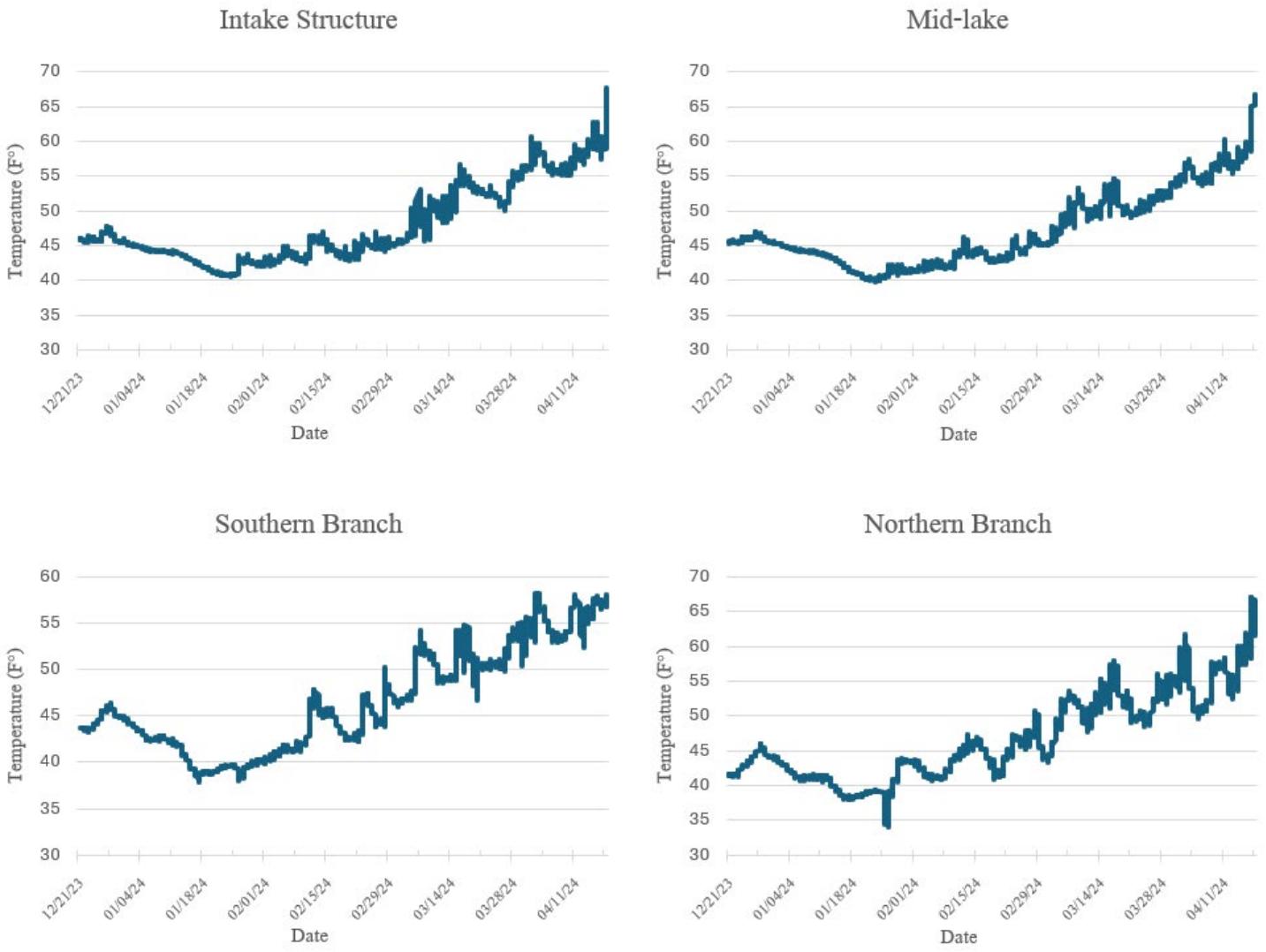

Figure 15. Temperature data was recorded every hour at four locations in Paintsville Lake from 21 DEC 2023 to 18 APR 2024. The northern and southern branches experienced prolonged periods of lower temperatures, conditions that are inhospitable for threadfin shad.

Grayson Lake Oil Spill

The Water Quality Team collected samples and water quality measurements following an oil and brine spill at a tributary of Grayson Lake in late January 2024. Kentucky Emergency Management was first alerted to the spill on 28 JAN 24, which had occurred in Big Caney Creek. The source of the spill was traced to a brine tank on private property and the leak was repaired by 30 JAN 24. An undetermined amount of brine was released into the lake and oil was observed on the property, in an unnamed tributary, and in Big Caney Creek. Kentucky Emergency Management deployed contractors to install absorbent booms at the mouth of Big Caney Creek and to collect all contaminated solids and sediments.

The Water Quality Team took specific conductance readings on 06 FEB 24 in Big Caney Creek upstream of the SR 504 culvert and near the Caney Creek boat ramp at Grayson Lake. The readings ranged between 130-140 µS/cm. During the visit, oil was observed in Big Caney Creek trapped in debris piles and on rocks and on the banks (Figure 16).

To test for residual contamination after the spill cleanup, on 26 APR 24, the Water Quality Team collected water samples near the mouth of Big Caney Creek. Gas, diesel, and oil analytes were non-detectable. Additional sampling was deemed unnecessary and no complaints regarding residual oil were received.

Figure 16. An oil spill occurred in Big Caney Creek, a tributary of Grayson Lake, causing oil to be visible on the streambank and leading to the deployment of two sorbent booms at the mouth of the creek.

Hydrilla Survey at Alum Creek Lake

The Water Quality Team assisted with the annual hydrilla survey at Alum Creek Lake on 25 SEP 24. This year's survey involved staff from USACE Operations at Alum Creek and Delaware, the Ohio Department of Natural Resources, Cleveland Metroparks, and the City of Columbus. Hydrilla was first discovered in Alum Creek Lake in 2021 and has since spread throughout the lake. As a result, herbicide treatments have been required in recreational areas and around boat ramps. Additionally, hydrilla poses risks to lake operations.

The Water Quality Team surveyed over five miles of the littoral zone, documenting hydrilla coverage using GPS. The survey recorded the depth at which hydrilla was present, documented other species encountered, and categorized hydrilla coverage as none, sparse, or dense. A throw rake was used to ensure accurate identification of hydrilla and to survey deeper waters. Additionally, the team encountered *Potamogeton wrightii*, a non-native pondweed. This species, first observed in Alum Creek Lake in 2021, is currently only known to occur in North America at this location. The survey results will be released in 2025.

Hydrilla Survey at Clendening Lake

Hydrilla was first discovered at Tappan Lake in 2024 by staff from the Muskingum Watershed Conservancy District (MWCD). This marked the first known occurrence of the invasive aquatic plant in a Muskingum area lake. In response, MWCD began treatment for hydrilla and decided to survey the remaining lakes in their district: Atwood, Beach City, Charles Mill, Clendening, Leesville, Piedmont, Pleasant Hill, Seneca, and Wills Creek. The Water Quality Team supported MWCD by conducting surveys of Clendening Lake on 12 SEP 24 and 17 SEP 24.

During these surveys, the team focused on the littoral zone of the lake and used a throw rake to perform spot checks on macrophyte beds for signs of hydrilla. While no hydrilla was found, the team observed brittle naiad, Eurasian water-milfoil, fennel-leaf pondweed, coontail, and American lotus. MWCD did not find hydrilla in any of their other lakes, and it remains present only in Tappan Lake.

Bluestone Lake Fish Kill

A fish kill occurred at Bluestone Lake around 29 JUN 24. Rangers on boat patrol observed a few dozen dead channel catfish, carp, and shad throughout the lake. WVDNR was aware of the issue and noted that fish kills have occurred intermittently at Bluestone Lake around the beginning of July for decades. However, they have been unable to confirm a definitive cause. The fish kill appears to coincide with the hatching of burrowing mayflies, which occurs most years

around the same time. The working hypothesis is that the emergence of mayflies from the substrate quickly depletes a significant amount of dissolved oxygen.

The Water Quality Team conducted a site visit on 2 JUL 24 to investigate the fish kill. A few decomposing fish from the kill were observed, along with numerous burrowing mayfly skins floating in the lake, which confirmed that a hatch had occurred. A normal stratified lake profile was observed with sufficient dissolved oxygen levels down to 7 meters. To further investigate, the Water Quality Team is working to deploy a lake buoy to monitor dissolved oxygen levels during the period when fish kills typically occur (June-July). The buoy would measure DO levels throughout the water column over time to determine if oxygen depletion is contributing to the fish kills.

North Branch of Kokosing River Lake Dead Storage

Significant drought conditions persisted in October 2024, which led to concerns about losing reservoir storage at North Branch of Kokosing River Lake. The Water Control Manual states that the dam must operate to maintain minimum pool of 1121' and a minimum outflow of 1 cfs. This led to additional concerns about impacts to the fishery within the lake and mussels downstream of the lake.

The Water Quality Team conducted a bathymetric assessment within the lake to determine if there were any areas below the depth of the sluice gate that would have held any remaining water storage in the event of losing pool. There was a small area in front of the sluice gate that would have held negligible dead storage, which would have left no refugia for the fishery (Figure 17).

The Water Quality Team also conducted a flow assessment on October 28th throughout the downstream to determine impacts to mussels if the outflow dropped below minimum flow (Figure 18). The immediate tailwater measured 2.1 cfs, and outside of this area (approximately two-mile reach) the stream fed into a quarry system, which upon exiting, gained an additional 5 cfs. Flow coming from Knox Lake (East Branch of Kokosing River) was flowing at 4 cfs before joining the confluence of the North Branch Kokosing River at Fredericktown. Based on the measured flows, the tailwater area upstream of the quarry system was likely the only section that would have potentially incurred impacts related to a decrease in outflow from North Branch of Kokosing River Lake.

In conjunction with Ohio Department of Natural Resources (ODNR), the Water Quality Team assessed habitat and mussel resources throughout the downstream. Several areas in the tailwater upstream of the quarry system contained deep pools that would likely have continued to hold water in the absence of flow. Habitat for mussels was good, but no live mussels were observed. At the time of this assessment, North Branch of Kokosing River Lake stopped losing significant pool. However, USACE and ODNR concurred on potential future plans as a result of the assessment.

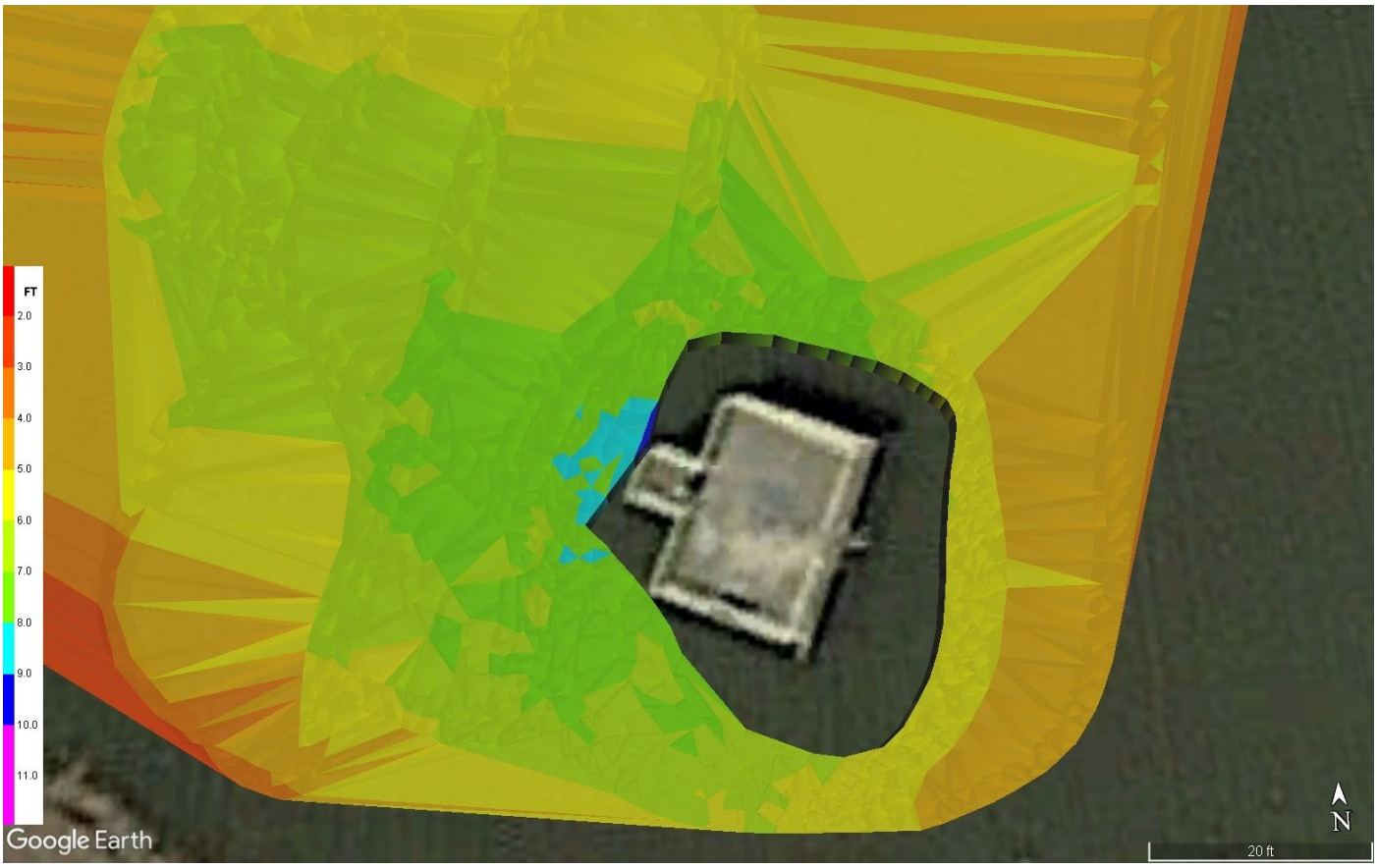

Figure 17. Bathymetry raster near the intake structure at North Branch of Kokosing River Lake highlighting the small area that would have held negligible water storage below the depth of the sluice gate (dark blue).

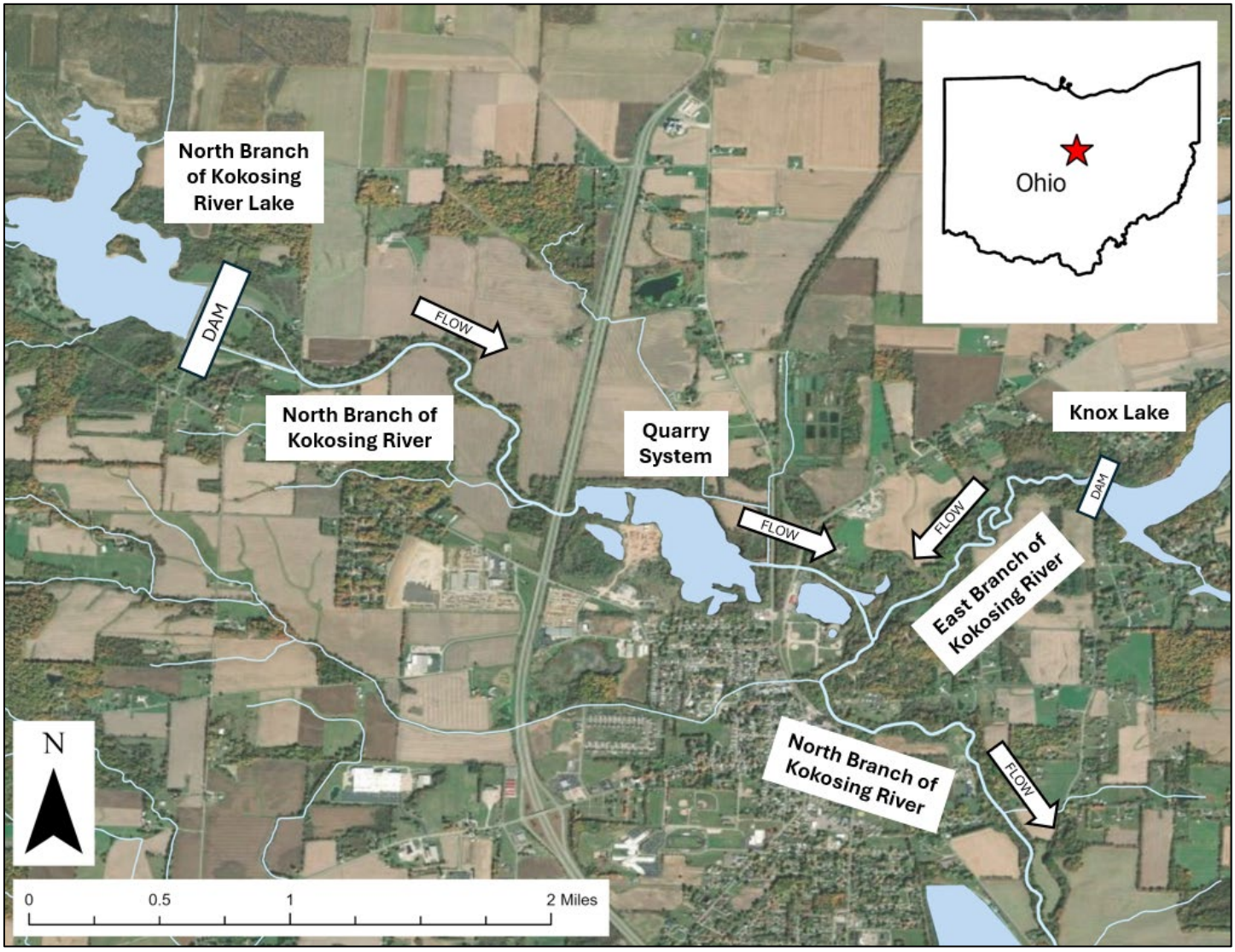

Figure 18. North Branch of Kokosing River Lake and the downstream.

STEM

LDP2 Technical Demo – The Water Quality Team presented a technical demonstration for the Leadership Development Program Level 2 at Harris Riverfront Park on the Ohio River in May 2024. The demonstration included data collection using M9 ADCPs, water quality sondes, and electrofishing units while informing students about the capabilities and uses to support multiple purposes for the District.

Trail Snail Nature Group – The Water Quality Team presented to Trail Snail Nature Group students at Beech Fork Lake, WV in July 2024 about the importance of water quality, monitoring, fish, and Water Management in the District.

Cabell County Water Festival – The Water Quality Team presented a booth at the Cabell County Water Festival at Barboursville Park, WV in October 2024. Water Quality Staff educated a variety of students about the Water Quality Mission, benthic macroinvertebrates, freshwater mussels, and fish.

Coordination with Other Agencies

Muskingum Watershed Conservancy (MWCD) – The LRH Water Quality Team maintains ongoing coordination with the MWCD. The MWCD provides the Water Quality Team with assistance in the field during years when a Muskingum basin project falls on the intensive sampling schedule. Where staffing levels permit, the MWCD may opt to perform sampling duties themselves, which lessens the workload of the Water Quality Team, or they may accompany the Water Quality Team during sampling events. The Water Quality Team also coordinates closely with the MWCD during environmental events such as a HAB at a Muskingum basin project.

WV Division of Natural Resources (WVDNR) – The LRH Water Quality Team frequently collaborates with the WVDNR on fish collection and mitigation efforts in the LRH District. In recent years, the team has partnered with the WVDNR and USFWS to support the lake propagation of native mussels at Burnsville and Sutton Lakes. In 2024, the Water Quality Team assisted at Sutton Lake by placing a new generation of mussels, consolidating mussel grow-out cages, and maintaining those cages. A total of 4,860 juvenile mussels, including *Lampsilis fasciola*, *L. ovata*, *L. cardium*, and *L. siliquoidea*, were placed in the cages at Sutton Lake. Additionally, 1,244 mussels that had been placed in grow-out cages in previous years were consolidated into two cages for continued grow out. Past efforts have successfully produced stockable-size mussels, which have been relocated to various areas across the state of West Virginia. This ongoing program is expected to continue benefiting the West Virginia mussel resource through cooperative efforts.

Ohio River Valley Mollusk Group – The Water Quality Team attended the Ohio River Valley Mollusk Group meeting at Thomas More University Biology Field Station in March 2024.

Ohio University – The Water Quality Team was involved in an effort to update the Ohio River Nutrient Reduction Strategy with Ohio University in 2024. The Ohio EPA awarded a grant to update the plan along with a group of stakeholders as part of the Gulf Hypoxia Task Force. In addition to the USACE, stakeholders from many organizations were represented such as Ohio EPA, Ohio Department of Agriculture, USGS, and ORSANCO. The group met monthly throughout 2024 to establish target watersheds, identify data gaps, prioritize goals for the basin, and prepare a final report. The report will help guide decision makers in improving water quality programs in watersheds throughout Ohio.

The Nature Conservancy – The Nature Conservancy was completing an analysis of the resilience of freshwater systems in North America which included considering how dams obstruct movement of aquatic organisms. The Water Quality Team provided information regarding fish passage at Muskingum projects.

Mohican River Watershed Degradation – The LRH Water Quality Team has assisted in determining the source of increased nutrient loads and subsequent watershed degradation in the Mohican River basin. The Ohio EPA Large River Survey report showed that water quality is declining in the Mohican River, which is currently listed as a State Scenic River. Preliminary discussions have focused around identifying data gaps and next steps needed to address the issue, with meetings scheduled throughout 2024. This is a multi-agency effort that includes the Muskingum Watershed Conservancy, Ohio EPA, Ohio DNR, as well as other local water quality organizations in the basin.

Requests for Data

The Water Quality Team is often called to fulfill Freedom of Information Act (FOIA) requests from outside agencies or individuals, or data requests from other government entities. The following list details requests for LRH Water Quality data in 2024:

- **Kent State University** – physical and chemical water quality data from Atwood, Leesville, and Tappan Lakes
- **MWCD** – physical profile data from Atwood, Leesville, and Tappan Lakes
- **Youngstown State University** – nutrient, temperature, and sedimentation data for Tappan Lake
- **KY Division of Water** – routine data call for KY lakes within LRH district
- **Ohio Division of Natural Resources** – nutrient and sedimentation data for Dillon Lake
- **WV Department of Environmental Protection** – routine data call for WV lakes within LRH district

Training and Professional Development

National Committee on Water Quality - Andrew Johnson is a member of the USACE National Committee on Water Quality which is comprised of representatives from many districts and results in technical support related to water quality operations throughout the Corps.

LRD Water Quality Meeting – Lakes and Rivers Division hosted a Water Quality Program Review in January 2024 in Cincinnati, OH. The goals of the meeting were for Districts to provide a self-assessment, to facilitate cross-talk between Districts, and to look for opportunities to improve efficiencies.

Training - In addition to the mandatory USACE training courses, the following training or professional development courses were completed and/or ongoing in 2024 by one or more members of the Water Quality Team:

- Principles and Techniques of Electrofishing, National Conservation Training Center – Josh
- Prospect Course 280, Ecosystem Restoration – Andy
- Statistical Modeling for Conservation, National Conservation Training Center – Thad
- CURG – Nate

Looking Forward

Watershed land uses and water quality issues are continually changing, providing new challenges for our program. Socioeconomic and environmental needs are in constant flux and are impacting many of our watersheds. Along with resource extraction shifting from coal mining to natural gas hydraulic fracturing, record dry, hot years have impacted water quality throughout the District. This year's activities and findings have emphasized several needs and modifications to the water quality program.

Intake structure modifications at Muskingum Basin Lakes have proven successful. Studies completed at Tappan, Clendening, and Piedmont lakes have yielded highly positive results. Atwood and Leesville lakes remain scheduled for modification in the future.

Environmental Flows describe the management of water flow needed to sustain or increase wildlife habitat quality and water quality while managing operational needs. The District continues to work on Sustainable Rivers Projects and looks for potential e-flow opportunities.

Partnerships with other agencies and watershed groups are extremely beneficial when planning or implementing a monitoring strategy. Increasing our network of partnerships at the watershed level should continue to be a goal over the next couple of years. This provides us more intimate knowledge of a watershed and more "eyes" on the stream.

Bathymetry surveys were completed at several lakes to update the storage curves used in CWMS for daily water management modeling and operations. These surveys will continue to be conducted yearly and as needed.

Stream restoration or mitigation efforts may benefit project waters experiencing chronic water quality issues, much like the wetland treatment areas at Wills Creek Lake. These wetlands are settling out metals that previously were directly entering Wills Creek Lake and possibly impacting the biota. Chronic environmental issues impacting District lakes and inflows should be prioritized and these sources considered for some type of remediation. Sediment erosion and sedimentation of lake headwaters are a major issue that can potentially benefit from passive treatment such as in-stream structures that will lessen the sediment loads entering the lakes.

Appendix A - Informational Tables

Table 4. Complete list of sampling locations and descriptions for 2024.

PROJECT	LOCATION ID	TYPE	NAME	COUNTY	STATE	LATITUDE	LONGITUDE
Alum Creek	ACS0001	Stream	Alum Creek of Scioto River	Delaware	Ohio	40.18416667	-82.96388889
Alum Creek	ACS0002	Lake	Alum Creek of Scioto River	Delaware	Ohio	40.18638889	-82.96861111
Alum Creek	ACS0003	Stream	Alum Creek of Scioto River	Delaware	Ohio	40.35583333	-82.92194444
Alum Creek	ACS0013	Stream	Big Run of Alum Creek	Delaware	Ohio	40.27777778	-82.98027778
Deer Creek	DCS0001	Stream	Deer Creek of Scioto River	Pickaway	Ohio	39.619444	-83.212222
Deer Creek	DCS0002	Lake	Deer Creek of Scioto River	Pickaway	Ohio	39.620833	-83.214722
Deer Creek	DCS0013	Stream	Deer Creek of Scioto River	Fayette	Ohio	39.652333	-83.262944
Deer Creek	DCS0014	Stream	Clarks Run of Deer Creek	Pickaway	Ohio	39.650527	-83.238194
Delaware	DEO0001	Stream	Olentangy River of Scioto River	Delaware	Ohio	40.35813	-83.069212
Delaware	DEO0002	Lake	Olentangy River of Scioto River	Delaware	Ohio	40.359699	-83.069125
Delaware	DEO0019	Stream	Olentangy River of Scioto River	Marion	Ohio	40.459722	-83.071388
Delaware	DEO0021	Stream	Whetstone Creek of Olentangy River	Delaware	Ohio	40.415555	-83.020277
Grayson	GRL0001	Stream	Little Sandy River of Ohio River	Carter	Kentucky	38.254722	-82.989166
Grayson	GRL0002	Lake	Little Sandy River of Ohio River	Carter	Kentucky	38.250833	-82.984166
Grayson	GRL0003	Stream	Little Sandy River of Ohio River	Elliot	Kentucky	38.114652	-83.115621
Grayson	GRL0009	Stream	Big Caney Creek	Elliot	Kentucky	38.155833	-83.089722
Grayson	GRL0010	Stream	Newcombe Creek of Little Sandy River	Elliot	Kentucky	38.073611	-83.054166
Grayson	GRL0033	Stream	Big Caney Creek	Elliot	Kentucky	38.148888	-83.106944
Grayson	GRL0035	Stream	Middle Fork of Little Sandy River	Elliot	Kentucky	38.092138	-83.090861
Kanawha River	KR02912	Dredge	Kanawha River at Hurricane Creek	Putnam	West Virginia	38.535833	-81.945279
Kanawha River	KR02919	Disposal	Kanawha River at Hurricane Creek	Putnam	West Virginia	38.539475	-81.948706
Kanawha River	KR03061	Disposal	Kanawha River at Winfield Locks	Putnam	West Virginia	38.524482	-81.92411
Kanawha River	KR03069	Dredge	Kanawha River at Winfield Locks	Putnam	West Virginia	38.525278	-81.922222
Kanawha River	KR06671	Disposal	Kanawha River at Marmet Locks	Kanawha	West Virginia	38.262393	-81.573177
Kanawha River	KR06729	Dredge	Kanawha River at Marmet Locks	Kanawha	West Virginia	38.256726	-81.568529
Kanawha River	KR08219	Disposal	Kanawha River at London Locks	Kanawha	West Virginia	38.1968	-81.374096
Kanawha River	KR08229	Dredge	Kanawha River at London Locks	Kanawha	West Virginia	38.19485	-81.372165
Ohio River	OR16209	Dredge	Ohio River at Willow Island Locks	Pleasants	Ohio	39.358528	-81.324556
Ohio River	OR16230	Disposal	Ohio River at Willow Island Locks	Pleasants	Ohio	39.354444	-81.326944
Ohio River	OR23751	Dredge	Ohio River at Racine Locks	Meigs	Ohio	38.915833	-81.914611
Ohio River	OR23757	Disposal	Ohio River at Racine Locks	Meigs	Ohio	38.913972	-81.911389
Paint Creek	PCS0001	Stream	Paint Creek of Scioto River	Highland	Ohio	39.252755	-83.348504
Paint Creek	PCS0002	Stream	Paint Creek of Scioto River	Highland	Ohio	39.319972	-83.386111
Paint Creek	PCS0009	Stream	Rattlesnake Creek of Paint Creek	Highland	Ohio	39.290833	-83.456388

Paint Creek	PCS0014	Lake	Paint Creek of Scioto River	Highland	Ohio	39.248611	-83.355833
Senecaville	SES0001	Stream	Seneca Fork of Wills Creek	Guernsey	Ohio	39.924416	-81.437972
Senecaville	SES0002	Lake	Seneca Fork of Wills Creek	Guernsey	Ohio	39.925666	-81.432638
Senecaville	SES0003	Stream	Seneca Fork of Wills Creek	Noble	Ohio	39.854083	-81.277194
Senecaville	SES0004	Stream	South Fork of Seneca Fork	Noble	Ohio	39.843222	-81.317388
Senecaville	SES0010	Stream	Beaver Creek of Seneca Fork	Noble	Ohio	39.901194	-81.319555
Senecaville	SES0014	Stream	Glady Run of Seneca Fork	Noble	Ohio	39.859416	-81.345194
Senecaville	SES0015	Stream	Mud Run of Seneca Fork	Noble	Ohio	39.880944	-81.370222

Table 9. List of state-designated impaired waterways sampled by USACE in 2024 during intensive surveys.

Project Name	Waterbody Name	Stations on Waterway	Station Type	Watershed	Impairment
Alum Creek	Alum Creek	ACS0001	Inflow	Scioto	*E. coli*, Sedimentation/Siltation, Habitat Alterations, Nutrients, Organic Enrichment/Low Dissolved Oxygen, Temperature, TSS, Flow Regime Modification
Alum Creek	Big Run	ACS0013	Inflow	Scioto	*E. coli*, Sedimentation/Siltation, Habitat Alterations, Nutrients, Organic Enrichment/Low Dissolved Oxygen, Temperature, TSS, Flow Regime Modification
Deer Creek	Deer Creek	DCS0001	Outflow	Scioto	*E. coli*, Nutrients, Organic Enrichment/Oxygen Depletion
Deer Creek	Deer Creek Lake	DCS0002	Lake	Scioto	*E. coli*, Nutrient/Eutrophication Biological Indicators
Deer Creek	Deer Creek	DCS0013	Inflow	Scioto	*E. coli*
Delaware	Olentangy River	DEO0019	Inflow	Scioto	*E. coli*, Sedimentation/Siltation, Habitat Alterations, Nutrients, Flow Regime Modification
Delaware	Olentangy River	DEO0001	Outflow	Scioto	*E. coli*, Sedimentation/Siltation, Habitat Alterations, Nutrients, Flow Regime Modification
Delaware	Whetstone Creek	DEO0021	Inflow	Scioto	*E. coli*, Sedimentation/Siltation, Habitat Alterations, Nutrients, Thermal Modifications, Flow Regime Modification
Grayson	Little Sandy River	GRL0003	Inflow	Little Sandy	*E. coli*, Sedimentation/Siltation
Grayson	Newcombe Creek	GRL0010	Inflow	Little Sandy	Sedimentation/Siltation, TDS
Grayson	Grayson Lake	GRL0002	Lake	Little Sandy	Mercury in Fish Tissue
Paint Creek	Paint Creek	PCS0002	Inflow	Scioto	*E. coli*, Organic Enrichment
Paint Creek	Paint Creek	PCS0001	Outflow	Scioto	E. coli, Sedimentation/Siltation, Habitat Alterations, Dissolved Oxygen
Paint Creek	Rattlesnake Creek	PCS0009	Inflow	Scioto	E. coli
Senecaville	Seneca Fork	SES0001	Outflow	Muskingum	*E. coli*, Sedimentation/Siltation, Habitat Alterations, Flow Regime Modification
Senecaville	Glady Run	SES0014	Inflow	Muskingum	*E. coli*, Sedimentation/Siltation
Senecaville	Seneca Fork	SES0003	Inflow	Muskingum	*E. coli*
Senecaville	South Fork of Seneca Fork	SES0004	Inflow	Muskingum	*E. coli*, Sedimentation/Siltation
Senecaville	Beaver Creek	SES0010	Inflow	Muskingum	*E. coli*, Habitat Alterations

Table 5. Authorized project purposes for LRH lakes.

Project	Operating Purposes	Authorized Purposes	Authorizing Laws
Alum Creek	Water Supply	Water Supply	PL 87-874
	Fish & Wildlife	Fish & Wildlife	PL 87-874
	Flood Control	Flood Control	PL 87-874
	Recreation	Recreation	PL 87-874
Atwood Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Beach City Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Beech Fork Lake	Recreation	Recreation	PL 87-874, PL 100-676
	Water Quality	Water Quality	PL 87-874
	Flood Control	Flood Control	PL 87-874
	Fish and Wildlife	Fish & Wildlife	PL 87-874
Bluestone Lake	Flood Control	Flood Control	PL 74-738, PL 75-761
		Hydroelectric Power	PL 74-738, PL 75-761
	Recreation	Recreation	PL 78-534, PL 100-676
	Low Flow Augmentation	Low Flow Augmentation	PL 74-738, PL 75-761
	Fish & Wildlife	Fish & Wildlife	PL 74-738
Bolivar Dam	Flood Control	Flood Control	PL 76-396, PL 73-67
Burnsville Lake	Recreation	Recreation	PL 78-534
		Low Flow Augmentation	PL 75-761
	Flood Control	Flood Control	PL 75-761
	Water Quality	Water Quality	PL 87-88
	Fish and Wildlife	Fish and Wildlife	PL 87-874
Charles Mill Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Clendening Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Deer Creek Lake	Flood Control	Flood Control	PL 75-761
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Recreation	Recreation	PL 78-534
	Fish & Wildlife	Fish & Wildlife	PL 85-624
Delaware Lake	Flood Control	Flood Control	PL 75-761
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761

Project	Operating Purposes	Authorized Purposes	Authorizing Laws
	Recreation	Recreation	PL 78-534
	Fish and Wildlife	Fish and Wildlife	PL 87-874
Dewey Lake	Flood Control	Flood Control	PL 75-761
	Recreation	Recreation	PL 78-534
	Fish & Wildlife	Low Flow Augmentation	PL 75-761
Dillon Lake	Flood Control	Flood Control	PL 75-761
	Recreation	Recreation	PL 78-534
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Fish and Wildlife	Fish and Wildlife	PL 87-874
Dover Dam	Flood Control	Flood Control	PL 76-396, PL 73-67
		Water Conservation*	PL 76-396, PL 73-67
East Lynn Lake	Flood Control	Flood Control	PL 75-761
	Recreation	Recreation	PL 78-534, PL 100-676
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Water Quality	Water Quality	PL 87-88
	Fish and Wildlife	Fish and Wildlife	PL 87-874
Fishtrap Lake	Flood Control	Flood Control	PL 75-761
	Recreation	Recreation	PL 78-534
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Water Quality	Water Quality	PL 87-88
	Fish & Wildlife	Fish & Wildlife	PL 85-624
Grayson Lake	Flood Control	Flood Control	PL 86-645
	Recreation	Recreation	PL 86-645
	Water Quality	Water Quality	PL 87-88
	Fish and Wildlife	Fish and Wildlife	PL 87-874
John W. Flannagan Dam	Flood Control	Flood Control	PL 75-761
	Recreation	Recreation	PL 78-534
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Water Quality	Water Quality	PL 87-88
	Fish & Wildlife	Fish & Wildlife	PL 85-624
	Water Supply	Water Supply	PL 85-500
Leesville Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Mohawk Dam	Flood Control	Flood Control	PL 76-396, PL 73-67
Mohicanville Dam	Flood Control	Flood Control	PL 76-396, PL 73-67
North Branch Kokosing River Lake	Flood Control	Flood Control	PL 78-534, PL 87-874
	Recreation	Recreation	PL 78-534, PL 87-874

Project	Operating Purposes	Authorized Purposes	Authorizing Laws
	Fish & Wildlife	Fish & Wildlife	PL 85-624
North Fork of Pound Lake	Flood Control	Flood Control	PL 86-645
	Water Supply	Water Supply	PL 85-500
	Fish & Wildlife	Fish & Wildlife	PL 85-624
	Recreation	Recreation	PL 86-645, PL 85-624
Paint Creek Lake	Flood Control	Flood Control	PL 75-761
	Water Quality	Water Quality	PL 87-88
	Water Supply	Water Supply	PL 85-500
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Recreation	Recreation	PL 78-534
	Fish and Wildlife	Fish and Wildlife	PL 87-874
Paintsville Lake	Flood Control	Flood Control	PL 89-298
	Recreation	Recreation	PL 89-298
	Water Quality	Water Quality	PL 89-298
	Fish and Wildlife	Fish and Wildlife	PL 87-874
Piedmont Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Pleasant Hill Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
R.D. Bailey Lake	Flood Control	Flood Control	PL 87-874
	Recreation	Recreation	PL 87-874, PL 100-676
	Water Quality	Water Quality	PL 87-874
	Fish & Wildlife	Fish & Wildlife	PL 79-732, PL 85-624
Senecaville Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Summersville Lake	Flood Control	Flood Control	PL 75-761
	Recreation	Recreation	PL 78-534, PL 100-676
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Water Quality	Water Quality	PL 87-88
	Fish & Wildlife	Fish & Wildlife	PL 79-732
Sutton Lake	Flood Control	Flood Control	PL 75-761
	Recreation	Recreation	PL 78-534, PL 100-676
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761
	Fish & Wildlife	Fish & Wildlife	PL 79-732

Project	Operating Purposes	Authorized Purposes	Authorizing Laws
Tappan Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Tom Jenkins Dam	Flood Control	Flood Control	PL 78-534
	Recreation	Low Flow Augmentation	PL 78-534
	Water Supply	Recreation	PL 78-534
	Fish and Wildlife	Water Supply	PL 85-500
		Fish and Wildlife	PL 87-874
Wills Creek Lake	Flood Control	Flood Control	PL 76-396, PL 73-67
	Recreation	Recreation	PL 76-396, PL 73-67
	Fish & Wildlife	Water Conservation*	PL 76-396, PL 73-67
Yatesville Lake	Flood Control	Flood Control	PL 75-761, PL 89-298
	Water Quality	Water Quality	PL 89-298
	Recreation	Recreation	PL 89-298
	Low Flow Augmentation	Low Flow Augmentation	PL 75-761, PL 89-298
	Fish and Wildlife	Fish and Wildlife	PL 87-874

Table 6. Long-term water quality sampling schedule.

WATER QUALITY SAMPLING SCHEDULE

HUNTINGTON DISTRICT LAKE PROJECTS

Reviewed 22 September 2022: Previous Editions Obsolete

PROJECT	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
ATI			X					X			
BCS				X					X		
BOS											
CLB					X					X	
CMB			X					X			
DOT											
LEM			X					X			
MKW											
MOL											
PES					X					X	
PHC			X					X			
SES	X					X					X
TAL					X					X	
WEW		X					X				
NBN			X					X			
DIL				X					X		
TJE		X					X				
ACS	X					X					X
DCS	X					X					X
DEO	X					X					X
PCS	X					X					X
BLN				X					X		
SUM				X					X		
SUT				X					X		
DEW		X					X				
FRL		X					X				
JWF		X					X				
NFP		X					X				
PIV					X					X	
YBC					X					X	
BBF			X					X			
ELT			X					X			
BUS				X					X		
GRL	X					X					X
RDB					X					X	

Appendix B – Additional Documents and Reports

To access the following reports, please contact the offices specified.

Maintenance Dredging Mitigation Report (2024)

Contact:

Huntington District USACE
Waterways Section
Christopher Blake Chadwick
christopher.b.chadwick@usace.army.mil
304-399-5083

Huntington District USACE
Water Quality Team
Andrew Johnson
andrew.n.johnson@usace.army.mil
304-399-5189

Water Quality Annual Operating Plan (2024)
Water Quality Program Management Plan (2024)

Contact:

Huntington District USACE
Water Quality Team
Andrew Johnson
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304-399-5189

Huntington District USACE
Water Quality Team
Kamryn Tufts
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Appendix C – LRH Lake Summaries

Alum Creek Lake (ACS) Water Quality Summary

Updated: June 2025

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include iron, dissolved oxygen, phosphorus, strontium, specific conductance, aluminum, and total Kjeldahl nitrogen. Chloride, sulfate, and specific conductance appear to be on a downward trend. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

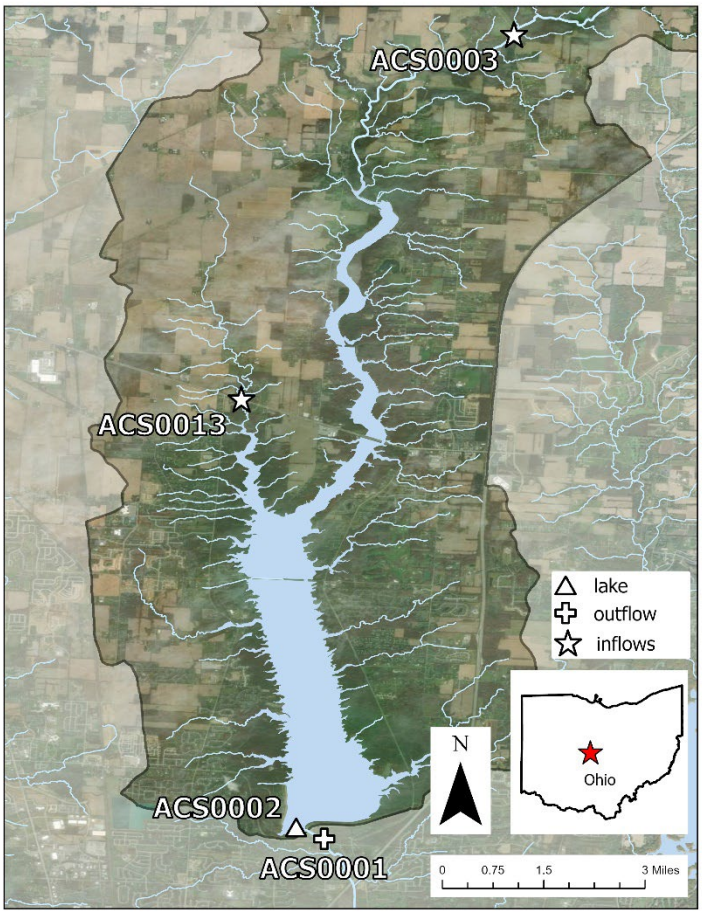

Figure 19. Water quality sampling locations for Alum Creek Lake in 2024.

WATERSHED SUMMARY: Alum Creek Lake is in Delaware County, Ohio, on Alum Creek, a tributary of the Scioto River. It is located 26 miles above the mouth of Alum Creek and 157 miles above the mouth of the Scioto River, a tributary of the Ohio River. The purposes for the project are flood control, recreation, fish and wildlife conservation and water supply. The watershed is 122 squares miles and the main land use within the watershed is agriculture and housing with small forested areas. The lake has a maximum depth of 67 feet with an average retention time of approximately 391 days.

HISTORICAL CONCERNS: Agriculture and land development are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of strontium and nutrients
- Increased risk of harmful algae blooms in the lake

2024 ACTIVITIES: Six sampling events were conducted in the Alum Creek Lake watershed in 2024. Two major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Fish, macroinvertebrate, and habitat surveys were conducted at both inflow sites and the outflow in 2024. Results are displayed in the table below. Alum Creek Lake is scheduled to be intensively sampled again in fiscal year 2029.

OBSERVED WATER QUALITY CONCERNS: Water quality analysis revealed elevated inputs of strontium, phosphorus, sulfate, and nitrogen into the lake from the main inflows (ACS0003 and ACS0013). Water quality data from the outflow reveals similar concerns at lesser concentrations showing that the lake is buffering some pollutants. Elevated levels of nitrogen and strontium are being passed downstream but are still within historical ranges. During one sampling trip the inflow streams exceeded several thresholds including those for metals and nutrients. This appears to be an

isolated incident due to a flooding event that was occurring at the time of sampling. Concentrations of chloride and sulfate appear to be on a downward trend in the watershed, which is reflected by a downward trend in specific conductance as well. All other constituents of concern appear to be stable.

Ongoing discussions surrounding a proposed relocation of the Delaware County sewer treatment discharge to a new site on Big Run (ACS0013) prompted the addition of the stream to the intensive sampling schedule in 2019. Big Run is a small tributary of the northwestern end of Alum Creek Lake. The Team included Big Run in the routine monitoring for FY2019 in order to understand baseline conditions should the sewage discharge proposal move forward. Strontium concentrations remain very high in Big Run, especially during periods of low flow.

ADDITIONAL INFORMATION: Alum Creek Lake has a multi-level intake structure for optimization of water quality in the outflow. It is also a water supply reservoir. Delaware County has proposed the discharge of treated sewage into the lake as part of a regional sewage treatment project. The District is currently working with the County to address the treatment need while minimizing impacts to the lake's project authorities.

All water quality concerns revealed in intensive surveys at ACS have been previously documented in the WCM with no new concerns surfacing, except for the collection of strontium, which began with 2013 sampling. Active agricultural land use is most likely contributing the nutrients to the watershed through runoff of farm fields and poor administration of fertilizers. The main inflows, ACS0003 and ACS0013, provide most of the nutrient loading into the lake. The lake is acting as a water quality buffer, trapping the sediments, nutrients, metals and ions contributed by the inflow that would ultimately create a larger impact to the watershed. Increased nutrients at Alum Creek Lake make it highly susceptible to Harmful Algal Blooms which can negatively affect water supplies, recreation, and wildlife.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Alum Creek Lake scored 44 for average TSI in 2024, which is categorized as mesotrophic. Mesotrophic lakes are usually characterized by having moderate clarity, nutrients, and algal growth. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth. Oligotrophic lakes are usually characterized by having high clarity, low nutrients, and low algal growth.

Table 7. Alum Creek Lake samples exceeding state criteria and/or District levels of concern in 2024.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
ACS0001	Outflow	Alum Creek	TKN	3	NONE
			Total Strontium	6	NONE
ACS0002	Lake	Alum Creek	Manganese	2	NONE
			Total Strontium	4	NONE
ACS0003	Inflow	Alum Creek	TKN	1	NONE
			Total Phosphorus	2	NONE
			Sp. Conductance	6	NONE
			Total Strontium	6	NONE
ACS0013	Inflow	Big Run of Alum Creek	Dissolved Oxygen	2	NONE
			TKN	4	NONE
			Manganese	2	NONE
			Total Phosphorus	1	NONE
			Sp. Conductance	6	NONE
			Total Strontium	6	NONE

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
			Total Sulfate	3	NONE

Table 8. Alum Creek Lake biological and habitat results in 2024.

Site	Stream	Fish Score	Fish Category	Dominant Species	Macro Score	Macro Category	RBP Score	RBP Categories Scoring Marginal or Worse
ACS0001	Alum Creek of Scioto River	36	Good	Central Stoneroller	24	Fair	99	embeddedness, channel alteration, riffle frequency, vegetative protection, riparian width
ACS0003	Alum Creek of Scioto River	46	Good	Central Stoneroller	40	Good	145	bank stability, vegetative protection
ACS0013	Big Run of Alum Creek	34	Fair	Creek Chub	18	Low Fair	124	available cover, embeddedness, sediment deposition, bank stability

Atwood Lake (ATI) Water Quality Summary

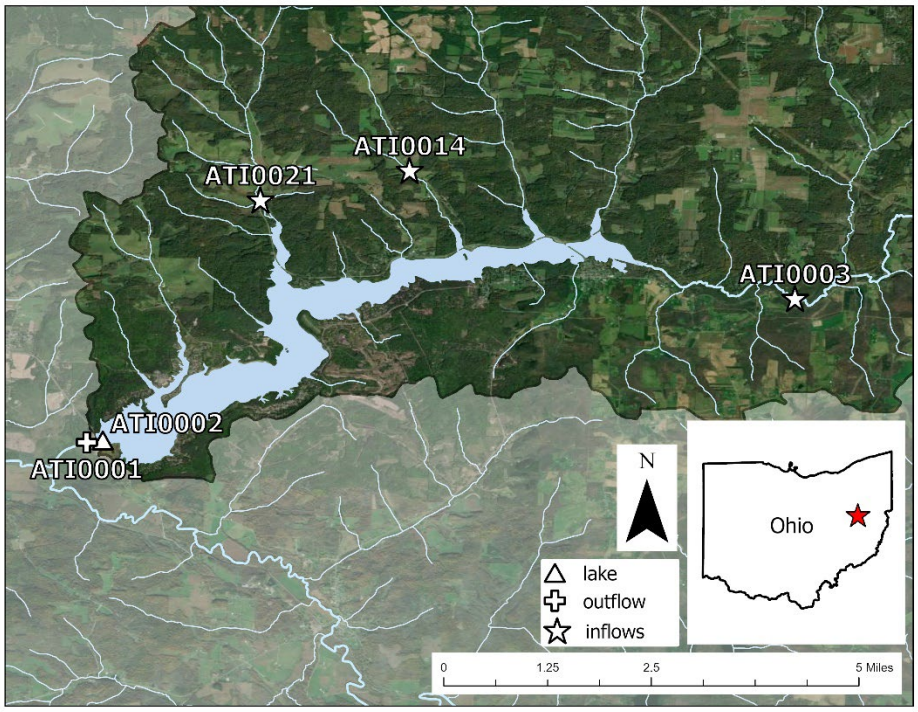

Figure 20. Water quality sampling locations for Atwood Lake in 2021.

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include bromide, dissolved oxygen, iron, manganese, phosphorus, specific conductance, strontium, and total Kjeldahl nitrogen. New for 2021, Aluminum exceeded levels of concern multiple times at three separate sites (ATI0002, ATI0003, and ATI0014). Samples in 2016 and 2021 from one inflow site (ATI0021) yielded three detections of bromide, which can be an indicator of natural gas fracking activity in the watershed. Instances of low dissolved oxygen and high dissolved metals in the outflow could be rectified in the future with the addition of a trash rack weir. This structural modification could be completed as soon as 2018. Elevated constituent levels will be reported to the Ohio EPA to facilitate potential mitigation efforts by the state.

WATERSHED SUMMARY: Atwood Lake is located in Carroll and Tuscarawas Counties in Northeastern Ohio. Indian Fork of Conotton Creek is the major stream in the basin. Honey Run and Gantz Creek feed Indian Fork of Conotton Creek and join near the city of Carrollton in the upper end of the basin. The Atwood Lake basin drains about 70 square miles of forest and farmland, with Carrollton in its headwaters. Shale gas extraction is a significant industry in the watershed. The authorized project purposes of the lake are flood control, fish and wildlife, and recreation. The lake has a maximum depth of 42 feet with an average residence time of 113 days.

HISTORICAL WATERSHED CONCERNS: Resource extraction, agriculture, and poor land management are the primary sources of watershed degradation resulting in:

- Elevated levels of aluminum, manganese, iron, specific conductance, and sulfates
- Elevated levels of nutrients

2021 ACTIVITIES: There were six sampling events in the 2021 sampling season. All six events included collecting YSI ambient readings as well as water chemistry parameters. These events include routine water quality sampling of Atwood Lake, select inflows, and the outflow. Macroinvertebrate community samples were collected at two locations. Invertebrate community index (ICI) scores for ATI0014 and ATI0021 were both low fair (18), indicating an somewhat impaired aquatic macroinvertebrate community at these locations. Fish surveys were also conducted at ATI0021. This site received an IBI score of 33 (fair). *NEXT SAMPLING YEAR: 2026*

ADDITIONAL INFORMATION: Similar to Tappan Lake in 2015, structural modifications are scheduled for the outlet structures at Atwood Lake. The purpose of this trash rack modification is to minimize the release of hydrogen sulfide gas that is produced from outflow water originating in the hypolimnion. Additionally, increased phosphorus and nitrogen

inputs from the inflows are being passed into the tailwaters without being buffered by the lake. Atwood Lake scored 50 for average TSI in 2021, which is categorized as eutrophic.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Atwood Lake scored 50 for average TSI in 2021, which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 9. Atwood Lake samples exceeding state criteria and/or District levels of concern in 2021.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF RESULTS THAT EXCEED SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
ATI0001	Outflow	Indian Fork	Iron, Total	3	NONE
			Kjeldahl Nitrogen, Total	7	NONE
			Manganese, Total	3	NONE
			Oxygen, Dissolved	1	NONE
			Phosphorus, Total	2	NONE
ATI0002	Lake	Indian Fork	Aluminum	1	NONE
			pH	3	YES
			Phosphorus, Total	2	NONE
ATI0003	Inflow	Indian Fork	Aluminum	1	NONE
			Kjeldahl Nitrogen, Total	5	NONE
			Phosphorus, Total	7	NONE
			Specific Conductance	4	NONE
			Strontium, Total	1	NONE
ATI0014	Inflow	Grapevine Creek	Aluminum	3	NONE
			Iron, Total	1	NONE
			Kjeldahl Nitrogen, Total	2	NONE
			Phosphorus, Total	5	NONE
			Strontium, Total	2	NONE
ATI0021	Inflow	Indian Fork UT	Bromide, Total	3	NONE
			Iron, Total	1	NONE
			Kjeldahl Nitrogen, Total	2	NONE
			Phosphorus, Total	3	NONE
			Specific Conductance	3	NONE
			Strontium, Total	5	NONE

Beach City Lake (BCS) Water Quality Summary

Updated: April 2023

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include aluminum, iron, manganese, strontium, sulfate, total Kjeldahl nitrogen, phosphorus, low dissolved oxygen, and specific conductance. Degraded water quality conditions in the lake have resulted in discussions regarding the conversion of Beach City Dam into a dry dam that is impounded only when necessary. No other known operational changes can be made at this current time to mitigate elevated levels of pollutants from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

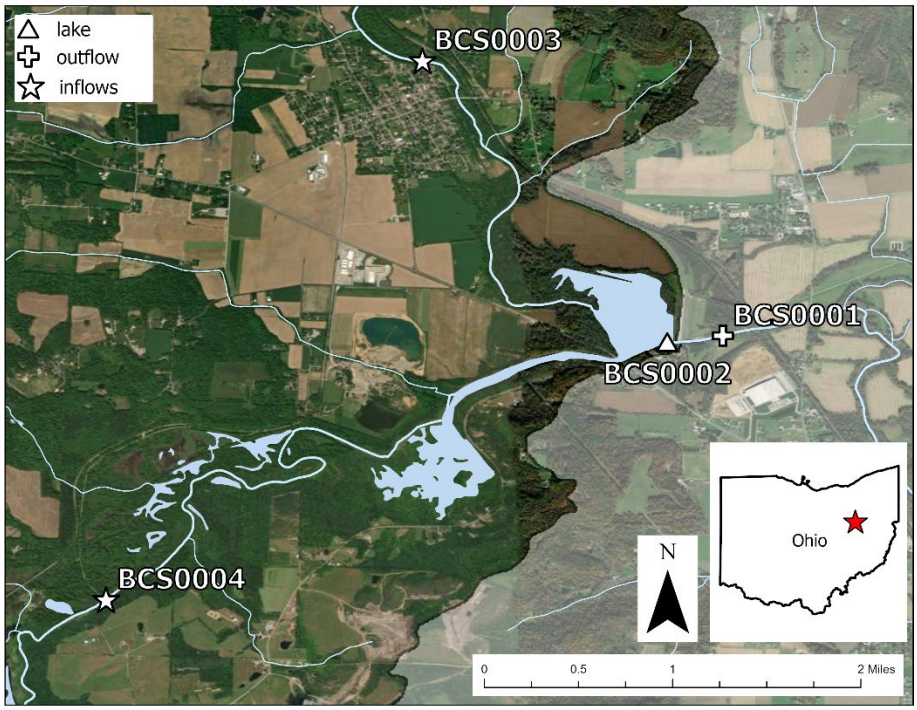

Figure 21. Water quality sampling locations for Beach City Lake in 2022.

WATERSHED SUMMARY: Beach City Dam is located in Tuscarawas County, Ohio, on Sugar Creek, a tributary of the Tuscarawas River in the Muskingum River basin. It is 180 miles upstream of the confluence of the Muskingum and Ohio Rivers at Marietta, Ohio. Beach City Lake has a drainage area of 300 square miles. The lake project's authorized purposes include flood control, recreation, and fish and wildlife conservation. Due to the small size of the impoundment, the hydraulic residence time of the lake averages 0.1 days. The watershed is dominated by agriculture. With an average depth of approximately 12 inches, nearly the entire conservation pool for Beach City has been lost due to sedimentation.

HISTORICAL CONCERNS: Agriculture and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased nutrient concentrations
- Increased temperature and frequency of harmful algal blooms

2022 ACTIVITIES: There were a total of six routine sampling trips in the 2022 sampling season. These were comprised of four sample collection events from Beach City Lake, six collections from select inflows, and six collections from the outflow. Due to increasingly shallow lake depths, samples were only collected at the lake surface. Water samples were analyzed for a pre-determined suite of chemical analytes and chlorophyll a, b, and c at the lake site only. Physical water quality measurements were collected simultaneously using a multiparameter data sonde during all six sampling events. Macroinvertebrate community samples were collected at three locations using Hester-Dendy samplers and fish were surveyed at one site. Beach City Lake will be monitoring again in 2027.

OBSERVED WATER QUALITY CONCERNS: Based on 2022 monitoring results, chloride appears to be trending upward across the watershed while concentrations still remain below USACE thresholds and within historical ranges. Increasing chloride concentrations can be an indicator of increased pollution in the watershed, for example fertilizers, wastewater effluent, or landfill run off. Also trending upward are pH values, which could signal an increase in productivity in the

watershed, possibly stemming from elevated nutrient levels. At the same time, manganese concentrations appear to be trending downward in the lake and South Fork of Sugar Creek inflow possibly due to increasing pH levels. Metals tend to be less soluble at higher pH, suggesting that more manganese is remaining in sediments. Most manganese results in 2022 were below historical ranges.

Invertebrate community index (ICI) scores from sites sampled at Beach City Lake in 2022 were as follows: BCS0001 – 36 (good), BCS0003 – 28 (fair), BCS0004 – 10 (poor). Overall, these scores indicate a somewhat impaired aquatic macroinvertebrate community at these locations. A fish survey was also conducted at the main inflow site (BCS0003), yielded an Ohio Index of Biotic Integrity (OHIBI) score of 24 (poor).

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements, chlorophyll a, and total phosphorus concentrations in the water column. Based on phosphorus and chlorophyll concentrations in 2022, Beach City Lake ranged from mesotrophic to hypereutrophic indicating a nutrient rich environment. Combined with increasingly shallow depths, there is a higher potential for HABs.

ADDITIONAL INFORMATION: Inflow water into Beach City Lake is characteristic of the calcareous nature of the watershed. Ionic concentrations and buffering capacity (alkalinity) are high. Nutrient levels are fairly high, but over productivity seems to be kept in check by pollution sources. Beach City Lake receives domestic pollution from the Sugar Creek Waste Water Treatment Plant and non-point discharges from agricultural runoff. In the upper reaches of Sugar Creek there are several food processors and clay mining operations which may contribute to the low pH and other related problems. Continual sedimentation has resulted in a shallow impoundment, increased sunlight penetration, increased temperatures, and more frequent HABs. Beach City provides little recreational value due to a diminished conservation pool as a result of significant sedimentation. It is recommended that USACE and MWCD coordinate to convert Beach City into a dry dam which in turn would likely mitigate water quality issues in the lake. As a dry dam Beach City would be impounded only during high water events to reduce downstream flooding; however, conservation pool would be lost completely.

Table 10. Beach City Lake samples exceeding state criteria and/or District levels of concern in 2022.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1BCS0001	Outflow	Sugar Creek	Aluminum, Total	3	NONE
			Iron, Total	3	NONE
			Kjeldahl Nitrogen, Total	2	NONE
			Phosphorus, Total	4	NONE
			Strontium, Total	4	NONE
			Sulfate, Total	1	NONE
			Specific Conductance	6	NONE
1BCS0002	Lake	Beach City Lake	Aluminum, Total	1	NONE
			Iron, Total	1	NONE
			Kjeldahl Nitrogen, Total	2	NONE
			Phosphorus, Total	2	NONE
			Specific Conductance	4	NONE
			Strontium, Total	4	NONE
1BCS0003	Inflow	Sugar Creek	Iron, Total	2	NONE
			Kjeldahl Nitrogen, Total	1	NONE

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
			Phosphorus, Total	4	NONE
			Specific Conductance	4	NONE
			Strontium, Total	4	NONE
1BCS0004	Inflow	South Fork of Sugar Creek	Aluminum, Total	2	NONE
			Ammonia	1	YES
			Iron, Total	3	NONE
			Kjeldahl Nitrogen, Total	1	NONE
			Manganese	1	NONE
			Phosphorus, Total	3	NONE
			Specific Conductance	5	NONE
			Strontium	2	NONE
			Sulfate	1	NONE

Beech Fork Lake (BBF) Water Quality Summary

Updated: June 2022

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include aluminum, specific conductance, dissolved oxygen, iron, manganese, phosphorus, and TKN; new to 2021, strontium exceeded once at BBF0108. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the West Virginia Department of Environmental Protection to facilitate potential mitigation efforts by the state.

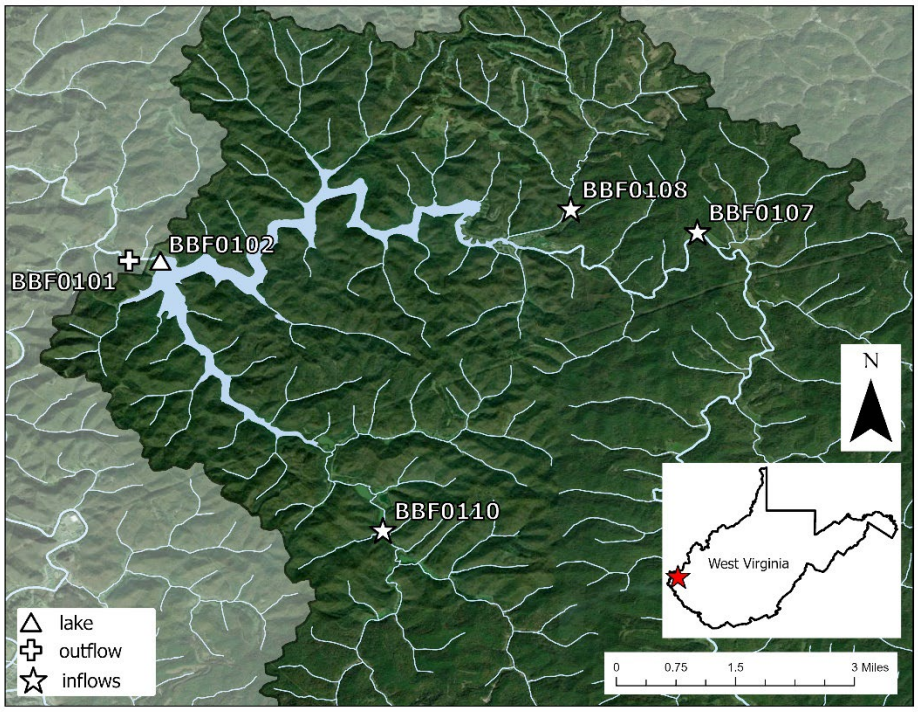

Figure 22. Water quality sampling locations for Beech Fork Lake in 2021.

WATERSHED SUMMARY: Beech Fork Lake is located in Wayne and Cabell Counties in western West Virginia. The authorized project purposes for Beech Fork Lake are flood control, recreation, enhanced recreation (whitewater), fish and wildlife conservation, and water quality control. The Beech Fork drainage basin is roughly 78 square miles of mountains and rugged hills. Beech Fork is a small tributary of Twelvepole Creek and the largest tributary of Beech Fork is Millers Fork, which drains about 26% of the area within the Beech Fork basin. The maximum depth of the lake is 40 feet with an average residence time of approximately 40 days.

HISTORICAL CONCERNS: Agriculture, silviculture and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation

2021 ACTIVITIES: There were six sampling events in the 2021 sampling season. All six events included collecting YSI ambient readings as well as water chemistry parameters. These events include routine water quality sampling of Beech Fork Lake, select inflows, and the outflow. Macroinvertebrate community samples and fish surveys were collected at four locations. The Kentucky Index of Biotic Integrity (KYIBI) was used because West Virginia does not have an IBI for fish. The KYIBI is the most compatible with West Virginia streams in the Huntington District.

West Virginia Stream Condition Index (WVSCI) scores: BBF0101 – 59.4 (slightly impaired), BBF0107 – 69.4 (unimpaired-good), BBF0108 – 63 (impaired-gray zone), and BBF0110 69.6 (unimpaired-good).

Kentucky Index of Biotic Integrity (KYIBI) Scores: 1BBF0101 – 47 (Fair), 1BBF0107 – 47 (Fair),

1BBF0108 – 61 (Fair/Good), 1BBF0110 - 63 (Good).

NEXT SAMPLING YEAR: 2026

ADDITIONAL INFORMATION: Fine suspended sediments block light penetration throughout the lake reducing the depth of the epilimnion and decreasing primary production. Decreased primary production limits food sources for fish, and as

a result, the sport fishery in Beech Fork Lake is negatively impacted. Marshall University is in the early stages of developing a study to determine the causes and impacts of the high levels of suspended sediments in the lake.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Beech Fork Lake scored 50 for average TSI in 2021, which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 11. Beech Fork Lake samples exceeding state criteria and/or District levels of concern in 2021.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
BBF0101	Outflow	Beech Fork	Aluminum, Total	7	7
			Iron, Total	9	5
			Kjeldahl Nitrogen, Total	3	NONE
			Manganese, Total	2	NONE
			Phosphorus, Total	1	NONE
BBF0102	Lake	Beech Fork Lake	Aluminum, Total	3	3
			Kjeldahl Nitrogen, Total	1	NONE
			Iron, Total	8	6
			Phosphorus, Total	1	NONE
BBF0107	Inflow	Beech Fork	Aluminum, Total	3	3
			Iron, Total	3	3
			Kjeldahl Nitrogen, Total	1	NONE
			Phosphorus, Total	3	NONE
BBF0108	Inflow	Long Branch	Aluminum, Total	4	4
			Iron, Total	4	2
			Phosphorus, Total	2	NONE
			Strontium	1	NONE
BBF0110	Inflow	Millers Fork	Aluminum, Total	3	3
			Iron, Total	3	1
			Kjeldahl Nitrogen, Total	1	NONE
			Phosphorus, Total	1	NONE

Bluestone Lake (BLN) Water Quality Summary

Updated: April 2023

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include ammonia, manganese, total Kjeldahl nitrogen, strontium, and phosphorus. High nutrient loadings from the watershed have the potential to exacerbate algal blooms. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the West Virginia Department of Environmental Protection to facilitate potential mitigation efforts by the state.

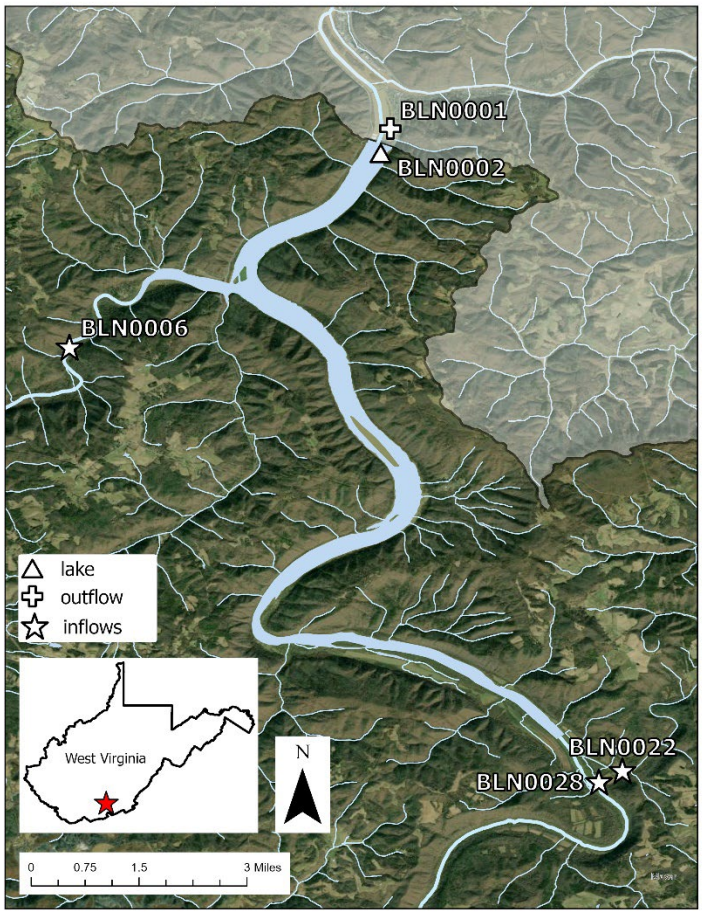

Figure 23. Water quality sampling locations for Bluestone Lake in 2022.

WATERSHED SUMMARY: Bluestone Lake is located in Summers County, West Virginia. The dam is located on the New River, a tributary of the Kanawha River, 162 miles upstream of its confluence with the Ohio River in Pt. Pleasant, West Virginia. Bluestone Lake has the largest drainage area in the Huntington District at 4,620 square miles. The lake project's authorized purposes include flood control, hydroelectric power, recreation, enhanced recreation (whitewater), low flow augmentation, and fish and wildlife conservation. The lake has a maximum depth of 42 feet with a hydraulic residence time averaging 2 days. The watershed is dominated by forested lands. The section of the river just downstream of Bluestone Dam is known as the "Miracle Mile" because it provides one of the best wadeable, large river, smallmouth bass fisheries for anglers. This section is also considered irreplaceable habitat according to the US Fish and Wildlife Service as a result of its rocky habitat and high water quality.

HISTORICAL CONCERNS: Mining, timbering, and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation

2022 ACTIVITIES: There were a total of six routine sampling trips in the 2022 sampling season. These were comprised of three sample collection events from Bluestone Lake, six collections from select inflows, and six collections from the outflow. Samples were collected from the epilimnion, metalimnion, and hypolimnion during each lake sampling event. The lake was not sampled in the fall due to an early turnover. Water samples were analyzed for a pre-determined suite of chemical analytes and chlorophyll a, b, and c at the lake site only. Physical water quality measurements were collected simultaneously using a multiparameter data sonde during all six sampling events. Macroinvertebrate community samples were collected at four locations and fish were collected at one location.

OBSERVED WATER QUALITY CONCERNS: Results of monitoring in 2022 yielded few significant findings with most parameters within or below historical ranges and no significant trends.

Macroinvertebrate scores for sites sampled at Bluestone Lake were calculated using the West Virginia Stream Condition Index (WVSCI). Scores are as follows: BLN0001 – 66 (slightly not attaining), BLN0006 – 73 (good attaining),

BLN0022 – 85 (very good attaining), and BLN0028– 85 (very good attaining). These scores reflect an overall healthy watershed above the lake.

Fish community scores were calculated using the Kentucky Index of Biotic Integrity (KYIBI) because West Virginia does not have an established IBI for fish. The KYIBI is the most compatible with West Virginia streams in the Huntington District. A fish community survey was conducted at only the Indian Creek inflow site (1BLN0022), yielding a score of 63 (good).

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements, chlorophyll a, and total phosphorus concentrations in the water column. Based on the results of monitoring in 2022, Bluestone Lake ranged between mesotrophic and eutrophic. A eutrophic state reflects high productivity in the lake, generally low water clarity, and high nutrient concentrations, whereas a mesotrophic state is characterized by moderate levels of the same components.

ADDITIONAL INFORMATION: Overall water quality within the Bluestone Lake watershed is generally good, however excessive productivity is the most significant problem in Bluestone Lake. High nutrient loadings from the watershed were the result of both point and non-point source loadings.

Table 12. Bluestone Lake samples exceeding state criteria and/or District levels of concern in 2022.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1BLN0001	Outflow	New River	None	-	-
1BLN0002	Lake	New River	Ammonia	1	NONE
			Manganese, total	2	NONE
			Total Kjeldahl Nitrogen	1	NONE
			Phosphorus, total	2	2
1BLN0006	Inflow	Bluestone River	Phosphorus, total	1	NONE
1BLN00022	Inflow	Indian Creek	Strontium	3	NONE
1BLN00028	Inflow	New River	Phosphorus, Total	2	NONE

Burnsville Lake (BUS) Water Quality Summary

Updated: April 2023

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include aluminum, iron, manganese, sulfate, and total Kjeldahl nitrogen. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the West Virginia Department of Environmental Protection to facilitate potential mitigation efforts by the state. Burnsville Lake's watershed has seen an increase in hydraulic fracturing for oil and gas which could alter water quality.

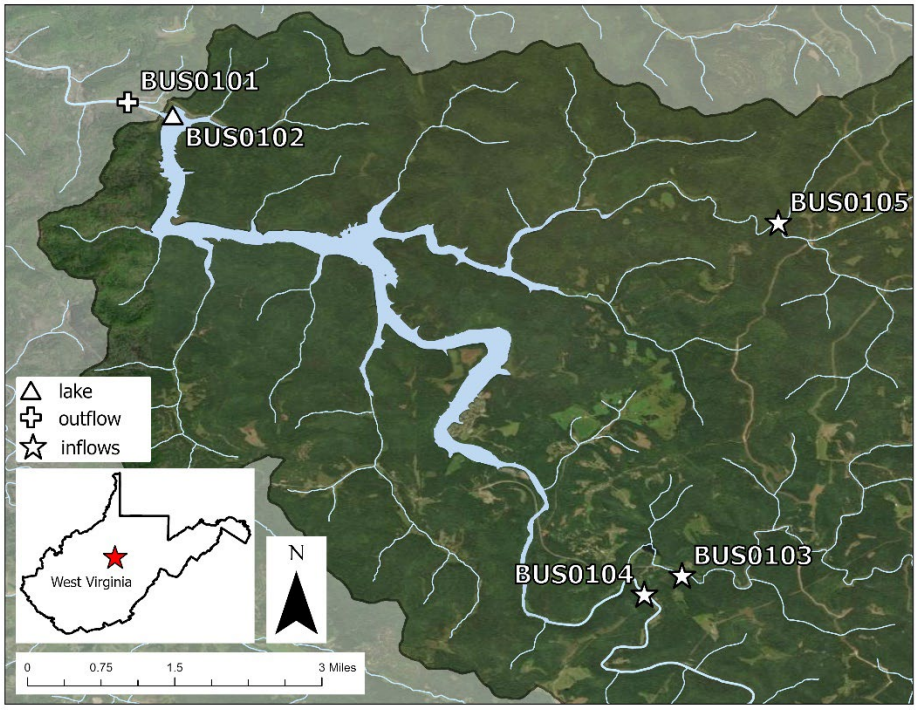

Figure 24. Water quality sampling locations for Burnsville Lake in 2022.

WATERSHED SUMMARY: Burnsville Lake is located in Braxton County, West Virginia. The dam is on the Little Kanawha River, 124 miles upstream of its confluence with the Ohio River. The drainage area of the impoundment is 165 square miles. The lake project's authorized purposes include flood control, recreation, enhanced recreation (whitewater), water quality, and fish and wildlife conservation. The lake has a maximum depth of 34 feet with a hydraulic residence time averaging 23 days. The land use of the watershed is dominated by forested land, but hydraulic fracturing is an emerging concern. Water quality in the basin is generally favorable but could be impacted by an increase in local oil and gas extraction.

HISTORICAL CONCERNS: Mining and oil and gas extraction are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Elevated levels of specific conductance, sulfates, chlorides, and metals

2022 ACTIVITIES: There were a total of six routine sampling trips in the 2022 sampling season. These were comprised of three sample collection events from Burnsville Lake, six collections from select inflows, and six collections from the outflow. Samples were collected from the epilimnion, metalimnion, and hypolimnion during each lake sampling event. The lake was not sampled in the fall due to an early turnover. Water samples were analyzed for a pre-determined suite of chemical analytes and chlorophyll a, b, and c at the lake site only. Physical water quality measurements were collected simultaneously using a multiparameter data sonde during all six sampling events. Macroinvertebrate community samples and fish surveys were collected at four locations and fish were collected at three locations.

OBSERVED WATER QUALITY CONCERNS: There were few metals exceedances from the lake bottom and outflow, which can be expected during summer stratification. Otherwise, there were no significant exceedances or trends to report in 2022, and monitoring results were within historical ranges.

Macroinvertebrate scores for sites sampled at Burnsville Lake were calculated using the West Virginia Stream Condition Index (WVSCI). Scores are as follows: BUS0101 – 58 (slightly not attaining), BUS0103 – 72 (good attaining),

BUS0104 – 80 (good attaining), BUS0105 – 80 (good attaining). These scores reflect an overall healthy watershed above the lake.

Fish community scores were calculated using the Kentucky Index of Biotic Integrity (KYIBI) because West Virginia does not have an established IBI for fish. The KYIBI is the most compatible with West Virginia streams in the Huntington District. Fish community surveys were conducted at the lake outflow and two inflow sites. Scores were as follows: Burnsville Outflow at Hyers Run – 82 (excellent), BUS0103 – 81 (excellent), BUS0105 – 54 (fair). Based on LRH Water Quality data, the Little Kanawha River below Burnsville Lake has the greatest species richness in the entire Huntington District.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements, chlorophyll a, and total phosphorus concentrations in the water column. Based on the results of monitoring in 2022, Burnsville Lake ranged between oligotrophic and mesotrophic. An oligotrophic state is characterized by low productivity, high water clarity, and low nutrient levels, whereas a mesotrophic state is characterized by moderate levels of the same components.

ADDITIONAL INFORMATION: Burnsville Lake stratifies seasonally with warm, oxygenated water on the top of the lake and cold, de-oxygenated water on the bottom of the lake. The Little Kanawha River watershed has very good water quality. In addition, Burnsville Lake has a selective withdrawal outflow that allows it to regulate the downstream water temperature and oxygen levels. As a result, the downstream reaches of the Little Kanawha River are home to endangered mussels and a very diverse fishery. However, increased gas extraction could negatively affect the water resources in the watershed.

The Little Kanawha River below Burnsville Lake has been designated as critical habitat for both the longsolid and round hickorynut mussels.

Table 13. Burnsville Lake samples exceeding state criteria and/or District levels of concern in 2022.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1BUS0101	Outflow	Little Kanawha River	Aluminum, Total	2	2
			Iron, Total	2	0
1BUS0102	Lake	Little Kanawha River	Iron, total	3	3
			Manganese	2	NONE
			Total Kjeldahl Nitrogen	1	NONE
1BUS0103	Inflow	Falls Run	None	-	-
1BUS0104	Inflow	Little Kanawha River	None	-	-
1BUS0105	Inflow	Knawl Creek	None	-	-

Charles Mill Lake (CMB) Water Quality Summary

Updated: June 2022

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include, aluminum, dissolved oxygen, iron, pH, phosphorus, specific conductance, strontium, and TKN. New for 2021, Aluminum exceeded levels of concern at CBM0001 (4x), CMB0002 (2x), and CMB0011 (1x). No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

WATERSHED SUMMARY: Charles Mill Lake is located on the Black Fork in Ashland and Richland Counties of northeastern Ohio. The crescent shaped basin of the Black Fork of the Mohican River is 215 square miles. The authorized purposes of this project are flood control and fish and wildlife enhancement. The Black Fork is one of the three main forks of the Mohican River, which combines with the Kokosing River to form the Walhonding River. The watershed is mainly comprised of woodland and farmland with little industry located within the basin. The lake has a maximum depth of 17 feet and an average residence time of approximately 12 days.

HITORICAL CONCERNS: Agriculture and poor land management are primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased nutrient concentrations

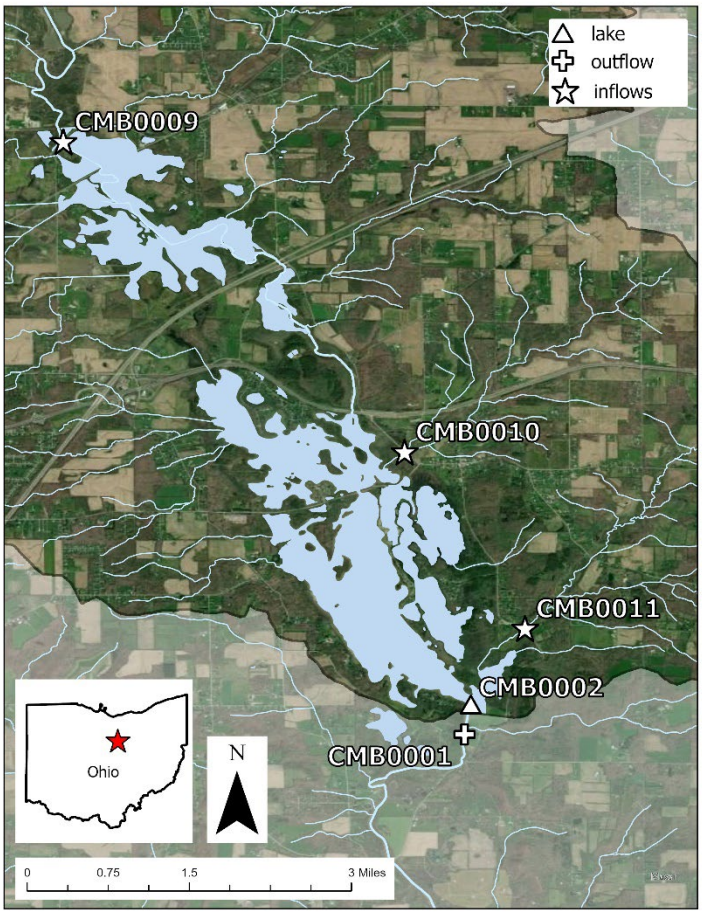

Figure 25. Water quality sampling locations for Charles Mill Lake in 2021.

2021 ACTIVITIES: There were six sampling events in the 2021 sampling season. All six events included collecting YSI ambient readings as well as water chemistry parameters. These events include routine water quality sampling of Charles Mill Lake, select inflows, and the outflow. Macroinvertebrate community samples were collected at one location (Table 13). Invertebrate community index (ICI) scores for CMB0009 and CMB0009 was low-fair (16), indicating an somewhat impaired aquatic macroinvertebrate community. Fish surveys were also conducted at one site CMB0011. It received a score of 34 (fair).

NEXT SAMPLING YEAR: 2026

ADDITIONAL INFORMATION: Concentrations of TKN, phosphorus, and specific conductance have been steadily increasing since 1985. Charles Mill Lake scored 77 for average TSI in 2021, which is categorized as hypereutrophic. Hypereutrophic lakes are usually characterized by having the lowest clarity, highest nutrients, and highest algal growth.

Table 14. Charles Mill Lake samples exceeding state criteria and/or District levels of concern in 2021.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
CMB0001	Outflow	Black Fork Mohican River	Aluminum, Total	4	NONE
			Iron, Total	5	NONE
			Kjeldahl Nitrogen, Total	7	NONE
			Phosphorus, Total	6	NONE
			Strontium, Total	9	NONE
CMB0002	Lake	Charles Mill Lake	Aluminum, Total	2	NONE
			Iron, Total	5	NONE
			Kjeldahl Nitrogen, Total	4	NONE
			Phosphorus, Total	4	NONE
			Strontium, Total	8	NONE
CMB0009	Inflow	Black Fork Mohican River	Aluminum, Total	6	NONE
			Iron, Total	6	NONE
			Kjeldahl Nitrogen, Total	5	NONE
			Oxygen, Dissolved	3	NONE
			Phosphorus, Total	5	NONE
			Specific Conductance	4	NONE
			Strontium, Total	5	NONE
CMB0010	Inflow	Ruffner Run	Phosphorus, Total	1	NONE
CMB0011	Inflow	Seymour Run	Aluminum, Total	1	NONE
			Iron, Total	1	NONE
			Kjeldahl Nitrogen, Total	1	NONE
			Phosphorus, Total	1	NONE
			Specific Conductance	1	NONE

Clendening Lake (CLB) Water Quality Summary

Updated: April 2024

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include aluminum, specific conductance, iron, strontium, sulfates, phosphorus, and total Kjeldahl nitrogen. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. Data analysis revealed that a structural modification completed in 2017 minimized hydrogen sulfide gas emissions, increased dissolved oxygen, and decreased dissolved metals in the outflow, improving overall water quality to the downstream area.

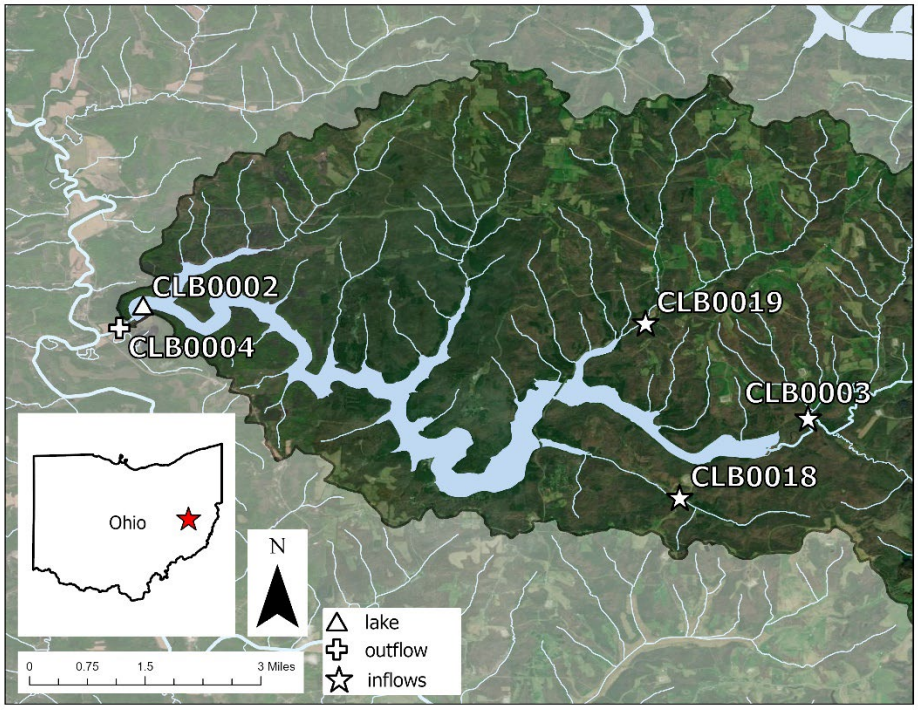

Figure 26. Water quality sampling locations for Clendening Lake in 2023.

WATERSHED SUMMARY: Clendening Lake is located in Harrison County, Ohio. The dam is located on Brushy Fork of Stillwater Creek, which is a tributary of the Tuscarawas River in the Muskingum River basin. Clendening Dam is 184 miles upstream of the confluence of the Muskingum River with the Ohio River. Clendening Lake has a drainage of 69 square miles. The lake project's authorized purposes include flood control, recreation, and fish and wildlife conservation. The lake has a maximum depth of 40 feet with a hydraulic residence time averaging 129 days. The watershed is dominated by agriculture, forest, and surface mining.

HISTORICAL CONCERNS: Mining and agriculture are the primary sources of watershed degradation resulting in:

- Elevated levels of sedimentation, specific conductance, sulfates, chlorides, and metals
- Dangerous emissions of hydrogen sulfide gas from the outlet structure

2023 ACTIVITIES: Six sampling events were conducted in the Clendening Lake watershed in 2023. Three major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Fish community surveys were conducted at the outflow and one inflow. Macroinvertebrate sampling was conducted at the outflow and three inflow sites. Clendening Lake will be surveyed again in 2028.

OBSERVED WATER QUALITY CONCERNS: Trend analysis revealed that increased nitrogen, phosphorus, strontium, and sulfate inputs from the inflows were being passed through the lake and discharged into the tailwaters. Other constituents exceeding levels of concern included specific conductance, iron, and aluminum. There was one detection of bromide in 2023 at the main inflow CLB0003 due to lower MDLs, giving the appearance of more frequent detections. In this case, the detection would not have occurred at the previous higher MDL and is not above the district threshold of concern. Elevated constituent levels will be reported to the Ohio Environmental Protection

Agency to facilitate potential mitigation efforts by the state. Otherwise, analyte levels in the watershed were within historical ranges.

Benthic macroinvertebrate sampling revealed that the primary inflow Brushy Fork (CLB0003) and the outflow (CLB0004) both scored in the Poor category, while Huff Run (CLB0018) and McFadden Run (CLB0019) both scored Fair. Fish community surveys from the outflow (CLB0004) resulted in a rating of Good, while McFadden Run (CLB0019) scored Fair.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Clendening Lake scored 63 for average TSI in 2023, which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth. Elevated levels of nutrients in a waterbody are thought to increase the occurrence of harmful algae blooms (HABs). HABs are comprised of toxin-producing cyanobacteria that can threaten human and animal health, recreation, and drinking water supplies.

ADDITIONAL INFORMATION: In the fall of 2017 the intake structure at Clendening Lake was retrofitted with a steel plate that allowed high quality surface water to be discharged downstream, with the intention of mitigating long-standing problems caused by hydrogen sulfide (H_2S) gas releases. Probabilistic vertical profiles of physical water quality parameters were collected from the lake between 2018 and 2023, and a continuous monitoring buoy was deployed at the dam site. Subsequent data analysis has shown no negative impacts to the downstream and/or lake fisheries at Clendening Lake, and overall water quality has significantly improved in the tailwaters. See the Muskingum Area Structural Modification Impact Study Section or Appendix B for more information.

Table 15. Clendening Lake samples exceeding state criteria and/or District levels of concern in 2023.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1CLB0002	Lake	Brushy Fork of Stillwater	Kjeldahl Nitrogen, Total	3	NONE
			Sp. Conductance	4	NONE
			Strontium	4	NONE
			Sulfate	4	NONE
			Phosphorus, Total	1	NONE
1CLB0003	Inflow	Brushy Fork of Stillwater	Specific Conductance	6	NONE
			Strontium	7	NONE
			Sulfate	7	NONE
			Phosphorus, Total	1	NONE
1CLB0004	Outflow	Brushy Fork of Stillwater	Kjeldahl Nitrogen, Total	6	NONE
			Phosphorus	2	NONE
			Sp. Conductance	6	NONE
			Strontium	6	NONE
			Sulfate	6	NONE
1CLB0018	Inflow	Huff Run of Brushy Fork	Phosphorus	1	NONE
			Specific Conductance	5	NONE
			Strontium	8	NONE
1CLB0019	Inflow	McFadden Run of Brushy Fork	Aluminum	1	NONE

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
			Iron	2	NONE
			Kjeldahl Nitrogen, Total	1	NONE
			Phosphorus	3	NONE

Deer Creek Lake (DCS) Water Quality Summary

Updated: June 2025

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including dissolved oxygen, iron, phosphorus, strontium, specific conductance, aluminum, and total Kjeldahl nitrogen. In 2025, District Water Quality Team will be assessing the potential benefits of a riser to the existing low flow gate. A riser similar to one constructed at Sutton Lake, could provide water quality benefits to both the tailwater and the lake. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. The Deer Creek inflow scored a 47 on the Ohio IBI (Rating = Good) and a 1.66 on the Shannon Index. The Deer Creek Lake outflow scored a 36 on the Ohio IBI (Rating = good), and a 0.49 on the Shannon Index.

Figure 282. Water quality sampling locations for Deer Creek Lake in 2024.

WATERSHED SUMMARY: Deer Creek Lake is located in Pickaway and Fayette Counties, Ohio in a 277 square mile watershed. Major land uses are agriculture with light residential use. The lake is considered eutrophic with high productivity. Surface waters are considered hard with high sulfate concentrations creating an ionic imbalance. The lake's authorized project purposes are flood control, recreation, fish and wildlife conservation and low flow augmentation. The lake has a maximum depth of 40 feet with an average retention time of 51 days.

HISTORICAL CONCERNS: Agriculture and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of strontium and nutrients
- Increased risk of harmful algae blooms in the lake

2024 ACTIVITIES: Six sampling events were conducted in the Deer Creek Lake watershed in 2024. One major inflow stream and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Fish, benthic macroinvertebrate, and habitat surveys were conducted at DCS0001 and DCS0013 and results are shown in the table below. Deer Creek Lake is scheduled to be intensively sampled again in fiscal year 2029.

OBSERVED WATER QUALITY CONCERNS: Water quality analysis revealed high inputs of TKN, phosphorus, and strontium into the lake from the primary inflow. During one sampling trip the inflow streams exceeded the aluminum and iron thresholds, however this was an isolated incident due to a flooding event. Water quality data from the outflow reveals many of the same concerns as the inflows. In many instances the outflow concentrations are higher,

whereas in other instances the lake is acting as a water quality buffer. Concentrations of sulfate appear to be on a downward trend, which is reflected in a slight downward trend in specific conductance. Conversely, concentrations of phosphorus appear to be on an upward trend with many values above historical ranges. Strontium continues to be at elevated levels, but concentrations are within historical ranges at a stable trend.

ADDITIONAL INFORMATION: Deer Creek Lake has minimal flexibility for outflow water quality. A low flow valve is located at a lake elevation that provides oxygenated water in the early summer. In the late summer, the low flow valve exists in the hypolimnion and does not provide adequate oxygen to the tailwater. Project staff have developed an aerator that seats within a sluice gate and provides a source of valuable oxygenation to the tailwater.

All water quality concerns revealed in the most recent intensive surveys at DCS have been previously documented in the WCM with no new concerns surfacing. Active agricultural land use is most likely contributing the nutrients to the watershed through runoff of farm fields and overuse of fertilizers. Increased nutrients from the inflows of Deer Creek Lake make it susceptible to harmful algal blooms. A HAB occurred in July of 2013 but did not result in any closures or impacts to recreation.

In 2025, District Water Quality Team will be assessing the potential benefits of a riser to the existing low flow gate. A riser similar to one constructed at Sutton Lake, could provide water quality benefits to both the tailwater and the lake.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Deer Creek Lake scored 66 for average TSI in 2024 which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 16. Deer Creek Lake samples exceeding state criteria and/or District levels of concern in 2024.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
DCS0001	Outflow	Deer Creek	Dissolved Oxygen	2	NONE
			Total Aluminum	1	NONE
			Ammonia	3	NONE
			TKN	5	NONE
			Total Phosphorus	4	NONE
			Sp. Conductance	1	NONE
			Total Strontium	6	NONE
DCS0002	Lake	Deer Creek	Ammonia	3	NONE
			Iron	2	NONE
			TKN	4	
			Manganese	1	
			Phosphorus	4	
			Total Strontium	4	
DCS0013	Inflow	Deer Creek	TKN	1	NONE
			Total Phosphorus	3	NONE
			Sp. Conductance	6	NONE
			Total Strontium	6	NONE

Table 17. Deer Creek Biological and Habitat Results

Site	Stream	Fish Score	Fish Category	Dominant Fish Species	Macro Score	Macro Category	RBP Score	RBP Categories Marginal or Worse
DCS0001	Deer Creek of Scioto River	32	Fair	Bluegill	22	Fair	132	channel alteration, vegetative protection, riparian width
DCS0013	Deer Creek of Scioto River	44	Good	Rainbow Darter	32	Marginally Good	164	NONE

Delaware Lake (DEO) Water Quality Summary

Updated: July 2025

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including strontium, aluminum, specific conductance, phosphorus, ammonia, and total Kjeldahl nitrogen. Some nutrient levels in the lake and outflow were above or in the upper historical ranges, whereas levels in the inflow streams were within historical ranges. Concentrations of sulfate and chloride appear to be on a downward trend, which is reflected in a slight downward trend in specific conductance. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. Fish and macroinvertebrate surveys scored "Fair" in all areas.

WATERSHED SUMMARY: Delaware Lake is located in Delaware County, Ohio, on the Olentangy River, 32 miles upstream from the confluence with the Scioto River at Columbus, Ohio. Delaware Lake has a watershed size of 386 square miles. Land use in the basin is predominantly agricultural with some mining and quarrying. Moderate levels of nutrient concentrations in the basin result in normal productivity in the lake. Water hardness is classified as moderately hard. The purposes of the project are flood control, recreation, low flow augmentation and fish and wildlife conservation. The lake has a maximum depth of 35 feet and an average retention time of approximately 17 days.

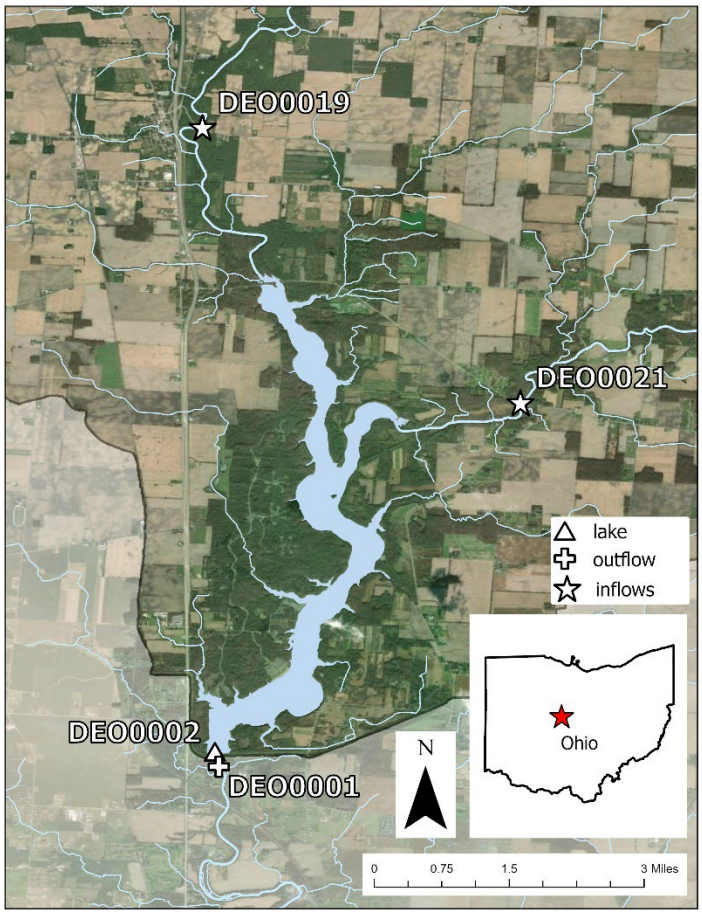

Figure 411. Water quality sampling locations for Delaware Lake in 2024.

HISTORICAL CONCERNS: Agriculture, mining/quarrying, and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of aluminum, manganese, iron, specific conductance, and sulfates
- Increased concentrations of nutrients

2024 ACTIVITIES: Six sampling events were conducted in the Delaware Lake watershed in 2024. Two major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. A fish survey was performed at the outflow. Benthic macroinvertebrate and habitat surveys were conducted at both inflow sites as well as the outflow and results are shown in the table below. Delaware Lake is scheduled to be intensively sampled again in fiscal year 2029.

OBSERVED WATER QUALITY CONCERNS: Water quality analysis revealed high inputs of TKN, phosphorus, and strontium into the lake from the primary inflows, the Olentangy River (1DEO0003, 1DEO0019) and Whetstone Creek

(1DEO0004, 1DEO0021). The outflow contained high levels of TKN and strontium, indicating that the lake is acting as a sink for phosphorus inputs but not other constituents. Nutrient levels in the lake and outflow were above or near the upper end of historical ranges, whereas levels in the inflow streams were within historical ranges. Concentrations of sulfate and chloride appear to be on a downward trend in the outflow, which is reflected in a slight downward trend in specific conductance. All other constituents appear to be stable in the watershed.

The outflow and primary inflow streams scored "Fair" on fish and macroinvertebrate surveys. Fish surveys were not completed in the inflow streams in 2019 or 2024, so there are no data to compare.

ADDITIONAL INFORMATION:

All water quality concerns revealed in the most recent intensive surveys at DEO have been previously documented in the WCM with no new concerns surfacing. Active agricultural land use is most likely contributing the nutrients to the watershed through runoff of farm fields and poor administration of fertilizers, while resource extraction is contributing to the metals observed in water quality samples.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Delaware Lake scored 69 for average TSI in 2024 which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 18. Delaware Lake samples exceeding state criteria and/or District levels of concern in 2024.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
1DEO0001	Outflow	Olentangy River	Total Aluminum	1	NONE
			Ammonia	1	NONE
			TKN	6	NONE
			Total Phosphorus	1	NONE
			Conductance	1	NONE
			Total Strontium	6	NONE
1DEO0002	Lake	Olentangy River	Ammonia	1	NONE
			TKN	4	NONE
			Total Phosphorus	4	NONE
			Total Strontium	4	NONE
1DEO0019 & 1DEO0003	Inflow	Olentangy River	TKN	6	NONE
			Total Phosphorus	4	NONE
			Sp. Conductance	5	NONE
			Total Strontium	6	NONE
1DEO0021 & 1DEO0004	Inflow	Whetstone Creek	TKN	6	NONE
			Total Phosphorus	5	NONE
			Sp. Conductance	6	NONE
			Total Strontium	6	NONE

Table 19. Delaware Lake biological and habitat results in 2024.

Site	Stream	Fish Score	Fish Category	Dominant Fish Species	Macro Score	Macro Category	RBP Score	RBP Categories Marginal or Worse
DEO0001	Olentangy River of Scioto River	32	Fair	Bluegill	28	Fair	109	channel alteration, riffle frequency, veg protection, riparian zone width
DEO0019	Olentangy River of Scioto River	NA	NA	NA	22	Fair	121	embeddedness, velocity/depth regime, sed deposition, riffle frequency
DEO0021	Whetstone Creek of Olentangy River	NA	NA	NA	26	Fair	106	available cover, velocity/depth regime, sed deposition, riffle frequency, bank stability, veg protection

Dewey Lake (DEW) Water Quality Summary

Updated: March 2021

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include specific conductance, aluminum, iron, total Kjeldahl nitrogen, strontium, manganese, and sulfates. Some levels of total iron exceeded Kentucky state criteria. All constituents are buffered within the lake, except aluminum; however, no operational changes can be made at this time to mitigate elevated levels from the inflow streams. Sites that exceeded state criteria will be reported to the Kentucky Division of Water to facilitate potential mitigation efforts by the state.

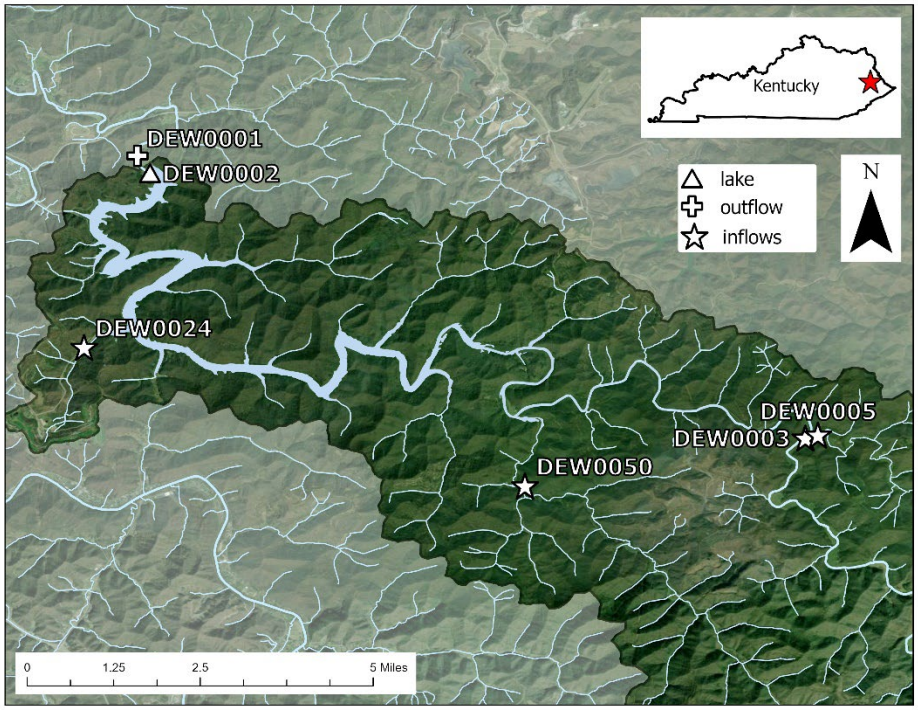

Figure 29. Water quality sampling locations for Dewey Lake in 2020.

WATERSHED SUMMARY: Dewey Lake is located in Floyd County, Kentucky on Johns Creek, a tributary of Levisa Fork of the Big Sandy River. Dewey Lake's authorized purposes are flood control, recreation, water quality, and fish and wildlife conservation. Dewey Lake is located 5.4 miles upstream of the mouth of Johns Creek, 79.4 miles above the mouth of the Big Sandy River, and is situated approximately 5 miles northeast of Prestonsburg, Kentucky. The Johns Creek watershed is long and narrow, extending approximately 36 miles from the headwaters to the mouth and has an average width of about 6 miles. The total drainage area is 225 square miles. The lake has a maximum depth of 50 feet and a water retention time of 27.8 days.

HISTORICAL WATERSHED CONCERNS: Mining and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of aluminum, manganese, iron, specific conductance, and sulfates

2020 ACTIVITIES: Six sampling events were conducted in the Dewey Lake watershed in 2020. Four major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification and analyzed for dissolved metals. Benthic macroinvertebrate samples were collected but samples were inadvertently discarded by the contracted lab prior to analysis. In 2021, macroinvertebrates were surveyed again and results were received. Kentucky Macroinvertebrate Bioassessment Scores (KYMBI): DEW0001 – 52.7 (Fair), DEW0005 – 46.8 (Poor), DEW0024 – 52.0 (Fair), DEW0050 – 47.7 (Poor). These scores indicate an overall somewhat impaired macroinvertebrate community. Dewey Lake is scheduled to be intensively sampled again in fiscal year 2025.

ADDITIONAL INFORMATION: During lake stratification, outflow conditions are managed through use of a water quality weir upstream of a sluice gate to meet downstream dissolved oxygen and temperature targets. The lake is also managed by the Kentucky Division of Fish & Wildlife for the presence of invasive zebra mussels and excessive aquatic

plant growth. Recent history has shown this watershed is susceptible to accidental discharges of coal mine waste. There were no operational changes or further sampling required to minimize impacts.

Elevated levels of strontium, sulfate, and specific conductance were present throughout the watershed but were within historical ranges. Chloride concentrations were also elevated but did not exceed state criteria. Levels were within historical ranges. Sulfate and chloride concentrations are likely driving the elevated specific conductance levels found throughout the watershed, which appear to be trending upward. The water appears to be getting more basic in pH throughout the watershed, though the cause is unknown.

Stratton Branch (1DEW0024) is a small tributary of Dewey Lake that has consistently had elevated sulfate concentrations that are several times greater than other sites in the watershed. This stream drains a reclaimed surface mine and valley fill area, which may account for the elevated sulfate concentrations. Areas of resource extraction are often linked to elevated levels of metals, sulfates, and sedimentation due to land disturbance. Because Stratton Branch is a very small tributary, its sulfate levels do not appear to affect Dewey Lake. Concentrations in the lake remain below screening thresholds.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Dewey Lake scored 44 for average TSI in 2020, which is categorized as mesotrophic. Mesotrophic lakes are usually characterized by having moderate clarity, nutrients, and algal growth.

Johns Creek below Dewey Lake has been designated as critical habitat for Big Sandy crayfish.

Table 20. Dewey Lake samples exceeding state criteria and/or District levels of concern in 2020.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
1DEW0001	Outflow	Johns Creek	Strontium, Total	9	None
			Sp. Conductance	3	None
1DEW0002	Lake	Johns Creek	Sulfate	2	None
			Strontium	12	None
			TKN	2	None
			Manganese	4	None
1DEW0003	Inflow	Johns Creek	Iron	1	None
			Sp. Conductance	4	None
			Strontium, Total	6	None
			Sulfate	3	None
1DEW0005	Inflow	Brushy Fork	Sp. Conductance	6	None
			Strontium, Total	6	None
			Sulfate, Total	4	None
			Iron	1	No
1DEW0024	Inflow	Stratton Branch	Total Iron	1	Yes
			TKN	1	None
			Sp. Conductance	6	None
			Strontium, Total	7	None

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
			Sulfate, Total	7	None
1DEW0050	Inflow	Buffalo Creek	Iron	1	No
			Sp. Conductance	5	None
			Strontium, Total	6	None
			Sulfate, Total	4	None

Dillon Lake (DIL) Water Quality Summary

Updated: April 2023

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include aluminum, specific conductance, iron, phosphorus, strontium, and total Kjeldahl nitrogen. High sedimentation rates in Dillon Lake are reducing the conservation storage and impacting the recreation pool. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

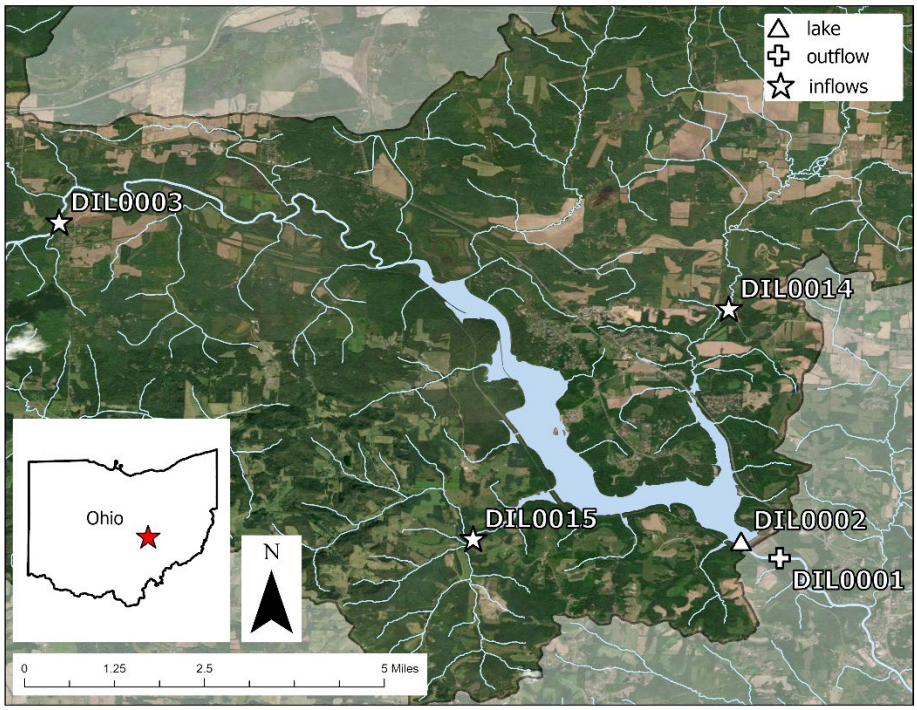

Figure 30. Water quality sampling locations for Dillon Lake in 2022.

WATERSHED SUMMARY: Dillon Lake is located in Muskingum County, Ohio on the Licking River, a tributary of the Muskingum River, of the Ohio River. The dam is located 83 miles upstream of the confluence of the Muskingum and Ohio Rivers. The drainage area of the lake is 742 square miles. The lake project's authorized purposes are flood control, recreation, and low flow augmentation. The lake has a maximum depth of 32 feet and a hydraulic residence time averaging 6 days. There is development and heavy residential use surrounding the lake.

HISTORICAL CONCERNS: Agriculture, forestry, mining, and land development are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased nutrient concentrations

2022 ACTIVITIES: There were a total of six routine sampling trips in the 2022 sampling season. These were comprised of four sample collection events from Dillon Lake, six collections from select inflows, and six collections from the outflow. Samples were collected from the epilimnion, metalimnion, and hypolimnion during each lake sampling event. Water samples were analyzed for a pre-determined suite of chemical analytes and chlorophyll a, b, and c at the lake site only. Physical water quality measurements were collected simultaneously using a multiparameter data sonde during all six sampling events. Macroinvertebrate community samples were collected at four locations using Hester-Dendy samplers and fish community surveys were completed at two locations. Dillon Lake will be intensively monitored again in 2027.

OBSERVED WATER QUALITY CONCERNS: Based on monitoring results in 2022 pH values appear to be trending upward, which could signal an increase in productivity in the watershed, possibly stemming from elevated nutrient levels. There is a possible upward trend of phosphorus in the lake and outflow, which can increase risk of more frequent harmful algal blooms. At the same time, manganese concentrations appear to be trending downward in the lake and outflow possibly due to increasing pH levels. Metals tend to be less soluble at higher pH, suggesting that more manganese is remaining in sediments. Most manganese results in 2022 were below historical ranges. There is a slight downward trend in sulfate concentrations suggesting that legacy mining impacts may be phasing out of the system. All sulfate results from 2022 were below seasonal averages but still within historical ranges.

Invertebrate community index (ICI) scores from sites sampled at Dillon Lake in 2022 were as follows: DIL0001 – 4 (poor), DIL0003 – 30 (fair), DIL0014 – 32 (marginally good), DIL0015 – 41 (good). Overall, these scores indicate a somewhat impaired aquatic macroinvertebrate community at these locations. Fish surveys were also conducted at two inflow sites, yielded the following Ohio Index of Biotic Integrity (OHIBI) scores: DIL0014 – 36 (good), DIL0015 – 41 (good).

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements, chlorophyll a, and total phosphorus concentrations in the water column. Based on the results of monitoring in 2022, Dillon Lake ranged from eutrophic to hypereutrophic. Hypereutrophic and eutrophic states are characterized by high nutrient concentrations, high productivity, and low water clarity

ADDITIONAL INFORMATION: Water is released from the lake through an outflow structure with three gated sluices. The structure was designed to release water from the bottom of the lake at all times. Therefore the quality of release water cannot be regulated. High sedimentation rates in Dillon Lake are reducing the conservation storage and impacting the recreation pool.

Table 21. Dillon Lake samples exceeding state criteria and/or District levels of concern in 2022.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1DIL0001	Outflow	Licking River	Kjeldahl Nitrogen, Total	2	NONE
			Phosphorus, Total	2	NONE
			Specific Conductance	1	NONE
			Strontium, Total	4	NONE
1DIL0002	Lake	Licking River	Aluminum, total	1	NONE
			Kjeldahl Nitrogen, Total	6	NONE
			Iron, total	1	NONE
			Phosphorus, total	6	NONE
			Specific Conductance	7	NONE
			Strontium, Total	12	NONE
1DIL0003	Inflow	Licking River	Iron, Total	1	NONE
			Kjeldahl Nitrogen, Total	1	NONE
			Phosphorus, Total	1	NONE
			Specific Conductance	1	NONE
			Strontium, Total	2	NONE
1DIL0014	Inflow	Big Run	Iron, Total	1	NONE
			Kjeldahl Nitrogen, Total	1	NONE
			Phosphorus, Total	1	NONE
1DIL0015	Inflow	Poverty Run of Licking River	Specific Conductance	2	NONE

East Lynn Lake (ELT) Water Quality Summary

Updated: June 2021

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include aluminum, dissolved oxygen, iron, manganese, phosphorus, and strontium. There was a noticeable reduction in the number of constituents exceeding levels of concern for ELT0001 (outflow). However, Kiah Creek (ELT0036) and Trough Fork (ELT0064) showed a noticeable increase in constituents exceeding levels of concern. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the West Virginia Department of Environmental Protection facilitate potential mitigation efforts by the state.

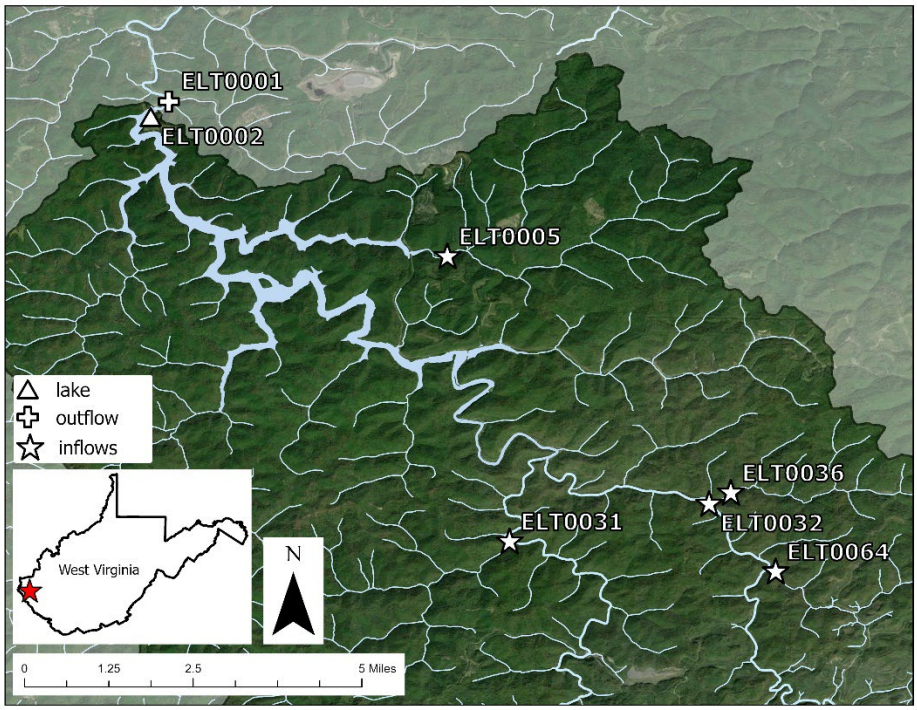

Figure 31. Water quality sampling locations for East Lynn Lake in 2021.

WATERSHED SUMMARY: East Lynn Lake lies in the southeastern portion of the Twelvepole Creek Basin in Wayne and Mingo Counties, West Virginia and drains 133 square miles. The authorized purposes of this lake are flood control, water quality, low flow augmentation, enhanced recreation (whitewater), and recreation. The major industry within the watershed is coal mining, while others include gas and oil extraction, timbering, and farming. The lake has a maximum depth of 50 feet and a residence time of approximately 42 days.

HISTORICAL CONCERNS: Mining and poor land management are the primary sources of watershed degradation resulting in:

- Elevated levels of aluminum, manganese, specific conductance and sulfates

2021 ACTIVITIES: There were six sampling events in the 2021 sampling season. All six events included collecting YSI ambient readings as well as water chemistry parameters. These events include routine water quality sampling of East Lynn Lake, select inflows, and the outflow. Macroinvertebrate community samples were collected at four locations. West Virginia Stream Condition Index (WVSCI) scores were ELT0001 – 32.1 (moderately impaired), ELT0031 – 80.5 (unimpaired-very good), ELT0032 - 75.2 (unimpaired-good), and ELT0064 - 75.6 (unimpaired-good) indicating a healthy aquatic macroinvertebrate community at three of the four locations. Fish surveys were conducted at six sites. The Kentucky Index of Biotic Integrity (KYIBI) was used because West Virginia does not have an IBI for fish. The KYIBI is the most compatible with West Virginia streams in the Huntington District. KYIBI scores were ELT0001 – 64 (Good), ELT0005 -54 (Fair), ELT0031 – 73 (Excellent), ELT0032 – 39 (Poor), ELT0036 -86 (Excellent), ELT0064 – 71 (Excellent) indicating an overall healthy fish community at five out of six sites. *NEXT SAMPLING YEAR: 2026*

ADDITIONAL INFORMATION: East Lynn Lake is functioning as a buffer by protecting downstream water quality against pollutants originating from the headwaters. Kiah Creek continues to be the major source of those pollutants to the lake. Currently, the selective withdrawal outflow tower has lost the use of a water quality gate. This has limited the ability of the project to control for downstream temperature and oxygen targets. This will result in warmer discharges from the lake until the gate has been fixed.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. East Lynn Lake scored 44 for average TSI in 2021, which is categorized as mesotrophic. Mesotrophic lakes are usually characterized by having moderate clarity, nutrients, and algal growth.

Table 22. East Lynn Lake samples exceeding state criteria and/or District levels of concern in 2021.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
ELT0001	Inflow	East Fork of Twelvepole Creek	Iron, Total	2	2
			Kjeldahl Nitrogen, Total	1	NONE
			Manganese, Total	2	NONE
ELT0002	Lake	East Fork of Twelvepole Creek	Aluminum, Total	1	1
			Kjeldahl Nitrogen, Total	1	NONE
ELT0005	Inflow	Lick Creek	Aluminum, Total	2	2
			Iron, Total	2	2
			Phosphorus, Total	1	1
ELT0031	Inflow	East Fork of Twelvepole Creek	Strontium, Total	1	NONE
ELT0032	Inflow	Kiah Creek	Kjeldahl Nitrogen, Total	1	NONE
			Specific Conductance	5	NONE
			Strontium, Total	3	NONE
			Sulfate, Total	3	NONE
ELT0036	Inflow	Big Laurel Creek	Aluminum, Total	1	1
			Iron, Total	1	1
			Phosphorus, Total	1	NONE
			Specific Conductance	5	NONE
ELT0064	Inflow	Trough Fork	Strontium, Total	8	NONE
			Sulfate, Total	6	NONE

Fishtrap Lake (FRL) Water Quality Summary

Updated: April 2021

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include specific conductance, aluminum, strontium, manganese, iron, phosphorus, bromide, and sulfates. Levels of *e. coli* bacteria exceeded state criteria at multiple locations. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. The Kentucky Division of Water is already aware of the exceedances for *e. coli*.

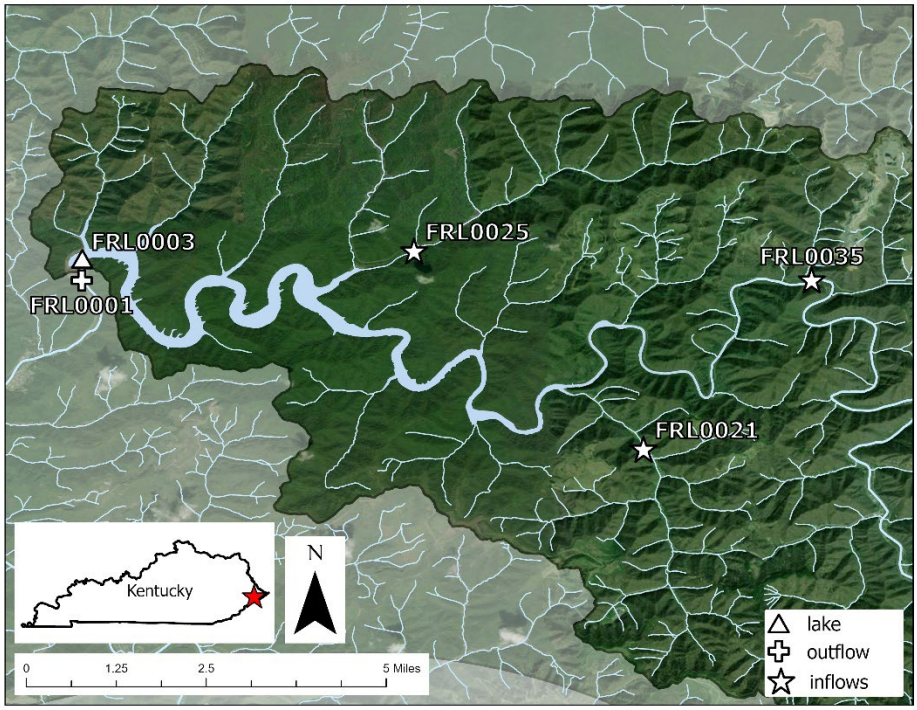

Figure 2124. Water quality sampling locations for Fishtrap Lake in 2020.

WATERSHED SUMMARY: Fishtrap Lake is located entirely in Pike County, Kentucky on the Levisa Fork of the Big Sandy River near the states of Virginia and West Virginia. The authorized purposes for Fishtrap Lake are flood control, recreation, water quality and fish and wildlife conservation. The dam is located on Levisa Fork of Big Sandy River, a tributary of the Ohio River, 130 miles from its mouth and approximately 7 miles above the City of Pikeville, Kentucky. The dam is also 3 miles above the confluence of Russell and Levisa Forks, 103 miles upstream from the mouth of Levisa Fork. The lake drains 392 square miles of Kentucky and Virginia. The lake has a maximum depth of 83 feet and an average retention time of 24 days.

HISTORICAL WATERSHED CONCERNS: Mining and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of *E.coli*, aluminum, phosphorous, manganese, bromide, iron, specific conductance, and sulfates

2020 ACTIVITIES: Six sampling events were conducted in the Fishtrap Lake watershed in 2020. Three major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification and analyzed for dissolved metals. Kentucky DOW requested additional *E. coli* sampling as part of our normal intensive routine. Benthic macroinvertebrate samples were collected but samples were inadvertently discarded by the contracted lab prior to analysis. In 2021, macroinvertebrates were surveyed again and results were received. Kentucky Macroinvertebrate Bioassessment Scores (KYMBI): FRL0001 – 39.2 (poor), FRL0021 – 52.8 (fair), FRL0025 – 70.3 (fair). These indicate an overall slightly impaired macroinvertebrate community. Fishtrap Lake is scheduled to be intensively sampled again in fiscal year 2025.

ADDITIONAL INFORMATION: Fishtrap Lake has a multi-level intake structure for optimization of water quality in the outflow. Debris and trash buildup continue to be a problem for the staff at Fishtrap Lake. Stretches of river downstream of Fishtrap Lake have been proposed as critical habitat for the Big Sandy crayfish, which has also been proposed as a federally threatened species. No operational changes were required for water quality.

Strontium and sulfate levels were elevated throughout the watershed, which is common in watersheds affected by land disturbance such as mineral extraction. Sulfate appears to be on an upward trend at the Lick Creek sample location (1FRL0021). Analyte concentrations were within historical ranges. Specific conductance levels were also high throughout the watershed, which are likely being driven by the high sulfate concentrations.

Grapevine Creek (1FRL0025) is a small tributary of Fishtrap Lake that is characterized by poor water quality and unsightly habitat. Concentrations of aluminum, iron, manganese, and sulfate were elevated at this location, which is the likely cause of the white precipitate that covers its substrate. *E. coli* bacteria exceeded state standards suggesting improper discharge of human or animal waste along Lick Creek and Grapevine Creek.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Fishtrap Lake scored 40 for average TSI in 2020, which is categorized as mesotrophic. Mesotrophic lakes are usually characterized by having moderate clarity, nutrients, and algal growth.

Levisa Fork below Fishtrap Lake has been designated as critical habitat for Big Sandy crayfish.

Table 23. Fishtrap Lake samples exceeding state criteria and/or District levels of concern in 2020.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF RESULTS THAT EXCEED SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1FRL0001	Outflow	Levisa Fork	Sp. Conductance	4	None
			Strontium, Total	9	None
1FRL0003	Lake	Fishtrap Lake	Aluminum	1	None
			Iron	1	No
			Manganese	4	None
			Phosphorus	1	None
			Strontium	12	None
1FRL0021	Inflow	Lick Creek	E. coli	1	Yes
			Sp. Conductance	6	None
			Strontium	7	None
			Sulfate	7	None
1FRL0025	Inflow	Grapevine Creek	E. coli	4	Yes
			Aluminum	6	None
			Iron	1	No
			Sp. Conductance	6	None
			Strontium	6	None
			Sulfate	4	None
1FRL0035	Inflow	Levisa Fork	Bromide	1	None
			Sp. Conductance	6	None
			Strontium	6	None

Grayson Lake (GRL) Water Quality Summary

Updated: July 2025

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include iron, manganese, total Kjeldahl nitrogen, dissolved oxygen, and phosphorus. All constituents of interest appear to be stable in the watershed. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Kentucky Division of Water to facilitate potential mitigation efforts by the state.

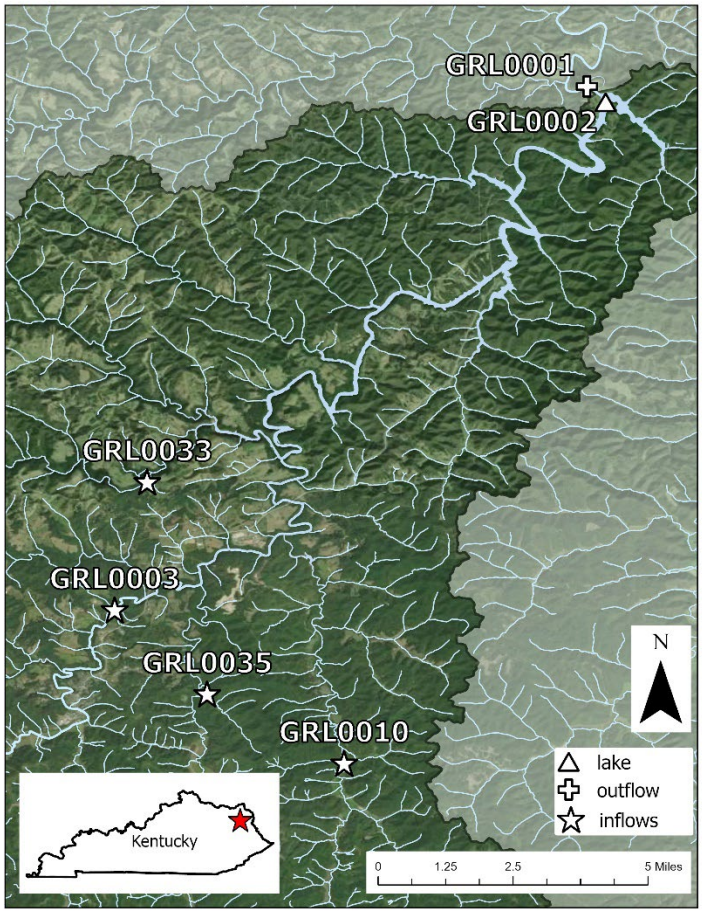

Figure 33. Water quality sampling locations for Grayson Lake in 2024.

WATERSHED SUMMARY: Grayson Lake lies within Carter and Elliott Counties, Kentucky. The dam site is located in Carter County, on the Little Sandy River, a tributary of the Ohio River. It is located 51.2 miles above the mouth of the Little Sandy River, 1.3 miles above the mouth of Big Sinking Creek, and about 6.5 road miles south of the town of Grayson, Kentucky. Grayson Lake drains 721 square miles of watershed. Most of the basin is forested and the main land uses are resource extraction (coal, gas/oil, timber) with light agriculture and residential impacts. The lake has a maximum depth of 60 feet and an average hydraulic retention time of 52 days.

HISTORICAL CONCERNS: Mining, agriculture, and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of manganese, iron, and specific conductance
- Increased concentrations of nutrients

2024 ACTIVITIES: Six sampling events were conducted in the Grayson Lake watershed in 2024. Four major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Fish, macroinvertebrates, and habitat were surveyed at the outflow and all inflow sites. Grayson Lake is scheduled to be intensively sampled again in fiscal year 2029.

OBSERVED WATER QUALITY CONCERNS: Water quality in the Grayson Lake watershed is generally good, which was reflected in data analysis from 2024 monitoring. There were few exceedances in the inflow streams, with low dissolved oxygen conditions that were likely due to ongoing drought conditions at the time. The lake exceeded screening thresholds multiple times throughout the year for iron, manganese, TKN, and dissolved oxygen at lower depths, which is typical during stratification. There is likely internal loading occurring in the lake, which is being exacerbated by anoxic conditions during summer stratification. However, the outflow did not exceed thresholds, which suggests that selective withdrawal capabilities are mitigating poor water quality from the lake's lower depths.

There appears to be an upward trend in pH throughout the watershed. All other constituents appear stable, and results from 2024 monitoring were within historical ranges.

The fish IBI scores for all of Grayson Lake appear to be higher than the macroinvertebrate IBI scores, meaning this would put the sites into different quality categories (Excellent, Good, Fair, Poor, etc.). This would not raise any concern if it was spotted at one site, but it is consistently higher scores for the fish IBIs at all sites collected. Further investigation is still needed, but there are few likely explanations why this discrepancy in scores is occurring. The fish diversity is high among all the sites that were sampled, but the dominant species are ones that are more pollution tolerant, which could still give a good IBI score, but show lack of pollution intolerant species. Macroinvertebrate scores might be lower due to the lower RBP (habitat scores) and these scores are noted for being lower for things like embeddedness, sediment deposition, available cover, channel alteration and various other factors that would be responsible for driving down the species richness and diversity of benthic macroinvertebrates. Even though there is good fish IBI scores, the fish species present maybe more generalists or herbivores, rather than insectivores, so lower numbers or richness of macroinvertebrates wouldn't have an impact on the fish IBI scores. The Water Quality Team will take a deeper look into the fish and benthic macroinvertebrate data to make sure there isn't a deeper issuing causing these IBI score discrepancies.

The Water Quality Team conducted sampling and water quality assessments on Big Caney Creek in response to an oil and brine spill in late January 2024. The spill, traced to a leaking brine tank on private property, was contained by 30 JAN 24 after absorbent booms and cleanup measures were deployed by Kentucky Emergency Management. Big Caney Creek is a direct tributary of Grayson Lake, therefore, there were concerns regarding potential impacts to recreation and wildlife within the lake itself due to the spill. Initial conductance readings in February indicated moderate contamination, and oil residue was observed in debris along the creek. On 26 APR 24, gas, diesel, and oil analytes were non-detectable. Additional sampling was deemed unnecessary, and no complaints regarding residual oil were received.

ADDITIONAL INFORMATION: Grayson Lake has a multi-level intake structure for optimization of water quality in the outflow. Although it is not an authorized project purpose, the lake serves as water supply for local residents. Despite presenting a low risk for harmful algae blooms (HABs) a toxin producing HAB was present in summer 2015.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Grayson Lake TSI score could not be calculated in 2024 due to the low phosphorus levels (below MDL (<0.014 mg/L)) from the four (4) lake samples that were collected over the summer. The low levels of phosphorus as well as low levels of chlorophyll is a good indication that the lake should be characterized as oligotrophic. Oligotrophic lakes are usually characterized by having high clarity, low nutrients, and low algal growth.

Table 24. Grayson Lake samples exceeding state criteria and/or District levels of concern in 2024.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
GRL0001	Outflow	Little Sandy River	Strontium	6	NONE
GRL0002	Lake	Little Sandy River	Bromide	1	NONE
			Iron	3	NONE
			Manganese	3	NONE
			TKN	4	NONE
			Strontium	4	NONE
GRL0003	Inflow	Little Sandy River	Strontium	6	NONE

GRL0009	Inflow	Big Caney Creek	Phosphorus	1	NONE
GRL0010	Inflow	Newcombe Creek	Bromide	6	NONE
			Dissolved Oxygen	3	YES
			Strontium	6	NONE
GRL0033	Inflow	Big Caney Creek	Bromide	1	NONE
			TKN	1	NONE
			Strontium	5	NONE
GRL0035	Inflow	Middle Fork of Little Sandy River	Bromide	1	NONE
			Strontium	6	NONE

Table 25. Grayson Lake biological and habitat results in 2024.

Site	Stream	Fish Score	Fish Category	Dominant Species	Macro Score	Macro Category	RBP Score	RBP Categories Marginal or Worse
GRL0001	Little Sandy River of Ohio River	51	Fair	Green Sunfish	22	Very Poor	124	channel alteration, riparian zone width
GRL0003	Little Sandy River of Ohio River	47	Fair	Bluntnose Minnow	36	Poor	123	embeddedness, sed deposition, riffle frequency, bank stability
GRL0010	Newcombe Creek of Little Sandy River	65	Good	Creek Chub	35	Very Poor	96	available cover, embeddedness, sed deposition, riffle frequency, bank stability, veg protection
GRL0033	Big Caney Creek of Little Sandy River	67	Good	Central Stoneroller	56	Fair	150	veg protection
GRL0035	Middle Fork of Little Sandy River	74	Excellent	Central Stoneroller	61	Fair	153	available cover, riffle frequency

John W. Flannagan Lake (JWF) Water Quality Summary

Updated: April 2021

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include specific conductance, strontium, TKN, manganese, bromide, and sulfates. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams.

This project is currently Licensed by the Federal Energy Regulatory Commission for the addition of non-Federal hydropower, which could potentially alter water quality at the project. The District is working together with the agency and the Licensee to determine the best options for the project.

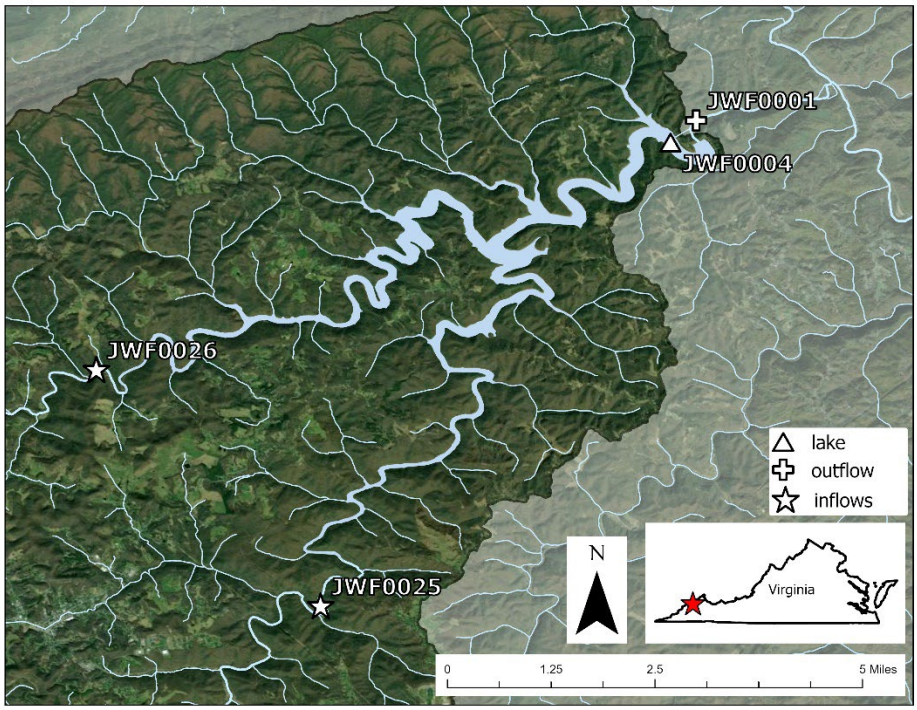

Figure 34. Water quality sampling locations for J.W. Flannagan Lake in 2020.

WATERSHED SUMMARY: John W. Flannagan Lake is located on Pound River, a tributary of Russell Fork, of Levisa Fork of the Big Sandy River, 150 river miles above the confluence of the Big Sandy and Ohio Rivers. The authorized purposes of the lake are flood control, recreation and fish and wildlife conservation. The project is located about 80 miles south of Huntington, WV. The reservoir drains an area of 221 square miles. The lake has a maximum depth of 186 feet and an average hydraulic retention time of 111 days.

HISTORICAL CONCERNS: Mining and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of aluminum, manganese, iron, bromide, specific conductance, and sulfates

2020 ACTIVITIES: Six sampling events were conducted in the John W. Flannagan Lake watershed in 2020. Two major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification and analyzed for dissolved metals. Benthic macroinvertebrate samples were collected but samples were inadvertently discarded by the contracted lab prior to analysis. In 2021, macroinvertebrates were surveyed again and results were received. Virginia Stream Condition Index (VSCI) scores: JWF0001 – 50.0 (impaired), JWF0025 – 64.8 (similar to reference), JWF0026 – 68.2 (similar to reference). These scores indicate a healthy macroinvertebrate community at two of three sites surveyed. John W. Flannagan Lake is scheduled to be intensively sampled again in fiscal year 2025.

ADDITIONAL INFORMATION: Water from J.W. Flannagan Lake is discharged from the hypolimnion resulting in cold, deoxygenated outflows. However, these discharges are quickly oxygenated downstream leading to a high quality trout

stream. The Virginia Department of Environmental Quality has re-classified the Pound River downstream of J.W. Flannagan Lake to a “natural reproducing trout water”. The Federal Energy Regulatory Commission has issued a license for the construction of a non-federal hydroelectric power plant at the dam. Construction of the plant could impact water quality downstream of the lake. Stretches of river within the impounded reservoir and downstream of J.W. Flannagan Lake have been proposed as critical habitat for the Big Sandy crayfish, which has also been proposed as a federally threatened species. Additionally, J.W. Flannagan Lake frequently has harmful algal blooms during both the cold winter season and the summer recreation season despite low nutrient concentrations and low productivity.

Elevated levels of strontium, sulfate, and specific conductance were seen in the inflow streams, though concentrations were within historical ranges. Specific conductance appears to trend upward throughout the watershed until about 2010, which could be driven by concentrations of sulfate. Elevated levels of these constituents are commonly found in watersheds subjected to land disturbances such as mining.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. John W. Flannagan Lake scored 39 for average TSI in 2020, which is categorized as oligotrophic. Oligotrophic lakes are usually characterized by having high clarity, low nutrients, and low algal growth.

The flood storage pool and the Pound River below J.W. Flannagan Lake have been designated as critical habitat for Big Sandy crayfish.

Table 26. J.W. Flannagan Lake samples exceeding state criteria and/or District levels of concern in 2020.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1JWF0001	Outflow	Pound River	Sp. Conductance	2	None
			Manganese	1	None
			Strontium	6	None
			Sulfate	2	None
1JWF0004	Lake	Cranes Nest River	Manganese	2	None
			pH	4	None
			Strontium	10	None
			Sulfate	1	None
			TKN	1	None
1JWF0025	Inflow	Cranes Nest River	Bromide	1	None
			Sp. Conductance	4	None
			Strontium	6	None
			Sulfate	4	None
1JWF0026	Inflow	Pound River	Bromide	1	None
			Sp. Conductance	6	None
			Strontium	6	None
			Sulfate	4	None

Leesville Lake (LEM) Water Quality Summary

Updated: June 2022

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include aluminum, dissolved oxygen, iron, manganese, phosphorus, and TKN. New for 2021, Aluminum and Iron exceeded levels of concern multiple times at LEM0012; these constituents did not exceed levels of concern during the last sampling round in 2016Instances of low dissolved oxygen and high dissolved metals in the outflow could be rectified in the future with the addition of a trash rack weir. This structural modification could be completed as soon as 2018. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

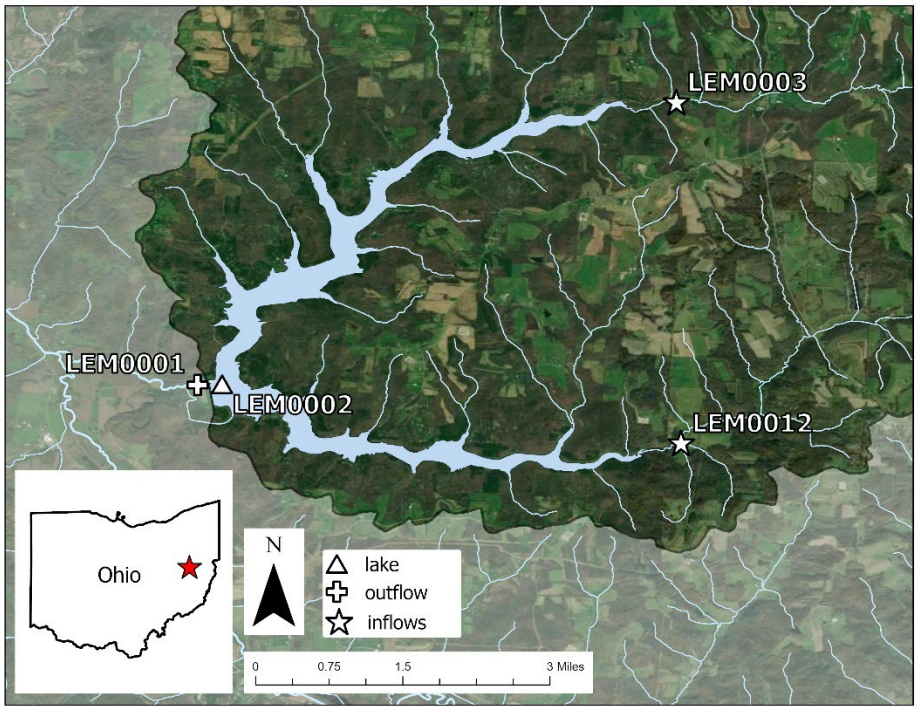

Figure 35. Water quality sampling locations for Leesville Lake in 2021.

WATERSHED SUMMARY: Leesville Lake is located in Carroll County in northeastern Ohio. The authorized project purposes for Leesville Lake are flood control, fish and wildlife, and recreation. The lake is supplied by two forks of Conotton Creek: McGuire Creek and North Fork of McGuire Creek. Together they drain roughly 48 square miles of forest and farmland. Shale gas extraction is a significant industry in the watershed. The lake has a maximum depth of 48 feet and a residence time of about 134 days.

HISTORICAL CONCERNS: Resource extraction, agriculture, and poor land management are the primary sources of watershed degradation resulting in:

- Elevated levels of aluminum, manganese, iron, sulfates, and nutrients

2021 ACTIVITIES: There were six sampling events in the 2021 sampling season. All six events included collecting physical chemistry as well as water quality samples. These events include routine sampling of Leesville Lake, select inflows, and the outflow. Macroinvertebrate community samples were collected at three locations. Invertebrate community index (ICI) scores: LEM0001 – 12 (low-fair), LEM0003 – 24 (fair), LEM0012 – 18 (low-fair), indicating an overall somewhat impaired aquatic macroinvertebrate community at these locations. Fish surveys were also conducted at two sites. Ohio Index of Biotic Integrity (OHIBI) scores: LEM0003 – 34 (fair), LEM0012 – 34 (fair). *NEXT SAMPLING YEAR: 2026*

ADDITIONAL INFORMATION: Modifications are scheduled for the outlet structures at Leesville and Atwood Lakes, however the unusual design of the intakes are causing delays in the project. The purpose of the trash rack modifications are to minimize the release of hydrogen sulfide gas that is produced from outflow water originating in the hypolimnion. While Leesville and Atwood Lakes produce hydrogen sulfide to a lesser extent than Tappan, Clendening, or Piedmont, the gas is still negatively affecting the structures and human health. Additionally, increased phosphorus and nitrogen inputs from the inflows are being passed into the tailwaters without being buffered by the lake.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Leesville Lake scored 42 for average TSI in 2021, which is categorized as mesotrophic. Mesotrophic lakes are usually characterized by having moderate clarity, nutrients, and algal growth.

Table 27. Leesville Lake samples exceeding state criteria and/or District levels of concern in 2021.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
LEM0001	Outflow	McGuire Creek	Iron, Total	4	NONE
			Kjeldahl Nitrogen, Total	2	NONE
			Manganese, Total	8	NONE
			Phosphorus, Total	2	NONE
LEM0002	Lake	Leesville Lake	Iron, Total	2	NONE
			Kjeldahl Nitrogen, Total	1	NONE
LEM0003	Inflow	North Fork McGuire Creek	Aluminum, Total	1	NONE
			Iron, Total	1	NONE
			Phosphorus, Total	1	NONE
LEM0012	Inflow	McGuire Creek	Aluminum, Total	4	NONE
			Iron, Total	5	NONE
			Kjeldahl Nitrogen, Total	4	NONE
			Phosphorus, Total	1	NONE

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include aluminum, dissolved oxygen, iron, phosphorus, strontium, specific conductivity, and TKN. New for 2021, there is a noticeable increase in strontium exceeding levels of concern for NBN0001. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

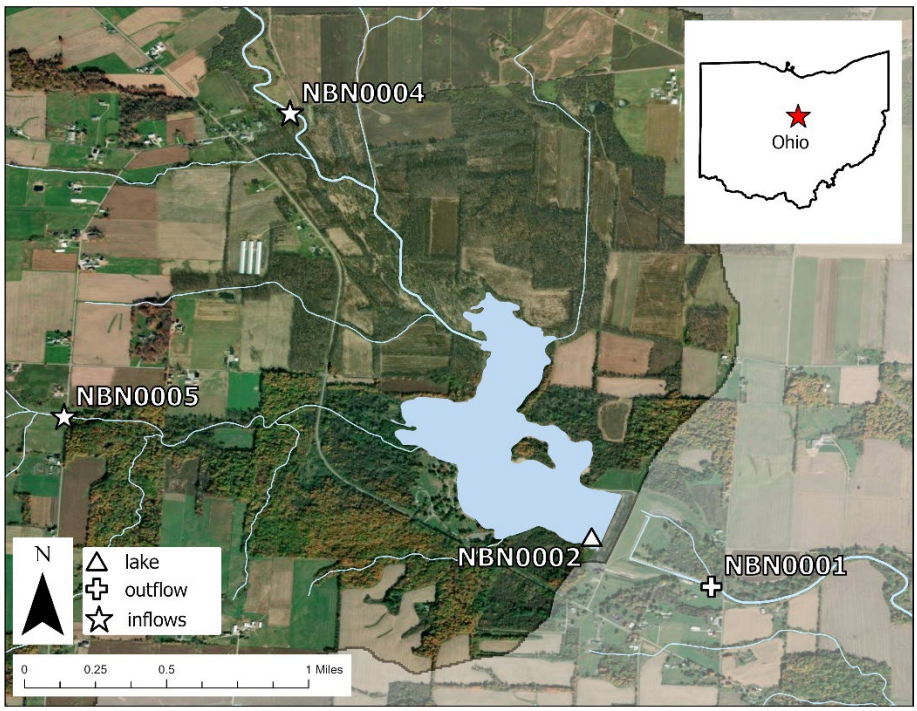

Figure 36. Water quality sampling locations for North Branch of Kokosing Lake in 2021.

WATERSHED SUMMARY: North Branch of Kokosing Lake is located in Knox County, in north central Ohio. The North Branch of the Kokosing River is located in the northwest portion of the much larger Kokosing River basin, which spans five counties. The North Branch basin drains roughly 45 square miles of gently rolling farmland. North Branch of Kokosing Lake is the smallest flood control lake in the Huntington District, and its authorized project purposes are flood control, fish and wildlife, and recreation. The lake has a maximum depth of 23 feet and a residence time of approximately 5 days.

HISTORICAL CONCERNS: Agriculture and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of nutrients

2021 ACTIVITIES: There were six sampling events in the 2021 sampling season. All six events included collecting physical chemistry and water quality samples. These events include routine sampling of North Branch of Kokosing Lake, select inflows, and the outflow. Macroinvertebrate community samples were collected at three locations. Invertebrate community index (ICI) scores: NBN0001 – 20 (low-fair), NBN0004 – 42 (very good), NBN0005 – 30 (marginally good) indicating an overall healthy aquatic macroinvertebrate community at these locations. Fish Surveys were also conducted at three sites. Ohio Index of Biotic Integrity (OHIBI) scores: NBN0001 – 34 (fair), NBN0004 – 46 (good), NBN0005 – 46 (good).

NEXT SAMPLING YEAR: 2026

ADDITIONAL INFORMATION: Concentrations of TKN, phosphorus, and specific conductance have been steadily increasing since 1985. Elevated levels of nutrients have contributed to increased algal growth and a shallow epilimnion due to reduced light penetration.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. North Branch of Kokosing Lake scored 69 for

average TSI in 2021, which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 28. North Branch of Kokosing Lake samples exceeding state criteria and/or District levels of concern in 2021.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
NBN0001	Outflow	Kokosing River	Aluminum, Total	3	NONE
			Iron, Total	3	NONE
			Kjeldahl Nitrogen, Total	8	NONE
			Oxygen, Dissolved	2	NONE
			Phosphorus, Total	7	NONE
			Strontium, Total	9	NONE
NBN0002	Lake	Kokosing Lake	Aluminum, Total	1	NONE
			Iron, Total	1	NONE
			Kjeldahl Nitrogen, Total	4	NONE
			Phosphorus, Total	4	NONE
			Strontium, Total	8	NONE
NBN0004	Inflow	North Branch of Kokosing River	Aluminum, Total	3	NONE
			Iron, Total	2	NONE
			Phosphorus, Total	3	NONE
			Specific Conductance	4	NONE
			Strontium, Total	5	NONE
NBN0005	Inflow	UT to North Branch of Kokosing River	Phosphorus, Total	1	NONE
			Specific Conductance	3	NONE
			Strontium, Total	5	NONE

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include iron, strontium, manganese, TKN, and specific conductance. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams.

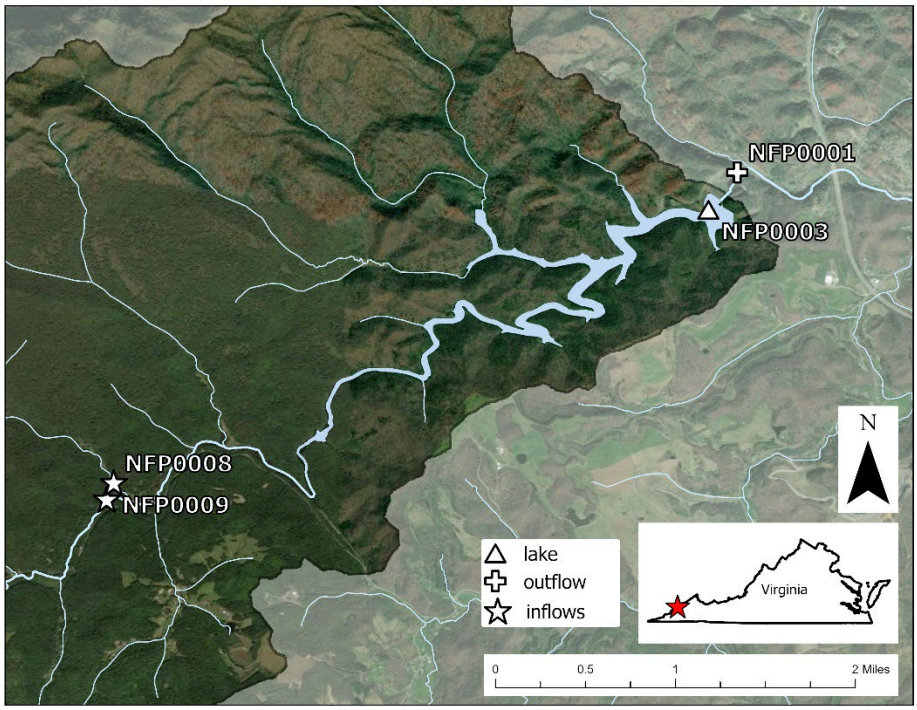

Figure 37. Water quality sampling locations for North Fork of Pound Lake in 2020.

WATERSHED SUMMARY: North Fork of Pound Dam is located on North Fork of Pound River, VA, a tributary of Pound River, of Russell Fork, of Levisa Fork, of the Big Sandy River. The dam is 184 river miles above the confluence of the Big Sandy and Ohio Rivers. The authorized purposes for the dam are flood control, recreation, water quality, and fish and wildlife conservation. The watershed is 17.2 square miles and is generally mountainous. The lake has a maximum depth of 61 feet and a water retention time of 59 days.

HISTORICAL CONCERNS: Based on District data, North Fork of Pound Lake has few water quality concerns.

2020 ACTIVITIES: Six sampling events were conducted in the North Fork of Pound Lake watershed in 2020. Two major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification and analyzed for dissolved metals. Benthic macroinvertebrate samples were collected but samples were inadvertently discarded by the contracted lab prior to analysis. In 2021, macroinvertebrates were surveyed again and results were received. Virginia Stream Condition Index (VSCI) scores: NFP0001 – 65.1 (similar to reference), NFP0008 – 63.4 (similar to reference), NFP0009 – 75.9 (similar to reference). These scores indicate a healthy macroinvertebrate community. North Fork of Pound Lake is scheduled to be intensively sampled again in fiscal year 2025.

ADDITIONAL INFORMATION: North Fork of Pound Lake has a multi-level intake structure for optimization of water quality in the outflow. Water quality in this watershed is generally good, likely due to its forested areas, and lack of major land disturbances such as agriculture or resource extraction.

Sample results from 2016 and 2020 confirm that an anomalous phosphorus result that exceeded the District threshold in 2015 was not an upward trend.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. North Fork of Pound Lake scored 33 for

average TSI in 2020, which is categorized as oligotrophic. Oligotrophic lakes are usually characterized by having high clarity, low nutrients, and low algal growth.

The North Fork of Pound River below North Fork of Pound Lake has been designated as critical habitat for Big Sandy crayfish.

Table 29. North Fork of Pound Lake samples exceeding state criteria and/or District levels of concern in 2020.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1NFP0001	Outflow	North Fork of Pound	None	-	-
1NFP0003	Lake	North Fork of Pound	Iron	1	None
			Manganese	8	None
			TKN	1	None
1NFP0008	Inflow	Bad Creek	None	-	-
1NFP0009	Inflow	North Fork of Pound	Sp. Conductance	2	None
			Strontium	4	None

Paint Creek Lake (PCS) Water Quality Summary

Updated: March 2020

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including ammonia, strontium, specific conductivity, iron, phosphorus, and total Kjeldahl nitrogen. Trends analysis revealed all constituents appear stable. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. For fish samples collected during 2024, the Paint Creek inflow scored a 41 on the Ohio IBI, which is a rating of "good". The Rattlesnake Creek inflow scored a 52 on the Ohio IBI, which is a rating of "excellent. The Paint Creek outflow scored a 36 on the Ohio IBI, which is a rating of "good".

Figure 38. Water quality sampling locations for Paint Creek Lake in 2024.

WATERSHED SUMMARY: Paint Creek Lake is located in Ross and Highland Counties, Ohio on Paint Creek, a tributary of the Scioto River. The dam site is 16 miles above the town of Bourneville, 36.8 miles above the mouth. Paint Creek Lake drains 570 square miles of watershed. The main land uses are agriculture and residential. The inflow water is characterized as calcium-chloride type representing an unbalanced condition. High concentrations of nutrients result in a high productivity in the lake. The lake has a maximum depth of 50 feet and an average retention time of 16 days.

HISTORICAL CONCERNS: Agriculture, residential, and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of strontium and nutrients
- Increased risk of harmful algae blooms in the lake

2024 ACTIVITIES: Six sampling events were conducted in the Paint Creek Lake watershed in 2024. Two major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Fish, macroinvertebrate, and habitat surveys were conducted in both the inflow streams and the outflow, with the results summarized in the table below. Paint Creek Lake is scheduled to be intensively sampled again in fiscal year 2029.

OBSERVED WATER QUALITY CONCERNS: Water quality analysis revealed high inputs of nitrogen, phosphorus, and strontium into the lake from the one of the primary inflows, Paint Creek (1PCS0002). The outflow contained high levels of nitrogen, phosphorus, and strontium, indicating that the lake is not acting as a buffer to the above sources. Trend analysis revealed a downward trend in sulfate. All other parameters of interest appear stable in the watershed.

All water quality concerns revealed in the most recent intensive surveys at Paint Creek Lake have been previously documented in the WCM with no new concerns surfacing. Active agricultural land use is most likely contributing the nutrients to the watershed through runoff of farm fields and overuse of fertilizers.

ADDITIONAL INFORMATION: Paint Creek Lake has a multi-level intake structure for optimization of water quality in the outflow.

The increased nutrient loading from the inflows make it susceptible to HABs. A HAB occurred in July of 2013 but did not result in any closures or impacts to recreation. In 2017 a HAB occurred on Little Pond, which is a small body of water adjacent to Paint Creek Lake. While not part of the main lake, Little Pond is an active recreation area managed by the Corps of Engineers. Signage has been placed to alert the public of the risks of contact with HABs.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Paint Creek Lake scored 66 for average TSI in 2024 which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 30. Paint Creek Lake samples exceeding state criteria and/or District levels of concern in 2024.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
1PCS0001	Outflow	Paint Creek	Ammonia	2	NONE
			TKN	6	NONE
			Total Phosphorus	5	NONE
			Sp. Conductance	1	NONE
			Total Strontium	6	NONE
1PCS0002	Inflow	Paint Creek	TKN	2	NONE
			Total Phosphorus	6	NONE
			Sp. Conductance	6	NONE
			Total Strontium	6	NONE
1PCS0009	Inflow	Rattlesnake Creek	TKN	1	NONE
			Sp. Conductance	6	NONE
			Total Strontium	6	NONE
1PCS0014	Lake	Paint Creek	Ammonia	2	NONE
			Iron	2	NONE
			TKN	4	NONE
			Phosphorus	4	NONE
			Total Strontium	4	NONE

Table 31. Paint Creek Lake biological and habitat results in 2024.

Site	Stream	Fish Score	Fish Category	Dominant Species	Macro Score	Macro Category	RBP Score	RBP Categories Marginal or Worse
PCS0001	Paint Creek of Scioto River	36	Good	Bluegill	14	Low Fair	146	NONE
PCS0002	Paint Creek of Scioto River	41	Good	Bluegill	42	Very Good	121	riffle frequency, bank stability, vegetative protection
PCS0009	Rattlesnake Creek of Paint Creek	52	Excellent	Sand Shiner	40	Good	158	NONE

Paintsville Lake (PIV) Water Quality Summary

Updated: April 2024

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include dissolved oxygen, manganese, strontium, and phosphorus. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Kentucky Division of Water to facilitate potential mitigation efforts by the state.

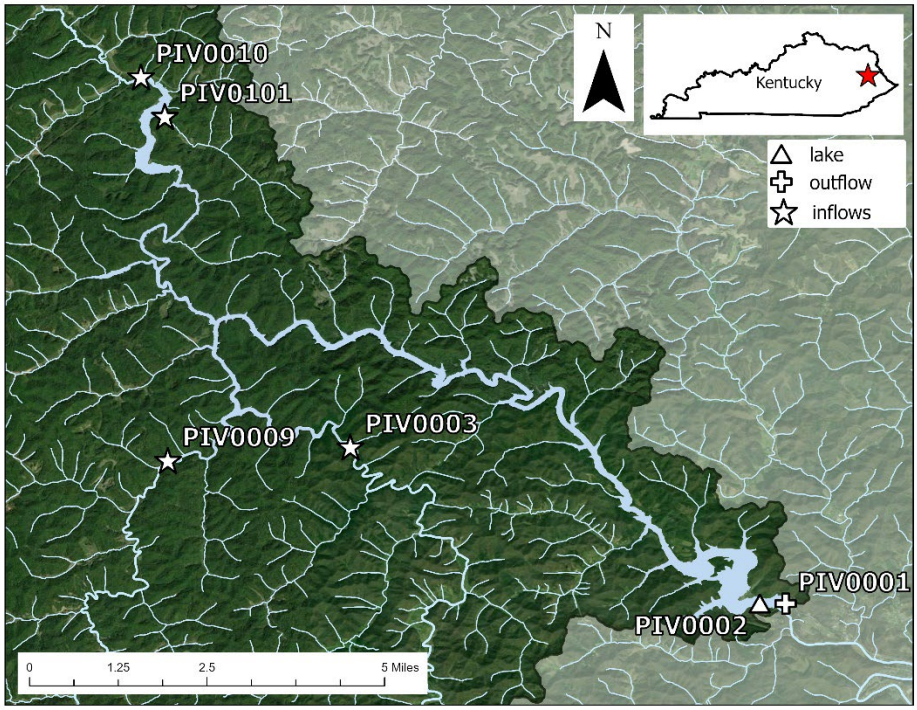

Figure 39. Water quality sampling locations for Paintsville Lake in 2023.

WATERSHED SUMMARY: Paintsville Lake is located primarily in Johnson County, Kentucky. The dam is on Paint Creek, a tributary of the Levisa Fork, of the Big Sandy River. The drainage area of the lake is approximately 92 square miles. The lake project's authorized purposes are flood control, recreation, and water quality. The tailwater of the lake is designated as a cold water fishery by the Commonwealth of Kentucky and it is managed year round for trout. The lake has a maximum depth of 112 feet and a hydraulic residence time of about 126 days. The watershed is dominated by forested land.

HISTORICAL CONCERNS: Mining and natural gas extraction are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Excessive levels of iron and manganese in the lake during times of stratification

2023 ACTIVITIES: Six sampling events were conducted in the Paintsville Lake watershed in 2023. Four major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Benthic macroinvertebrate sampling and fish assemblages were conducted at all four major inflows and the outflow. Paintsville Lake is scheduled to be intensively sampled again in fiscal year 2028.

OBSERVED WATER QUALITY CONCERNS: Water quality at Paintsville Lake is general good, and data analysis in 2023 did not reveal many new concerns. Metals were elevated in hypolimnion samples of Paintsville Lake, but these metals settle and become latent in the lake sediments, buffering any downstream impacts. The lake does heavily stratify leaving an anoxic hypolimnion with high metal concentrations, but selective withdrawal on the intake structure manages flows to minimally impact downstream water quality and aquatic communities. The headwaters of the lake are experiencing heavy sedimentation from the increased solids input caused by upstream land uses and erosion. Phosphorus exceeded its level of concern once in Little Paint Creek, Big Mine Fork, and Open Fork but productivity is generally not an issue within the lake. There were four detections of bromide in the Big Mine Fork inflow (PIV0009),

but all were due to the MDL being lowered. The MDL for the bromide test was lowered in recent years, giving the appearance of more frequent detections. Elevated constituent levels will be reported to the Kentucky Division of Water to facilitate potential mitigation efforts by the state. Otherwise, analyte levels in the watershed were within historical ranges.

As part of routine intensive sampling, fish and macroinvertebrates are collected. It is worth mentioning that benthic macroinvertebrates at all sites both scored in the poor category with the outflow (PIV0001) receiving the worst score of 16. Fish also scored poorly at the outflow and PIV0010 - Open Fork of Paint Creek with an IBI of 25 and 43 respectively. These are the only biological surveys at Paintsville that resulted in a poor categorization.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Paintsville Lake is categorized as oligotrophic based on an average TSI score of 38 in 2018 and an average TSI score of 30 in 2023. Oligotrophic lakes are usually characterized by having high clarity, low nutrients, and low algal growth.

ADDITIONAL INFORMATION: During the summer stratification period, the outflow is managed for the maintenance of the trout stream below our discharge. The use of selective withdrawal gates is also managed for the lake fishery because use of some gates can lead to insufficient water quality for pelagic game fish species.

Table 32. Paintsville Lake samples exceeding state criteria and/or District levels of concern in 2023.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1PIV0001	Outflow	Paint Creek	Manganese	1	NONE
1PIV0002	Lake	Paint Creek	None	-	-
1PIV0003	Inflow	Little Paint Creek	Phosphorus, Total	1	NONE
1PIV0009	Inflow	Big Mine Fork	Phosphorus, Total	1	NONE
			Strontium	4	NONE
1PIV0010	Inflow	Open Fork	Dissolved Oxygen	1	NONE
			Manganese	1	NONE
			Phosphorus, Total	1	NONE
1PIV0101	Inflow	Patoker Branch of Open Fork	None	-	-

Piedmont Lake (PES) Water Quality Summary

Updated: April 2024

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include aluminum, ammonia, specific conductance, selenium, sulfates, phosphorus, total Kjeldahl nitrogen, strontium, manganese, bromide, and iron. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. Data analysis revealed that a structural modification completed in 2017 minimized hydrogen sulfide gas emissions, increased dissolved oxygen, and decreased dissolved metals in the outflow, improving overall water quality to the downstream area.

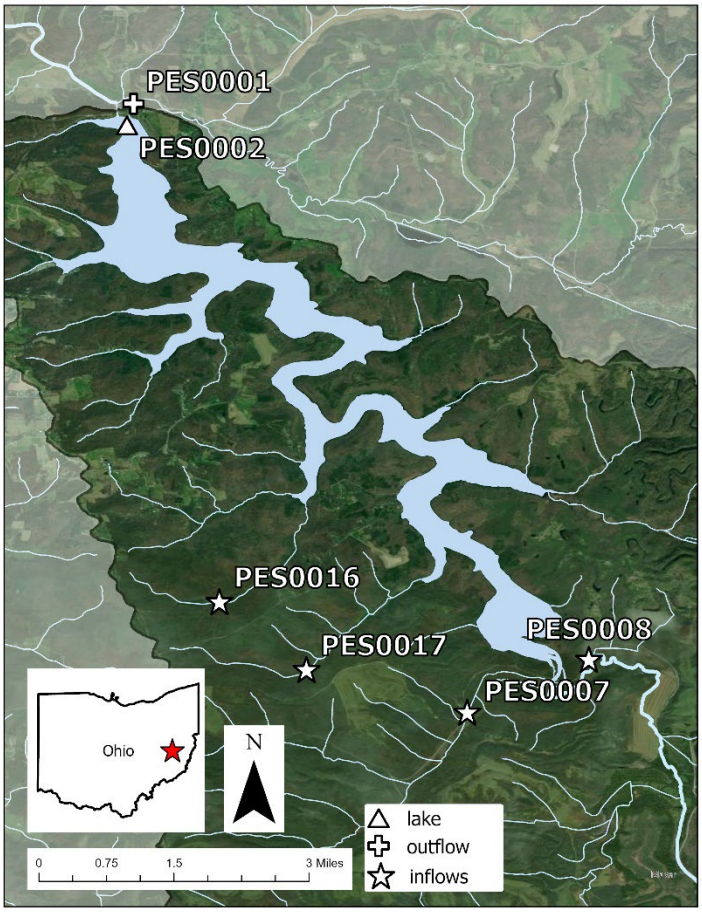

Figure 40. Water quality sampling locations for Piedmont Lake in 2023.

WATERSHED SUMMARY: Piedmont Lake is located in Harrison County, Ohio on Stillwater Creek, a tributary of the Tuscarawas River, of the Muskingum River. The dam is located 198 miles upstream of the confluence of the Muskingum River and the Ohio River. The drainage area of the lake is approximately 86 square miles. The lake project's authorized purposes are flood control, recreation, and fish and wildlife conservation. The lake has a maximum depth of 38 feet with an average residence time of 144 days. The watershed is dominated by surface mining, forest, and agriculture.

HISTORICAL CONCERNS: Mining and agriculture are the primary sources of watershed degradation resulting in:

- Elevated levels of specific conductance, sulfates, chlorides, and metals

2023 ACTIVITIES: Six sampling events were conducted in the Piedmont Lake watershed in 2023. Four major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Benthic macroinvertebrate sampling and fish assemblages were conducted at PES0001, PES0007, and PES0008, and only benthic sampling was collected at PES0017, an AMD site. PES0016 was not biologically sampled due to the small size of the stream. Piedmont Lake is scheduled to be intensively sampled again in fiscal year 2028.

OBSERVED WATER QUALITY CONCERNS: Trend analysis revealed that elevated strontium and sulfate inputs from the inflows were being passed through the lake and discharged into the tailwaters. Other constituents exceeding levels of concern included specific conductance, iron, aluminum, phosphorus, manganese, total Kjeldahl nitrogen, and bromide. The MDL for the bromide test was lowered in recent years, giving the appearance of more frequent detections. There were four detections of bromide in 2023, however three were due to the MDL being lowered. Only one exceeded the threshold of concern at the PES0017 AMD site. Elevated constituent levels will be reported to the

Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. Otherwise, analyte levels in the watershed were within historical ranges.

Sampling at the Lick Run site (PES0017) yielded results within historical ranges. Lick Run is comprised of a series of old retention ponds that discharge directly into Piedmont Lake and are the source of a white precipitate at the confluence with the lake. Analysis results show that high concentrations of metals (primarily aluminum, cobalt, iron, and manganese) and sulfates are discharged regularly from the pond. Additional sampling of the discharge at the confluence with Piedmont Lake would determine whether the subsequent ponds were buffering any of the metals prior to discharge into the lake. However, given the white coloration of the water in the upper end of the Lick Creek arm of the lake, this seems unlikely. While this inflow is a source of significantly high concentrations of unwanted constituents, it is small in comparison to the overall watershed. The bulk of the pollutants existing in the lake are likely sourced from the primary inflows Robinson Run (PES0007) and Stillwater Creek (PES0008).

Benthic macroinvertebrate sampling revealed that the outflow (PES0001) and inflow Robinson Run (PES0007) scored Fair on the Ohio ICI, while Stillwater Creek (PES0008) scored marginally good. Lick Run (PES0017) scored Poor. Fish community surveys from the outflow (PES0001) and two inflows (PES0007 and PES0008) resulted in a rating of Good on the Ohio IBI, with the outflow having the highest score of all Ohio sites sampled in 2023. The Indian Run (PES0016) site was not surveyed at all due to its small size.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Piedmont Lake scored 50 for average TSI in 2018, which is categorized as eutrophic. Piedmont Lake scored 48 for average TSI in 2023, which is categorized as mesotrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth, whereas mesotrophic lakes are characterized by moderate levels of the same components.

ADDITIONAL INFORMATION: In the fall of 2017 the intake structure at Piedmont Lake was retrofitted with a steel plate that allowed high quality surface water to be discharged downstream, with the intention of mitigating long-standing problems caused by hydrogen sulfide (H2S) gas releases. Lake buoy data showed no perceivable impacts to the water quality of the lake as a result of the structural modification.

In 2016, the Water Quality Team was called to investigate another pond discharging into Piedmont Lake that appeared blue in color. Analysis of samples collected from both the pond itself and its discharge showed high concentrations of metals and sulfates in the pond itself, but much lower concentrations in the pond's discharge. The pond discharges adjacent to the previously described series of retention ponds on Lick Run, but ultimately ends up in the same arm of the lake.

Table 33. Piedmont Lake samples exceeding state criteria and/or District levels of concern in 2023.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1PES0001	Outflow	Stillwater Creek	Kjeldahl Nitrogen, Total	3	NONE
			Manganese	1	NONE
			Specific Conductance	6	NONE
			Strontium	8	NONE
			Sulfate	8	NONE
1PES0002	Lake	Stillwater Creek	Kjeldahl Nitrogen, Total	2	NONE
			Specific Conductance	4	NONE
			Strontium	4	NONE
			Sulfate	4	NONE

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1PES0007	Inflow	Robinson Creek	Specific Conductance	6	NONE
			Strontium	6	NONE
			Sulfate	6	NONE
1PES0008	Inflow	Stillwater Creek	Aluminum	2	NONE
			Iron	2	NONE
			Phosphorus, Total	2	NONE
			Specific Conductance	6	NONE
			Strontium	6	NONE
			Sulfate	6	NONE
1PES0016	Inflow	Indian Run	Manganese	4	NONE
			Specific Conductance	6	NONE
			Strontium	6	NONE
			Sulfate	6	NONE
1PES0017	Inflow	Lick Run	Aluminum	5	NONE
			Ammonia	1	NONE
			Bromide	1	NONE
			Iron	5	NONE
			Kjeldahl Nitrogen, Total	2	NONE
			Manganese	5	NONE
			Selenium	5	NONE
			Specific Conductance	5	NONE
			Strontium	5	NONE
			Sulfate	5	NONE

Pleasant Hill Lake (PHC) Water Quality Summary

Updated: June 2022

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including dissolved oxygen, phosphorus, strontium, specific conductivity, and TKN. New for 2021, strontium has exceeded levels on concern multiple times at PHC0001, PHC0002, and PHC0005. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

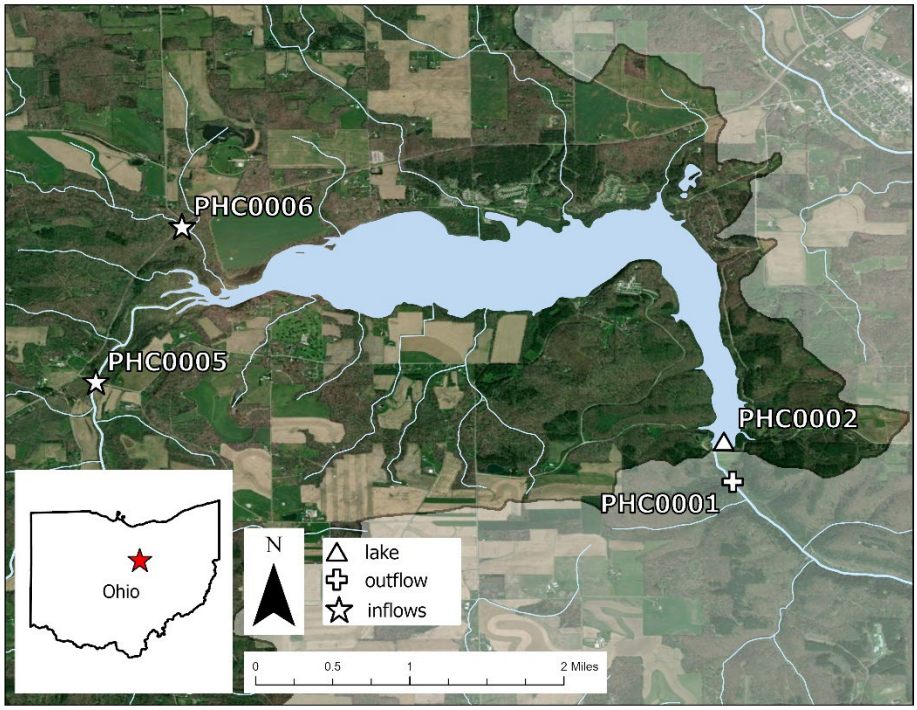

Figure 5665. Water quality sampling locations for Pleasant Hill Lake in 2021.

WATERSHED SUMMARY: The Pleasant Hill Lake drainage basin lies within portions of Ashland, Richland, Knox, and Morrow Counties in the north central portion of Ohio. Clear Fork of Mohican River is the major tributary in the basin. The lake drains approximately 197 square miles of forest and farmland southeast of Mansfield. The authorized project purposes for the lake are flood control, fish and wildlife, and recreation. The lake has a maximum depth of 55 feet and a residence time of approximately 24 days.

HISTORICAL CONCERNS: Agriculture and poor land management are the primary sources of watershed degradation resulting in:

- Increased concentrations of nutrients

2021 ACTIVITIES: There were six sampling events in the 2022 sampling season. All six events included assessing physical chemistry as well as the collection of water chemistry samples. These events assessed Pleasant Hill Lake, select inflows, and the outflow. Macroinvertebrate community samples were collected at three locations. Invertebrate community index (ICI) scores for PHC0001, PHC0005, and PHC0006 were all 42 (very good), indicating a healthy aquatic macroinvertebrate community at these locations. Fish surveys were conducted in 2020 and 2021. PHC0001 was surveyed during a 2020 periodic inspection and scored 38 (good) and PHC0006 was surveyed in 2021 and received a score of 42 (good) indicating an overall healthy fish community. *NEXT SAMPLING YEAR: 2026*

ADDITIONAL INFORMATION: Like many other watersheds in the region, the Clear Fork has impacts resulting from increased nutrients. However, relative to other Huntington District lakes in the Muskingum River basin, Pleasant Hill Lake has relatively high water quality.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Pleasant Hill Lake scored 56 for average TSI in 2021, which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 34. Pleasant Hill Lake samples exceeding state criteria and/or District levels of concern in 2021.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
PHC0001	Outflow	Clear Fork of Mohican River	Aluminum, Total	1	NONE
			Iron, Total	3	NONE
			Kjeldahl Nitrogen, Total	2	NONE
			Phosphorus, Total	5	NONE
			Strontium, Total	6	NONE
PHC0002	Lake	Pleasant Hill Lake	Kjeldahl Nitrogen, Total	2	NONE
			Phosphorus, Total	1	NONE
			Strontium	9	NONE
PHC0005	Inflow	Clear Fork of Mohican River	Iron, Total	1	NONE
			Phosphorus, Total	7	NONE
			Specific Conductance	1	NONE
			Strontium, Total	8	NONE
PHC0006	Inflow	Switzer Creek	None	-	-

R.D. Bailey Lake (RDB) Water Quality Summary

Updated: April 2024

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include specific conductance, selenium, strontium, and sulfate. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the West Virginia Department of Environmental Protection to facilitate potential mitigation efforts by the state.

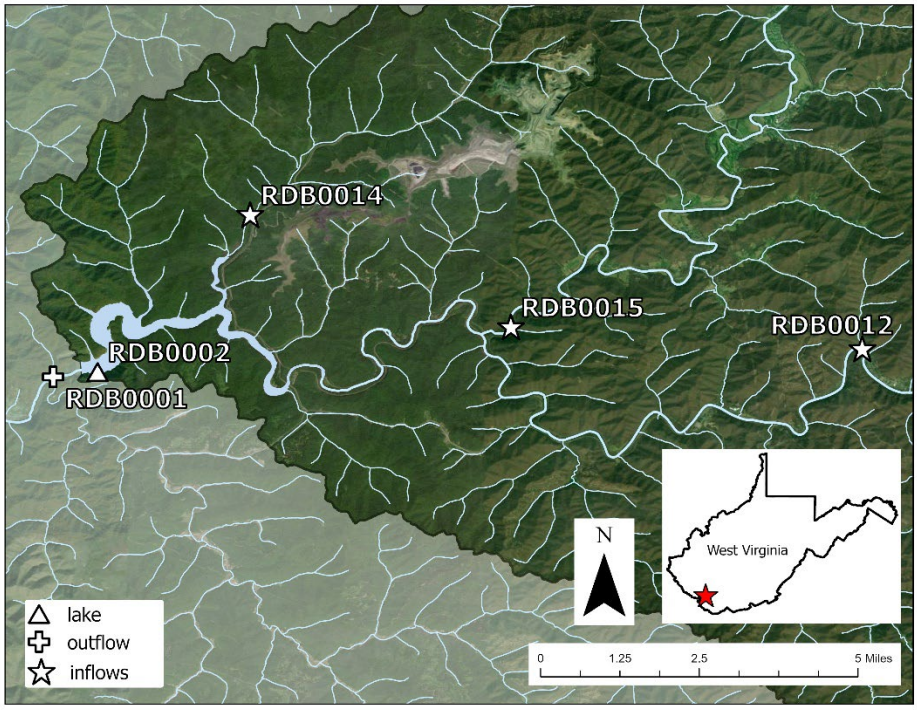

Figure 42. Water quality sampling locations for R.D. Bailey Lake in 2023.

WATERSHED SUMMARY: R.D. Bailey Lake is located in Wyoming and Mingo Counties, West Virginia. The dam site is 112 miles upstream of the mouth of the Guyandotte River with the Ohio River. The drainage area of the lake is 540 square miles. The lake project's authorized purposes include flood control, recreation, enhanced recreation (whitewater), fish and wildlife conservation, and water quality. The lake has a maximum depth of 145 feet and a hydraulic residence time averaging 18 days. The watershed is dominated by second-growth forested land. Water quality in the watershed is generally fair despite resource extraction activity.

HISTORICAL CONCERNS: Coal mining, natural gas extraction, and timbering are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Elevated specific conductance
- Elevated sulfates and metals

2023 ACTIVITIES: Six sampling events were conducted in the R.D. Bailey Lake watershed in 2023. Three major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Benthic macroinvertebrate sampling was conducted at the same three inflows where water samples were taken. No fish surveys were conducted due to restrictions in relation to federally listed crayfish. R.D. Bailey Lake is scheduled to be intensively sampled again in fiscal year 2028.

OBSERVED WATER QUALITY CONCERNS: Trend analysis revealed that elevated strontium inputs from the inflows were being passed through the lake and discharged into the tailwaters. Above normal strontium concentrations can be an indicator of land disturbance such as that caused by resource extraction or large-scale farming. Other constituents exceeding levels of concern from the inflow streams included specific conductance, selenium, phosphorus, and sulfate. However, these were being passed through the lake and discharged into the tailwaters in excessive amounts. The MDL

for the bromide test was lowered in recent years, giving the appearance of more frequent detections. There were four detections of bromide, however all were due to the MDL being lowered. Elevated constituent levels will be reported to the West Virginia Department of Environmental Protection to facilitate potential mitigation efforts by the state. Otherwise, analyte levels in the watershed were within historical ranges.

Although it is a small tributary of the lake, Big Cub Creek (RDB0014) continues to input high concentrations of strontium, selenium, and sulfate into the lake. There are also clear increasing trends in sulfate, strontium, and selenium, which can be an indication of mining activities in a watershed. A coal operation exists along Big Cub Creek, which drains directly into the lake, however other parameters of interest are within historical ranges in comparison with the main inflow streams Clear Fork (1RDB0015) and the Guyandotte River (1RDB0012). Much of the contaminants are bring diluted or trapped by the lake.

Fish community surveys were not conducted at R.D. Bailey Lake in 2023 due to restrictions in relation to federally listed crayfish. The flood storage pool of R.D. Bailey Lake has been designated as critical habitat for Guyandotte crayfish. Benthic macroinvertebrates were collected the outflow (RDB0001) and the three inflows: Guyandotte River (RDB0012), Big Cub Creek (RDB0014), and Clear Fork (RDB0015). The sites were scored using the West Virginia Stream Condition Index (WVSCI) with scores out of 100. The outflow and Big Cub Creek sites were rated as Not Attaining-Slightly (60 and 66), while the Guyandotte River and Clear Fork sites were rated as Attaining-Good (75 and 72).

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements, chlorophyll a, and total phosphorus concentrations in the water column. Based on the results of monitoring in 2023, R.D. Bailey Lake ranged between oligotrophic and mesotrophic. An oligotrophic state is characterized by low productivity, high water clarity, and low nutrient levels, whereas a mesotrophic state is characterized by moderate levels of the same components.

ADDITIONAL INFORMATION: R.D. Bailey Dam was constructed with a selective withdrawal system that allows for temperature and dissolved oxygen regulation as well as low-flow augmentation downstream. The WV Department of Environmental Protection classifies R.D. Bailey as a cool water lake, therefore it is subject to stricter water quality criteria. Despite historically low concentrations of nutrients, multiple harmful algal blooms have occurred on the lake in recent years but did not result in any closures or impacts to recreation. Due to changes in the sampling schedule, this project was not intensively sampled between 2008 and 2018.

Recent interest in government owned coal resources at R.D. Bailey Lake has resulted in applications to mine on fee lands. Those most recent applications have been denied due to the potentially significant impacts to the project's authorize purposes of flood control, fish and wildlife conservation, water quality, and recreation.

Table 35. R.D. Bailey Lake samples exceeding state criteria and/or District levels of concern in 2023.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1RDB0001	Outflow	Guyandotte River	Phosphorus, Total	1	NONE
			Strontium	6	NONE
1RDB0002	Lake	Guyandotte River	Strontium	3	NONE
1RDB0012	Inflow	Guyandotte River	Specific Conductance	2	NONE
			Strontium	7	NONE
1RDB0014	Inflow	Big Cub Creek	Selenium	6	NONE
			Specific Conductance	5	NONE
			Strontium	7	NONE
			Sulfate	7	NONE
1RDB0015	Inflow	Clear Fork	Strontium	5	NONE

Senecaville Lake (SES) Water Quality Summary

Updated: March 2020

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern including iron, aluminum, strontium, manganese, specific conductivity, dissolved oxygen, phosphorus, and total Kjeldahl nitrogen. Constituents were within or below historical ranges. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

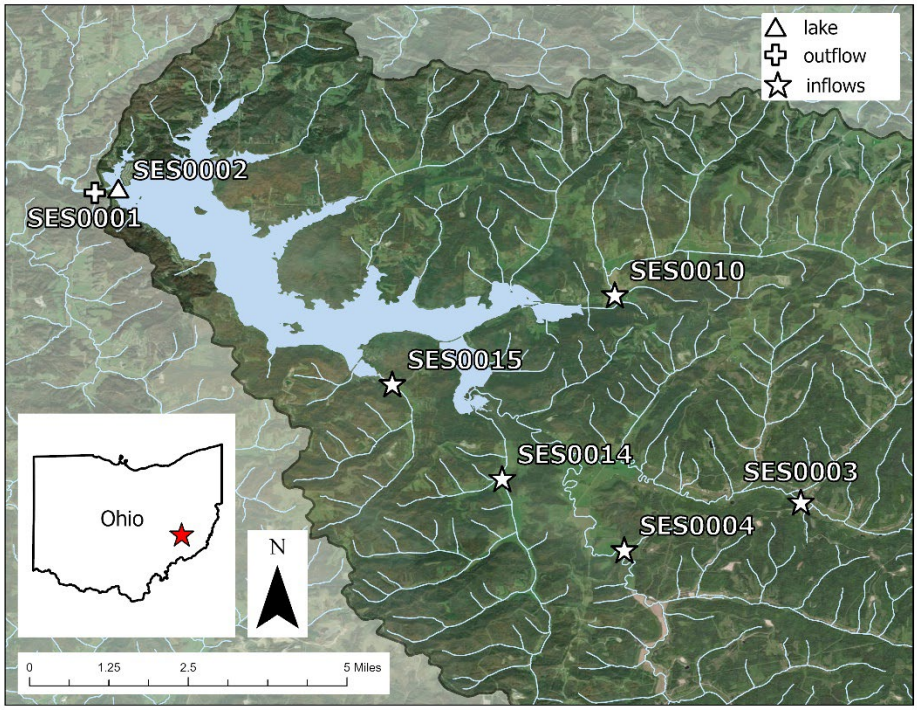

Figure 43. Water quality sampling locations for Senecaville Lake in 2024.

WATERSHED SUMMARY: The drainage basin contributing to Senecaville Lake has headwaters beginning in Noble, Belmont and Monroe Counties. The Senecaville dam site is located in Guernsey County, Ohio, on Seneca Fork of Wills Creek, a tributary of the Muskingum River. Senecaville Dam is approximately 1.5 miles upstream from the town of Senecaville and 10 miles southeast of Cambridge, Ohio. The lake drains 118 square miles of watershed. Sources of pollution in the drainage basin which might influence water quality are rural domestic, local industry, and active and inactive mining operations. The lake headwaters are characteristic of the calcareous nature of the watershed. Buffering capacity (alkalinity) is high, as well as nutrients, but over-productivity in the lake does not appear to be a problem. The lake has a maximum depth of 29 feet and an average retention time of 132 days.

HISTORICAL CONCERNS: Senecaville Lake has fewer water quality concerns than many of the other District lakes. However, mining, agriculture, and poor land management are sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of manganese, iron, and specific conductance
- Increased concentrations of nutrients

2024 ACTIVITIES: Six sampling events were conducted in the Senecaville Lake watershed in 2024. Six major inflow streams and the outflow were sampled six times each. In the previous sampling round conducted in 2019, samples were collected from Seneca Fork upstream of the lake at site 1SES0013, which represented a combination of two primary inflows. However, it was later determined that this site was lake impacted, prompting a return to the historical inflow sampling locations: 1SES0003 (Seneca Fork) and 1SES0004 (South Fork of Seneca Fork). These two sites were sampled again in 2024 along with other inflow sites.

The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Fish, macroinvertebrates,

and habitat surveys were conducted at the outflow and all inflow sites and the results are displayed in the table below. Senecaville Lake is scheduled to be intensively sampled again in fiscal year 2029.

OBSERVED WATER QUALITY CONCERNS: Water quality analysis of the project's main inflows revealed high inputs of nitrogen, phosphorus, and strontium throughout the sampling year. The lake, outflow and inflows showed high levels of strontium, the inflow levels being higher, suggesting the lake is buffering inputs from the inflows, but not completely buffer the strontium. The lake, inflows and outflow showed high concentrations of Kjeldahl nitrogen, with the outflow having all six samples being high, suggesting that nitrogen is being internally loaded in the lake and passed downstream. All constituents were within or below historical ranges. All constituents seem to be stable in the watershed. All water quality concerns revealed in the most recent intensive surveys at Senecaville Lake have been previously documented in the WCM with no new concerns surfacing.

ADDITIONAL INFORMATION: Historically, elevated concentrations of phosphorus, aluminum, iron and strontium and TKN were observed from the inflow stations. If the nutrient loading continues, the project may see an increase in productivity and could be more susceptible to HABs.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Senecaville Lake scored 59 for average TSI in 2024 which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 36. Senecaville Lake samples exceeding state criteria and/or District levels of concern in 2024.

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
1SES0001	Outflow	Seneca Fork	TKN	6	NONE
			Total Phosphorus	4	NONE
			Total Strontium	3	NONE
1SES0002	Lake	Seneca Fork	Total Strontium	3	NONE
1SES0003	Inflow	Seneca Fork	Ammonia	1	NONE
			Dissolved Oxygen	3	
			TKN	2	NONE
			Total Phosphorus	2	NONE
			Conductance	1	NONE
			Total Strontium	5	NONE
1SES0004	Inflow	South Fork	Ammonia	2	NONE
			Dissolved Oxygen	3	
			Total Iron	1	NONE
			TKN	2	NONE
			Manganese	1	NONE
			Total Phosphorus	2	NONE
			Total Strontium	5	NONE
1SES0010	Inflow	Beaver Creek	Dissolved Oxygen	2	
			TKN	2	NONE

STATION	STATION STYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEED NATIVE STATE CRITERIA
			Total Phosphorus	1	NONE
			Sp. Conductance	6	NONE
			Total Strontium	6	NONE
1SES0014	Inflow	Glady Run	Ammonia	1	NONE
			Dissolved Oxygen	2	
			TKN	5	NONE
			Manganese	2	NONE
			Total Phosphorus	2	NONE
			Strontium	6	NONE
1SES0015	Inflow	Mud Run	Dissolved Oxygen	1	
			Total Iron	1	NONE
			TKN	2	NONE
			Manganese	1	NONE
			Total Phosphorus	2	NONE
			Total Strontium	6	NONE

Table 37. Senecaville Lake biological and habitat results in 2024.

Site	Stream	Fish Score	Fish Category	Dominant Species	Macro Score	Macro Category	RBP Score	RBP Categories Marginal or Worse
SES0001	Seneca Fork of Wills Creek	34	Fair	Bluegill	22	Fair	129	Channel alteration, riffle frequency, bank stability, veg protection
SES0003	Seneca Fork of Wills Creek	36	good	Creek Chub	12	Poor	88	available cover, embeddedness, sed deposition, riffle frequency, bank stability, veg protection, riparian width
SES0004	South Fork of Seneca Fork	22	poor	Bluntnose Minnow	28	Fair	105	sed deposition, riffle frequency, bank stability, veg protection, riparian width
SES0010	Beaver Creek of Seneca Fork	36	Good	Creek Chub	16	Low Fair	105	available cover, embeddedness, sed deposition, riffle frequency, bank stability, riparian width

SES0014	Glady Run of Seneca Fork	30	fair	Creek Chub	20	Low Fair	73	available cover, embeddedness, sed deposition, riffle frequency, bank stability, veg protection, riparian width
SES0015	Mud Run of Seneca Fork	46	good	Bluegill	14	Low Fair	92	available cover, embeddedness, velocity/depth regime, sed deposition, riffle frequency, bank stability

Summersville Lake (SUM) Water Quality Summary

Updated: April 2023

Based on the most recent sampling and analysis, there were no water quality constituents that exceeded District levels of concern. Water quality in the watershed is generally high, and all results were within historical ranges. Any future elevated constituent levels will be reported to the West Virginia Department of Environmental Protection to facilitate potential mitigation efforts by the state.

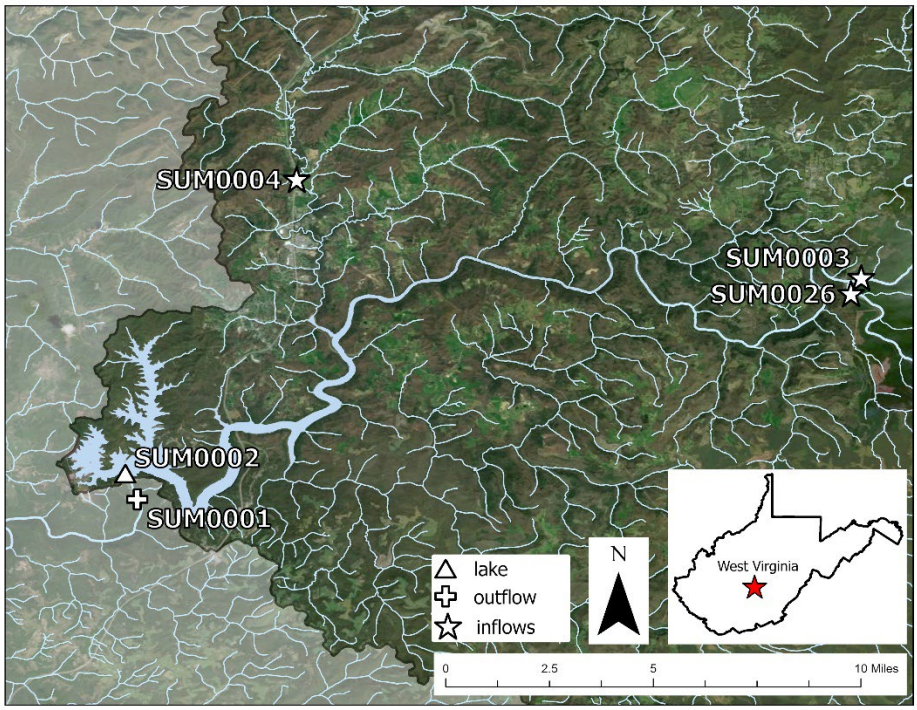

Figure 44. Water quality sampling locations for Summersville Lake in 2022.

WATERSHED SUMMARY: Summersville Lake is located in Nicholas County, West Virginia. The dam is located on the Gauley River, a tributary of the Kanawha River; 131 miles above the confluence of the Kanawha River with the Ohio River. Summersville Lake has a drainage area of 803 square miles. The lake project's authorized purposes include flood control, recreation, enhanced recreation (whitewater), low flow augmentation, water quality, and fish and wildlife conservation. The lake has a maximum depth of 267 feet and a hydraulic residence time averaging 45 days. The watershed is dominated by forested mountains and, as a result, the Gauley River has some of the highest water quality within the Huntington District.

HISTORICAL CONCERNS: Based on historical data, Summersville Lake has few water quality concerns. Despite favorable water quality conditions, several problems still exist: (1) Acid rain in the headwaters of the Gauley River is linked to the burning of fossil fuels and coal-fired power plants. If left unchecked, acid rain could prove detrimental to the sensitive species that are present in the watershed. (2) While over-production is a common issue in many Huntington District lakes, Summersville has been historically plagued by low productivity. A moderate level of production in a lake is necessary to maintain a healthy fishery, yet not so much as to encourage nuisance algae blooms. (3) Cold water pollution is perhaps an unavoidable problem surrounding Summersville Lake. Due to the extreme depth of the lake and all-sluice withdrawal system, discharges from the dam are constantly cold even in the hottest months of the year. Cold water pollution disrupts the natural temperature regimes in a riverine system and negatively affect the biota that live within it. Because of the cold nature of our discharge, West Virginia has listed the tailwaters of Summersville Lake as a "Trout Waters". This area is now managed for trout and trout fishing.

2022 ACTIVITIES: There were a total of six routine sampling trips in the 2022 sampling season. These were comprised of three sample collection events from Summersville Lake, six collections from select inflows, and six collections from the outflow. Samples were collected from the epilimnion, metalimnion, and hypolimnion during each lake sampling event. The lake was not sampled in the fall due to an early turnover. Water samples were analyzed for a pre-determined suite of chemical analytes and chlorophyll a, b, and c at the lake site only. Physical water quality measurements were collected simultaneously using a multiparameter data sonde during all six sampling events. Macroinvertebrate community samples were collected at four locations and fish were collected at one location. Summersville Lake will be intensively monitored again in 2027.

OBSERVED WATER QUALITY CONCERNS: Based on results of monitoring in 2022 pH values appear to be trending upward, likely due to liming in the headwaters of the Gauley River watershed in an effort to mitigate acid rain effects. At the same time, manganese concentrations appear to be trending downward across the lake's watershed, possibly due to increasing pH levels. Metals tend to be less soluble at higher pH, suggesting that more manganese is remaining in sediments. Manganese results in 2022 were below averages but within historical ranges. There were no other significant trends or exceedances to report.

Macroinvertebrate scores for sites sampled at Summersville Lake were calculated using the West Virginia Stream Condition Index (WVSCI). Scores are as follows: SUM0001 – 62 (slightly not attaining), SUM0003 – 87 (excellent attaining), SUM0004 – 63 (slightly not attaining), SUM0026 – 71 (slightly not attaining).

Fish community scores were calculated using the Kentucky Index of Biotic Integrity (KYIBI) because West Virginia does not have an established IBI for fish. The KYIBI is the most compatible with West Virginia streams in the Huntington District. A fish community survey was conducted at the Muddlety Creek inflow site (1SUM0004), yielding a KYIBI score of 29 (poor). This is reflected in the poorer water quality found in this stream relative to the rest of the watershed. Other intensive sites could not be surveyed due to the presence of the federally endangered candy darter.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements, chlorophyll a, and total phosphorus concentrations in the water column. Based on the results of monitoring in 2022, Summersville Lake ranged from oligotrophic to mesotrophic. An oligotrophic state is characterized by low productivity, high water clarity, and low nutrient levels, whereas a mesotrophic state is characterized by moderate levels of the same components.

ADDITIONAL INFORMATION: Summersville Lake boasts some of the best water quality in the Huntington District. Basin geology, morphology, and land use largely determine the quality of water within a basin while rock types determine, to a great extent, the inorganic composition of the water. Rocks in the Summersville Lake Basin consist of sandstones, shales, and coal. Basin morphology is that of steep topography which indicates that the potential for erosion and sedimentation is high. However, most of the basin is generally covered by second growth timber and wild vegetation. In addition, the invert of the outlet tunnel is located 83 feet above the streambed, creating a dead storage pool of about 6,900 acre-feet capacity. For these reasons, the possibility of greater than average sedimentation in the basin is believed to be of little consequence. The major industries in the basin are coal mining and timbering.

Although its water quality is good relative to other watersheds in the LRH District, the Muddlety Creek inflow is of noticeably poorer water quality than other monitored streams in the Gauley River basin. Chlorides, sulfates, strontium, other metals, and specific conductance are consistently higher than other streams likely due to mining activity in the headwaters of the creek. In addition, biological and habitat index scores were lower here than at other monitored Kanawha River tributaries. Muddlety Creek is a small tributary relative to other streams in the basin, therefore it does not largely impact the overall health of the lake and outflow.

The Gauley River below Summersville Lake has been designated as critical habitat for the candy darter.

Table 38. Summersville Lake samples exceeding state criteria and/or District levels of concern in 2022.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1SUM0001	Outflow	Gauley River	None	-	-
1SUM0002	Lake	Gauley River	None	-	-
1SUM0003	Inflow	Gauley River	None	-	-
1SUM0004	Inflow	Muddlety Creek	None	-	-
1SUM0026	Inflow	Cherry River	None	-	-

Sutton Lake (SUT) Water Quality Summary

Updated: April 2023

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include ammonia, iron, manganese, specific conductance, and total Kjeldahl nitrogen. Surface mining upstream has resulted in high concentrations of sulfate and decreased scores in benthic macroinvertebrate and fish surveys of Laurel Creek. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the West Virginia Department of Environmental Protection to facilitate potential mitigation efforts by the state.

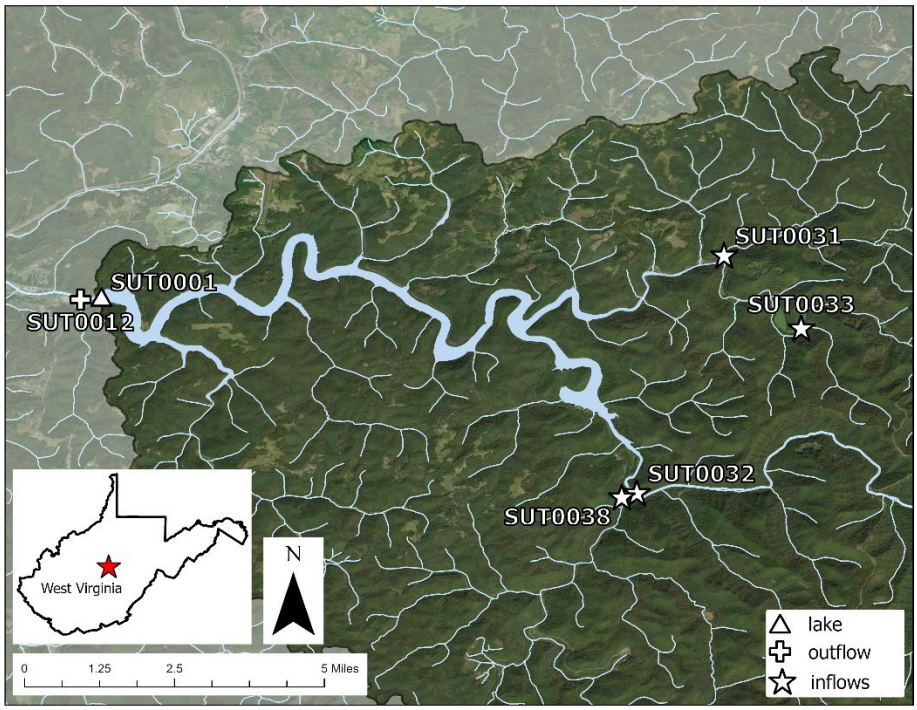

Figure 45. Water quality sampling locations for Sutton Lake in 2022.

WATERSHED SUMMARY: Sutton Lake is located in Braxton County, West Virginia. The dam is located on the Elk River, a tributary of the Kanawha River; 100 miles upstream of the confluence of the Kanawha River with the Ohio River. Sutton Lake has a drainage area of 537 square miles. The lake project's authorized purposes include flood control, recreation, enhanced recreation (whitewater), low flow augmentation, and fish and wildlife conservation. The lake has a maximum depth of 110 feet and a hydraulic residence time averaging 22 days. The watershed is dominated by forested mountains and has maintained good water quality. Federally endangered mussels and a diverse fishery exist throughout the tailwater on the Elk River.

HISTORICAL CONCERNS: Mining, silviculture, and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Coldwater pollution discharges

2022 ACTIVITIES: There were a total of six routine sampling trips in the 2022 sampling season. These were comprised of three sample collection events from Sutton Lake, six collections from select inflows, and six collections from the outflow. Samples were collected from the epilimnion, metalimnion, and hypolimnion during each lake sampling event. The lake was not sampled in the fall due to an early turnover. Water samples were analyzed for a pre-determined suite of chemical analytes and chlorophyll a, b, and c at the lake site only. Physical water quality measurements were collected simultaneously using a multiparameter data sonde during all six sampling events. Macroinvertebrate community samples and fish surveys were collected at five locations and fish were collected at three locations. Sutton Lake will be intensively monitored again in 2027.

OBSERVED WATER QUALITY CONCERNS: Sulfate concentrations appear to be trending upward in the Laurel Creek inflow, although they are still below thresholds of concern. Sulfate concentrations in 2022 were above averages but still within historical ranges. Additionally, a decrease in fish species richness and an increase in pollution tolerant species are leading to an overall decrease in IBI score despite a similar number of total individuals.

Macroinvertebrate scores for sites sampled at Sutton Lake were calculated using the West Virginia Stream Condition Index (WVSCI). WVSCI scores were as follows: SUT0012 – 55 (slightly not attaining), SUT0031 - 73 (good attaining), SUT0032 – 76 (good attaining), SUT0033 – 80 (good attaining), SUT0038 – 71 (slightly not attaining).

Fish community scores were calculated using the Kentucky Index of Biotic Integrity (KYIBI) because West Virginia does not have an established IBI for fish. The KYIBI is the most compatible with West Virginia streams in the Huntington District. Fish community surveys were conducted at three inflow streams. KYIBI scores are as follows: SUT0031 – 71 (excellent), SUT0033 – 58 (fair), SUT0038 – 57 (fair).

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements, chlorophyll a, and total phosphorus concentrations in the water column. Based on the results of monitoring in 2022, Sutton Lake ranged from oligotrophic to mesotrophic. An oligotrophic state is characterized by low productivity, high water clarity, and low nutrient levels, whereas a mesotrophic state is characterized by moderate levels of the same components.

ADDITIONAL INFORMATION: Historically, sulfate levels, chloride, specific conductance, and total dissolved solids were low in the watershed, the lake, and in the outflow. The system has a low inherent capacity to resist shifts in pH as indicated by low alkalinity values and water hardness classifications of "soft". This indicates a potential for watershed problems if land use is not managed properly. Laurel Creek is a small tributary of the Elk River above Sutton Lake and is characterized by high specific conductance driven by high sulfate. High concentrations of sulfate are likely being supplied by the surface coal mine that is in the headwaters of the creek. However, substantial flows from the Elk River and its other tributaries dilute sulfate concentrations before reaching Sutton Lake.

As a result of declining communities of endangered mussels downstream of the dam, operational changes were made in order to increase the wintertime passage of sediments through the lake and decrease the summertime discharges of cold water pollution. These cold water discharges can severely impact the reproductive success of mussels on the Elk River. It is anticipated that these new operations will result in more successful mussel reproduction in the watershed. However, these operations may also have an impact to the turbidity and quality of the lake itself. The District will be monitoring for such impacts.

The Elk River below Sutton Lake has been designated as critical habitat for the longsolid mussel, hickorynut mussel, and diamond darter.

Table 39. Sutton Lake samples exceeding state criteria and/or District levels of concern in 2022.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1SUT0001	Lake	Elk River	Ammonia	1	NONE
			Total Kjeldahl Nitrogen	1	NONE
			Total Iron	2	NONE
			Total Manganese	3	NONE
1SUT0012	Outflow	Elk River	None	-	-
1SUT0031	Inflow	Left Fork Holly River	None	-	-
1SUT0032	Inflow	Elk River	None	-	-
1SUT0033	Inflow	Right Fork Holly River	None	-	-
1SUT0038	Inflow	Laurel Creek	Specific Conductance	1	NONE

Tappan Lake (TAL) Water Quality Summary

Updated: April 2019

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include specific conductance, strontium, sulfate, phosphorus, ammonia, and total Kjeldahl nitrogen. A structural modification was completed in 2015 to reduce hydrogen sulfate releases from the dam during lake stratification. The new operation yielded favorable results by returning higher quality water to the downstream area. No other operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

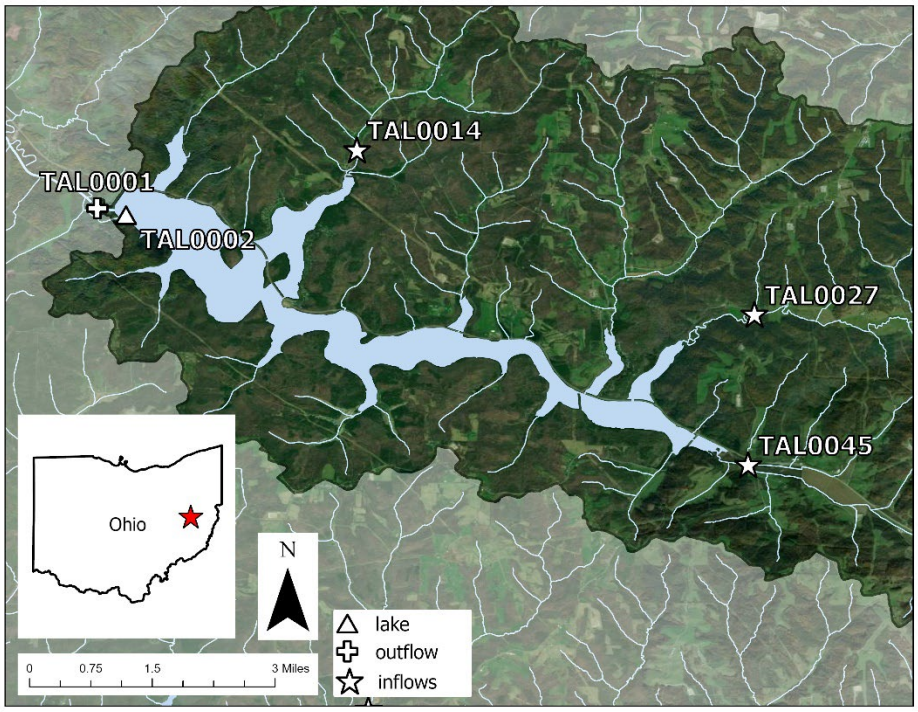

Figure 46. Water quality sampling locations for Tappan Lake in 2023.

WATERSHED SUMMARY: Tappan Lake is located in Harrison County, Ohio. The dam is located on Little Stillwater Creek, a tributary of Stillwater Creek, of the Tuscarawas River, of the Muskingum River; 174 miles above the confluence of the Muskingum River with the Ohio River. Tappan Lake has a drainage area of 71 square miles. The lake project's authorized purposes include flood control, recreation, and fish and wildlife conservation. The lake has a maximum depth of 34 feet and a hydraulic residence time that averages 190 days. The watershed is dominated by agriculture, forest, and surface mining.

HISTORICAL CONCERNS: Agriculture and mining are the primary sources of watershed degradation resulting in:

- Elevated levels of sedimentation, specific conductance, sulfates, chlorides, nutrients, and metals
- Dangerous concentrations of hydrogen sulfide gas discharges from the outlet structure

2023 ACTIVITIES: Six sampling events were conducted in the Tappan Lake watershed in 2023. Three major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Benthic macroinvertebrate sampling was conducted at the same sites where water samples were taken. Fish were sampled at two outflow sites (TAL0001, TAL0016) and one inflow site (TAL0014). Tappan Lake is scheduled to be intensively sampled again in fiscal year 2028.

OBSERVED WATER QUALITY CONCERNS: Trend analysis revealed that elevated nitrogen, phosphorus, strontium, and sulfate inputs from the inflows were being passed through the lake and discharged into the tailwaters. Other constituents of concern included specific conductance and bromide. The MDL for the bromide test was lowered in recent years, giving the appearance of more frequent detections. There were four detections of bromide at Tappan Lake in 2023, however they were only detected due to the lower MDL. Three of the four detections were from the

Lower Beaverdam Run inflow (TAL0014), although they were at very low concentrations. Elevated constituent levels will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state. Otherwise, analyte levels in the watershed were within historical ranges.

Benthic macroinvertebrates sampling at the outflow (TAL0001) scored 6, which places it in the Very Poor category. The outflow was the only biological survey at Tappan that resulted in a poor categorization. The inflows Lower Beaverdam Run (TAL0014), Clear Fork (TAL0027), and Standingstone Fork (TAL0045) scored Fair, Marginally Good, and Low Fair respectively. Fish community surveys from the two outflow sites both scored in the Good category of the Ohio IBI, while the inflow Lower Beaverdam Run (TAL0014) scored Fair. TAL0014 was ranked the worst of the Ohio sites sampled in 2023 with a score of 28 (Fair). The outflow site immediately below the dam (TAL0001) saw a modest increase in IBI score over previous surveys.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Tappan Lake scored 63 for average TSI in 2023, which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

ADDITIONAL INFORMATION: In the spring of 2015, a structural modification was made to the outlet structure at Tappan Lake. The purpose of this structure was to minimize the release of hydrogen sulfide gas that was produced from outflow water originating in the hypolimnion. The chemical and biological data collected as part of this study has shown that the release of hydrogen sulfide gas from the outfall of Tappan Lake has been significantly reduced. This modification had an additional benefit of returning high quality water to the habitat downstream of Tappan Lake while likely expanding the available fish habitat within Tappan Lake by increasing the size of the oxygen rich epilimnion. It appears from 2018 data, that the phosphorus buffering capacity of the lake could be diminished as a result of the structural modification. As a result, the water quality team will increase monitoring of phosphorus in the lake and at the outflow. Phosphorus levels are also elevated above our screening values in all three of the inflows to Tappan Lake.

Tappan Lake is a source of drinking water for the nearby town of Cadiz, OH. The lake has consistently high levels of microcystins, which must be constantly monitored by the Town of Cadiz to ensure public safety.

Table 40. Tappan Lake samples exceeding state criteria and/or District levels of concern in 2023.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1TAL0001	Outflow	Little Stillwater Creek	Ammonia	1	NONE
			Dissolved Oxygen	1	NONE
			Kjeldahl Nitrogen, Total	6	NONE
			Phosphorus, Total	2	NONE
			Specific Conductance	6	NONE
			Strontium	8	NONE
			Sulfate	3	NONE
1TAL0002	Lake	Little Stillwater Creek	Kjeldahl Nitrogen, Total	3	NONE
			Phosphorus, Total	1	NONE
			Specific Conductance	4	NONE
			Strontium	4	NONE
			Sulfate	3	NONE
1TAL0027	Inflow	Clear Fork	Phosphorus, Total	3	NONE
			Specific Conductance	6	NONE

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
			Strontium	5	NONE
			Sulfate	5	NONE
1TAL0014	Inflow	Lower Beaverdam Run	Phosphorus, Total	1	NONE
1TAL0045	Inflow	Standingstone Fork	Phosphorus, Total	3	NONE
			Specific Conductance	5	NONE
			Strontium	8	NONE
			Sulfate	7	NONE

Tom Jenkins Dam (TJE) Water Quality Summary

Updated: April 2021

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include aluminum, dissolved oxygen, iron, phosphorus, and total Kjeldahl nitrogen. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams.

WATERSHED SUMMARY: Tom Jenkins Dam (Burr Oak Lake) is in Athens County, Ohio on East Branch of Sunday Creek, a tributary of Sunday Creek of the Hocking River. The East Branch of Sunday Creek drains the northwestern segment of the Hocking River Basin, including portions of Athens, Morgan, and Perry counties in Ohio. The Burr Oak Lake watershed drains an area of 33 square miles. The project purposes are flood control, water conservation for recreation, water quality, water supply, and fish and wildlife conservation. The lake has a maximum depth of 30 feet and a water retention time of 99 days.

HISTORICAL CONCERNS: Mining, agriculture, and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of aluminum, manganese, iron, specific conductance, and sulfates
- Increased concentrations of nutrients

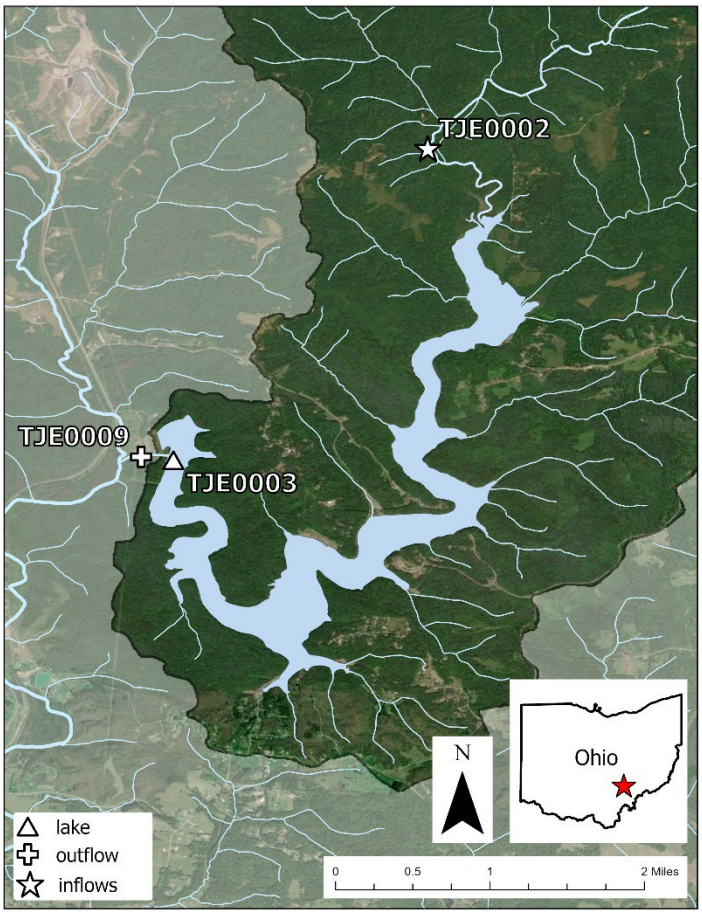

Figure 47. Water quality sampling locations for Tom Jenkins Dam in 2020.

2020 ACTIVITIES: Six sampling events were conducted in the Tom Jenkins watershed in 2020. One major inflow stream and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification and analyzed for dissolved metals. Benthic macroinvertebrate samples were collected from the inflow using Hester-Dendy samplers. Tom Jenkins (Burr Oak Lake) is scheduled to be intensively sampled again in fiscal year 2025.

ADDITIONAL INFORMATION: Low dissolved oxygen reading at 1TJE0002 was a result of collecting sample during critical low flow period. Average lake inflows during that time were regularly below 10 cfs.

Tom Jenkins frequently saw exceedances in concentrations of iron, manganese, phosphorus, and TKN in the lake and outflow. Exceedances were not as frequent in the inflow stream suggesting there is internal loading occurring in the lake that is being discharged downstream.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Burr Oak Lake scored 38 for average TSI in 2019 to 2020, which is categorized as oligotrophic. Oligotrophic lakes are usually characterized by having high clarity, low nutrients, and low algal growth.

Table 41. Tom Jenkins Dam samples exceeding state criteria and/or District levels of concern in 2020.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1TJE0002	Inflow	East Branch of Sunday Creek	Aluminum	2	None
			Dissolved Oxygen	1	None
			Iron	2	None
			Phosphorus	1	None
			TKN	1	None
1TJE0003	Lake	East Branch of Sunday Creek	Aluminum	2	None
			Iron	2	None
			Manganese	8	None
			Phosphorus	4	None
			TKN	8	None
1TJE0009	Outflow	East Branch of Sunday Creek	Aluminum	3	None
			Iron	6	None
			Manganese	6	None
			Phosphorus	4	None
			TKN	4	None

Wills Creek Lake (WEW) Water Quality Summary

Updated: April 2021

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern. Constituents exceeding levels of concern include bromide, dissolved oxygen, phosphorus, specific conductivity, strontium, iron, aluminum, manganese, sulfate, pH, and total Kjeldahl nitrogen. Some sampling locations exceeded the state of Ohio's criteria for pH. No known operational changes can be made at this time to mitigate elevated levels from the inflow streams. Sites that exceeded state criteria will be reported to the Ohio Environmental Protection Agency to facilitate potential mitigation efforts by the state.

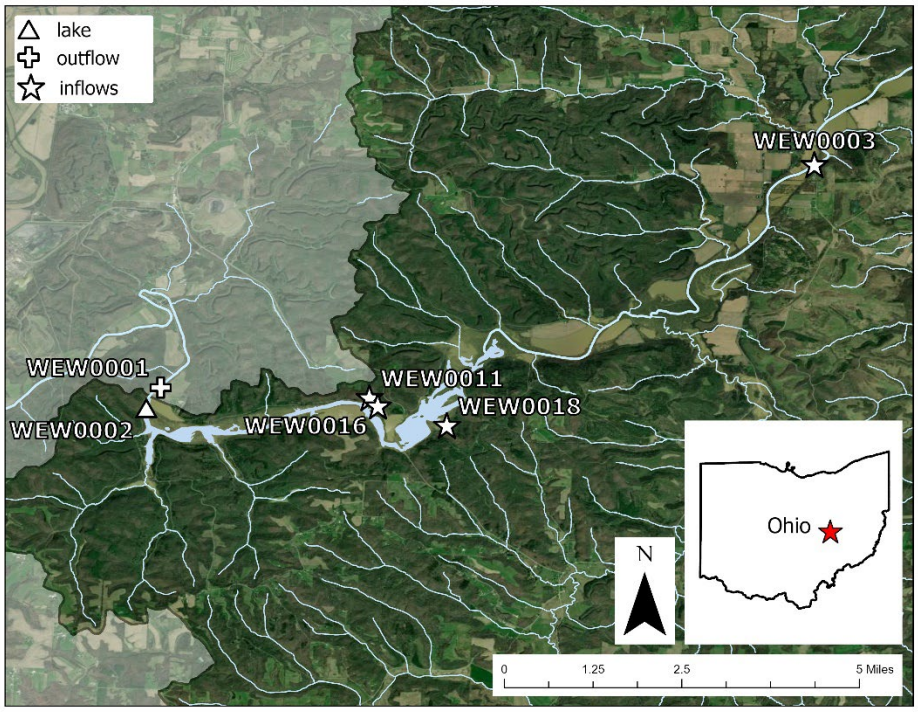

Figure 48. Water quality sampling locations for Wills Creek Lake in 2020.

WATERSHED SUMMARY: Wills Creek, a major tributary of the Muskingum River, is in eastern Ohio and extends in a general northwesterly direction from its headwaters in northwestern Monroe County and northeastern Noble County, Ohio. Wills Creek Lake is in Coshocton County, Ohio 6 miles above the mouth of Wills Creek and 108 miles above the mouth of the Muskingum River, a tributary of the Ohio River. The purposes for the project are flood control, water conservation for recreation, and fish and wildlife conservation. The lake drains approximately 841 square miles and the water retention time for the lake averages 0.6 days. The lake had a maximum depth of 22 feet, but most of the pool has been lost to sedimentation.

HISTORICAL CONCERNS: Mining, agriculture, and poor land management are the primary sources of watershed degradation resulting in:

- Excessive turbidity and sedimentation
- Increased concentrations of aluminum, manganese, iron, specific conductance, and sulfates
- Increased concentrations of nutrients

2020 ACTIVITIES: Six sampling events were conducted in the Wills Creek Lake watershed in 2020. One major inflow stream, two mine discharges, a treatment pond outflow, and the lake outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion sample with the addition of chlorophyll and dissolved metals analyses. The entire water column was not sampled due to lake accessibility issues. Filtered samples were also collected at the outflow site during lake stratification and analyzed for dissolved metals. Only one Hester-Dendy macroinvertebrate sampler was recovered from the treatment pond outflow. In 2021, a Hester-Dendy was placed at WEW0003 where it was lost in 2020. This time, it was able to be retrieved and received an Invertebrate Community Index (ICI) score of 12 (poor). Wills Creek Lake is scheduled to be intensively sampled again in fiscal year 2025.

ADDITIONAL INFORMATION: A series of ponds were constructed to retain and treat mine water discharge flowing into the lake. Discharges from the pond regularly exceed water quality criteria despite treatment efforts. Additionally, this

lake has lost significant capacity in the conservation pool due to excessive sedimentation. Sedimentation has impacted the recreation mission on the lake. LRH is reviewing existing authorities to determine if the water quality issues can be further mitigated.

Elevated levels of metals, nutrients, and sulfates are being passed downstream of Wills Creek Dam, suggesting that pollutants are not being buffered by the lake. Pollutant loading appears to come from the inflow streams and various mine discharges around the lake.

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Wills Creek Lake scored 57 for average TSI in 2020, which is categorized as eutrophic. Eutrophic lakes are usually characterized by having low clarity, high nutrients, and high algal growth.

Table 42. Wills Creek Lake samples exceeding state criteria and/or District levels of concern in 2020.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1WEW0001	Outflow	Wills Creek	Aluminum	4	NONE
			Bromide	2	NONE
			Conductance	3	NONE
			Iron	6	NONE
			TKN	5	NONE
			Phosphorus, Total	6	NONE
			Strontium, Total	5	NONE
			Sulfate	1	NONE
1WEW0002	Lake	Wills Creek	Aluminum	1	NONE
			Bromide	3	NONE
			Conductance	2	NONE
			Iron	1	NONE
			Phosphorus, Total	2	NONE
			Strontium, Total	3	NONE
			Sulfate	1	NONE
			TKN	2	NONE
1WEW0003	Inflow	Wills Creek	Aluminum	4	NONE
			Bromide	4	NONE
			Conductance	4	NONE
			Iron	5	NONE
			Phosphorus, Total	5	NONE
			Strontium, Total	5	NONE
			Sulfate	2	NONE
			TKN	2	NONE
1WEW0011	Inflow	Mine Discharge into treatment pond	Aluminum	2	NONE
			Conductance	6	NONE

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
			Iron	7	NONE
			Manganese	6	NONE
			pH	6	YES
			Strontium, Total	6	NONE
			Sulfate	7	NONE
			TKN	7	NONE
1WEW0016	Inflow	Discharge from treatment pond	Aluminum	1	NONE
			Bromide	1	NONE
			Conductance	6	NONE
			Iron	6	NONE
			Manganese	4	NONE
			pH	1	Yes
			Phosphorus	2	NONE
			Strontium, Total	6	NONE
			Sulfate	6	NONE
			TKN	2	NONE
1WEW0018	Inflow	Mine Discharge	Aluminum	4	NONE
			Conductance	6	NONE
			Dissolved Oxygen	6	NONE
			Iron	6	NONE
			Manganese	5	NONE
			pH	6	Yes
			Strontium, Total	6	NONE
			Sulfate	6	NONE
			TKN	6	NONE

Based on the most recent water quality sampling and analysis, some water quality constituents exceed District levels of concern, but are within historical ranges. Constituents exceeding levels of concern include iron, strontium, manganese, sulfate, phosphorus, total Kjeldahl nitrogen, dissolved oxygen, bromide, and specific conductance. No known operational changes can be made at this current time to mitigate elevated levels from the inflow streams. Elevated constituent levels will be reported to the Kentucky Division of Water to facilitate potential mitigation efforts by the state.

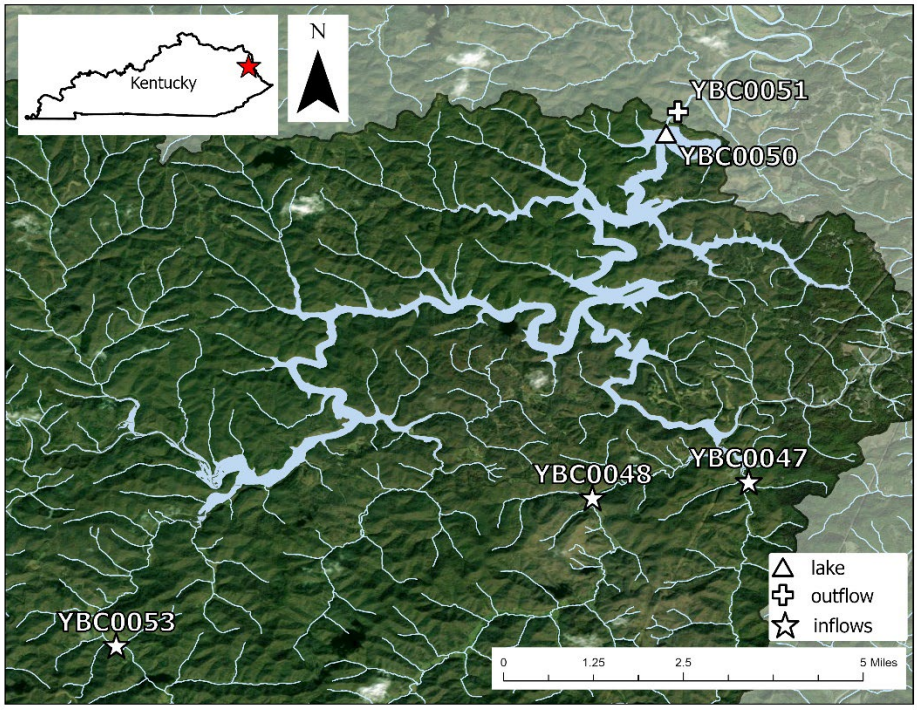

Figure 49. Water quality sampling locations for Yatesville Lake in 2023.

WATERSHED SUMMARY: Yatesville Lake is in Lawrence County, Kentucky on Blaine Creek, a tributary of the Big Sandy River, of the Ohio River. The dam is located 18.1 miles upstream of the mouth of Blaine Creek. The drainage area of the lake is 208 square miles. The lake project's authorized purposes include flood control, recreation, fish and wildlife conservation, and water quality. The outflow structure at the dam is the best example of a high functioning selective withdrawal structure within the District. The lake has a maximum depth of 57 feet and a hydraulic residence time of about 71 days. The watershed is dominated by forest with mineral and gas extraction industries present.

HISTORICAL CONCERNS: Oil and gas extraction and poor land management are the primary sources of watershed degradation resulting in:

- High levels of iron and manganese in the inflow streams are compounded in the lake because of anoxic conditions in the hypolimnion
- High Total Dissolved Solids (TDS) levels in the inflow streams cause layering in the lake which in-turn cause fall turnover to be later than expected
- Naturally Occurring Radioactive Materials (NORMs) are entering the watershed as a result of oil and gas extraction

2023 ACTIVITIES: Six sampling events were conducted in the Yatesville Lake watershed in 2023. Five major inflow streams and the outflow were sampled six times each. The lake was sampled four times during stratification at the primary lake station near the dam. All sampling events included the collection of physical water quality parameters via data sonde as well as water sample collection for a predetermined suite of water chemistry parameters. Each lake sampling event included an epilimnion, metalimnion, and hypolimnion sample with the addition of chlorophyll and dissolved metals analyses. Filtered samples were also collected at the outflow site during lake stratification to be analyzed for dissolved metals. Fish and macroinvertebrate samples were also collected at the same sites. Yatesville Lake will be sampled again in fiscal year 2028.

OBSERVED WATER QUALITY CONCERNS: Trend analysis revealed that elevated nitrogen and phosphorus inputs from the inflows were being passed through the lake and discharged into the tailwaters. Other constituents exceeding levels of concern included specific conductance, iron, and manganese. The MDL for the bromide test was lowered in

recent years, giving the appearance of more frequent detections. There were ten detections of bromide at Yatesville Lake in 2023, however only two were above the threshold of concern at the primary inflow YBC0054. Elevated constituent levels will be reported to the Kentucky Division of Water to facilitate potential mitigation efforts by the state. Otherwise, analyte levels in the watershed were within historical ranges.

Multiple sites scored in the poor category for benthic macroinvertebrates. These sites were Right Fork of Little Blaine Creek (YBC0048), Outflow (YBC0051), Brushy Creek of Blaine Creek (YBC0053), and Blaine Creek of Big Sandy River (YBC0054). The only fish survey that resulted in a poor categorization was at the Outflow (YBC0051).

Trophic State Index (TSI) is an assessment of the level of productivity in a waterbody based on Secchi disk measurements and chlorophyll and total phosphorus concentrations in the water column. Yatesville Lake scored 42 for average TSI in 2018, which is categorized as mesotrophic. Yatesville Lake scored 36 for an average TSI in 2023, which is categorized as oligotrophic. An oligotrophic state is characterized by low productivity, high water clarity, and low nutrient levels, whereas a mesotrophic state is characterized by moderate levels of the same components.

ADDITIONAL INFORMATION: The sampling event in January showed high concentrations of aluminum, iron, and nutrients in the inflows. These samples were collected during a high flow event in which stream turbidity was very high. This could account for the elevated constituents, since some metals and nutrients tend to bind to sediment. Results from the outflow were within historical ranges.

Chloride levels have continued to rise in the inflows but remain below our screening values for the analyte. Left Fork and Right Fork Little Blaine Creeks contributed high metals and sulfate concentrations to the lake throughout the year. There are active mine sites within the Little Blaine Creek watershed that is the likely source of these impairments. Additionally, aluminum, iron, manganese, and total Kjeldahl nitrogen concentrations were elevated in the hypolimnion of Yatesville Lake during several sampling events, suggesting that these constituents are accumulating in the sediment at the lake's bottom. The outflow also showed slightly elevated concentrations of these analytes, suggesting staff were making use of the project's selective withdrawal capabilities to improve water quality conditions downstream. Yatesville Lake boasts the District's most modern selective withdrawal system, regular use of which can help alleviate low oxygen and high metals issues that develop during summer stratification.

Table 43. Yatesville Lake samples exceeding state criteria and/or District levels of concern in 2023.

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1YBC0047	Inflow	Left Fork Little Blaine Creek	Dissolved Oxygen	1	NONE
			Phosphorus, Total	1	NONE
			Specific Conductivity	2	NONE
			Strontium	4	NONE
1YBC0048	Inflow	Right Fork Little Blaine Creek	Manganese	5	NONE
			Specific Conductivity	4	NONE
			Strontium	6	NONE
			Sulfate	5	NONE
1YBC0049	Inflow	Hood Creek	Iron	6	NONE
			Phosphorus, Total	2	NONE
1YBC0050	Lake	Blaine Creek	None	-	-
1YBC0051	Outflow	Blaine Creek	Kjeldahl Nitrogen	2	NONE
			Phosphorus, Total	2	NONE

STATION	STATION TYPE	STREAM NAME	ANALYTES W/ELEVATED CONCENTRATIONS	NUMBER OF SAMPLES EXCEEDING SCREENING VALUE	EXCEEDED APPLICABLE NATIVE STATE CRITERIA
1YBC0053	Inflow	Brushy Creek	Dissolved Oxygen	1	NONE
			Iron	1	NONE
			Kjeldahl Nitrogen	1	NONE
			Phosphorus, Total	2	NONE
1YBC0054	Inflow	Blaine Creek	Bromide	2	NONE
			Iron	1	No
			Phosphorus, Total	1	NONE
			Specific Conductance	3	NONE
			Strontium	5	NONE

Dry Dams: Bolivar (BOS), Dover (DOT), Mohawk (MKW), and Mohicanville (MOL)

There are currently four dry dams managed by the Huntington District: Bolivar, Dover, Mohawk, and Mohicanville Dams. Dry dams do not maintain a permanent pool or impoundment behind the dam and therefore are operated as run-of-the-river for the majority of the time. The dams will be operated to reduce downstream flooding only during times of excessive rain, so any resulting inundation behind the dam is only temporary. Additionally, there is no hydraulic residence time calculated for these projects. Water Quality sampling at these projects has historically been infrequent due to the nature of their operation, with Mohawk Dam receiving the most attention.

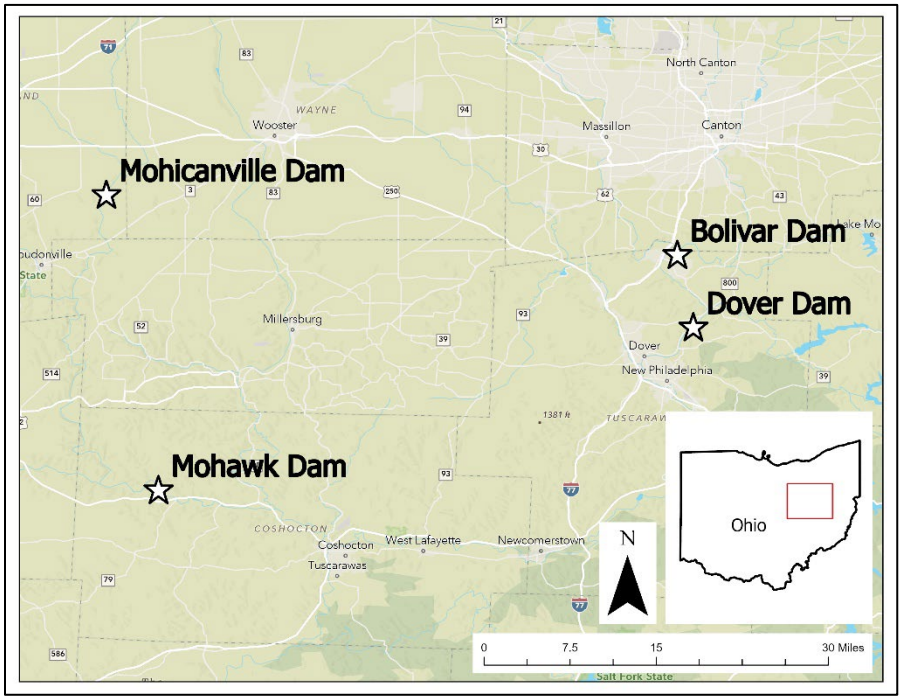

Figure 50. The locations of the four dry dams managed by the Huntington District USACE.

WATERSHED SUMMARY:

Bolivar: Bolivar Dam is in Stark and Tuscarawas Counties, Ohio, on Sandy Creek, a tributary of the Tuscarawas River, of the Muskingum River; 183 miles upstream of the confluence of the Muskingum and Ohio Rivers. The lake's authorized project purpose includes only flood control. The watershed is dominated by agriculture and drains 502 square miles.

Dover: Dover Dam is in Tuscarawas County, Ohio on the Tuscarawas River, a tributary of the Muskingum River, of the Ohio River. The dam is located 174 miles upstream of the confluence of the Muskingum and Ohio Rivers. The drainage area of the impoundment is 782 square miles. The authorized project purposes for Dover Dam include flood control and water conservation. Land use in the watershed is a mix of agriculture, housing, and forested land.

Mohawk: Mohawk Dam is in Coshocton County, Ohio on the Walhonding River, a tributary of the Muskingum River. The dam is 130 miles upstream of the confluence of the Muskingum and Ohio Rivers. The drainage area of the impoundment is 821 square miles. The only authorized project purpose for Mohawk Dam is flood control. Land use in the watershed is mostly agriculture and forested land.

Mohicanville: Mohicanville Dam is in Ashland County, Ohio on the Lake Fork of Mohican River, a tributary of the Walhonding River, of the Muskingum River, of the Ohio River. The dam is 171 miles upstream of the confluence of the Muskingum and Ohio Rivers. The drainage area of the impoundment is 271 square miles. The only authorized project purpose for Mohicanville Dam is flood control.

HISTORICAL CONCERNS:

Bolivar: Industrial, agricultural, livestock, and wastewater treatment runoff are the primary sources of high nutrient levels, metals, and sedimentation in the Sandy Creek watershed.

Dover: Industrial, agricultural, livestock, and resource extraction runoff are the primary sources of high nutrient levels, metals, and sedimentation in the Tuscarawas River watershed. A large drainage area behind the dam leads to many potential sources of pollutants. The original plans for Dover Dam provided for a permanent impoundment, but industrial

waste and heavy sediment loads from the Tuscarawas River initiated the decision to operate the project as a dry dam only.

Mohawk: Industrial, agricultural, livestock, and resource extraction runoff are the primary sources of high nutrient levels, metals, and sedimentation in the Walhonding River watershed. A large drainage area behind the dam leads to many potential sources of pollutants.

Mohicanville: Agricultural, livestock, and resource extraction runoff are the primary sources of high nutrient levels and metals in the Lake Fork watershed. Most of the watershed is devoted to agriculture, which can potentially introduce large amounts of sediment to the stream, especially during the winter months when soils are bare.

RECENT ACTIVITIES:

Bolivar: Water chemistry samples were last collected from the Bolivar Dam outflow in June of 2011 and analyzed for total and dissolved metals, nutrients, solids, ions, and physical parameters as part of the ambient sampling program. Additional sampling in the same fashion occurred in 2009, 1975, and 1974 at various times of the year.

Dover: Water chemistry samples were last collected from the Dover Dam outflow in June of 2011 and analyzed for total and dissolved metals, nutrients, solids, ions, and physical parameters as part of the ambient sampling program. Additional sampling in the same fashion occurred in 2009, 1975, and 1974 at various times of the year.

Mohawk: More extensive water chemistry sampling has been conducted at Mohawk Dam in both the outflow and the inflow. Samples were last collected from the outflow in June of 2011 and analyzed for total and dissolved metals, nutrients, solids, ions, and physical parameters as part of the ambient sampling program. Considerable amounts of sampling were conducted in 1974 to 1975 and 1992 to 1993.

Mohicanville: Water chemistry samples were last collected from the Mohicanville Dam outflow in June of 2011 and analyzed for total and dissolved metals, nutrients, solids, ions, and physical parameters as part of the ambient sampling program. Additional sampling in the same fashion occurred in 2009, 1975, and 1974 at various times of the year.

ADDITIONAL INFORMATION: There are currently no plans to conduct routine sampling as part of the intensive sampling program at any of the dry dam projects. Because these projects are only operated for flood damage reduction, which would supersede any water quality benefit, there is little value to be gained by monitoring them for water quality. Sampling may be conducted on an ad hoc basis should the need arise.

The Walhonding River below Mohawk Dam and the Lake Fork of Mohican River below Mohicanville Dam have been designated as critical habitat for the rabbitsfoot mussel.