North Carolina Division of Water Resources Ambient Lakes Monitoring Assessment of the Hiwassee River Basin Lakes and Reservoirs

North Carolina Department of Environmental Quality
Division of Water Resources
Water Science Section
Intensive Survey Branch

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Glossary

Algae Small aquatic plants that occur as single cells, colonies, or filaments. May also be referred to as phytoplankton, although phytoplankton are a subset of algae.

Algal Biovolume The volume of all living algae in a unit area at a given point in time. To determine biovolume, individual cells in a known amount of sample are counted. Cells are measured to obtain their cell volume, which is used in calculating biovolume.

Algal Density The density of algae based on the number of units (single cells, filaments and/or colonies) present in a milliliter of water. The severity of an algae bloom may be determined by the algal density as follows:

Mild bloom = 20,000 to 30,000 units/ml

Severe bloom = 30,000 to 100,000 units/ml

Extreme bloom = Greater than 100,000 units/ml

Algal Growth Potential Test (AGPT) A test to determine the nutrient that is the most limiting to the growth of algae in a body of water. The sample water is split such that one sub-sample is given additional nitrogen, another is given phosphorus, a third may be given a combination of nitrogen and phosphorus, and one sub-sample is not treated and acts as the control. A specific species of algae is added to each sub-sample and is allowed to grow for a given amount of time. The dry weights of algae in each sub-sample and the control are then measured to determine the rate of productivity in each treatment. The treatment (nitrogen or phosphorus) with the greatest algal productivity is said to be the limiting nutrient of the sample source. If the control sample has an algal dry weight greater than 5 mg/L, the source water is deemed unlimited for either nitrogen or phosphorus.

ALMP Ambient Lake Monitoring Program.

Centric Diatom Diatoms are photosynthetic algae that have a siliceous skeleton (frustule) found in almost every aquatic environment including fresh and marine waters, as well as moist soils. Centric diatoms are circular in shape and are often found in the water column.

Chlorophyll *a* Chlorophyll *a* is an algal pigment that is used as an approximate measure of algal biomass. The concentration of chlorophyll *a* is used in the calculation of the NCTSI, and the value listed is a lake-wide average from all sampling locations.

Clinograde In productive lakes where oxygen levels drop to zero in the lower waters near the bottom, the graphed changes in oxygen from the surface to the lake bottom produces what's known as a clinograde curve.

Coccoid Round or spherical shaped cell.

Conductivity The measure of the ability for water to conduct an electrical current. This measure increases as water becomes more mineralized. The concentrations listed are the range of values observed in surface readings from the sampling locations.

Dissolved Oxygen The range of surface water concentrations of oxygen found at sampling locations.

Dissolved Oxygen Saturation	The capacity of water to absorb oxygen gas. Often expressed as a percentage, the amount of oxygen that can dissolve into water will change depending on several parameters, the most important being temperature. Dissolved oxygen saturation is inversely proportion to temperature, that is, as temperature increases, water's capacity for oxygen will decrease, and vice versa.
Eutrophic	Describes a lake with high plant productivity and low water transparency.
Eutrophication	The process of physical, chemical, and biological changes associated with nutrients, organic matter, silt enrichment, and sedimentation of a lake.
Limiting Nutrient	The plant nutrient present in lowest concentration relative to need limits growth such that addition of the limiting nutrient will stimulate additional growth. In northern temperate lakes, phosphorus (P) is commonly the limiting nutrient for algal growth.
Manganese	A naturally occurring metal commonly found in soils and organic matter. As a trace nutrient, manganese is essential to all forms of biological life. Manganese in lakes is released from bottom sediments and enters the water column when the oxygen concentration in the water near the lake bottom is extremely low or absent. Manganese in lake water may cause taste and odor problems in drinking water and require additional treatment of the raw water at water treatment facilities to alleviate this problem.
Mesotrophic	Describes a lake with moderate plant productivity and water transparency.
NCTSI	North Carolina Trophic State Index was specifically developed for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NRCD 1982). It takes the nutrients present along with chlorophyll *a* and Secchi depth to calculate a lake's biological productivity.
Oligotrophic	Describes a lake with low plant productivity and high-water transparency.
pH	The range of surface water pH readings found at sampling locations. This value is used to express the relative acidity or alkalinity of water.
Photic Zone	The portion of the water column in which there is sufficient light for algal growth. DEQ considers 2 times the Secchi depth as depicting the photic zone.
Secchi Depth	This is a measure of water transparency expressed in meters. This parameter is used in the calculation of the NCTSI value for the lake. The depth listed is an average value from all sampling locations in the lake.
Temperature	The range of surface water temperatures found at sampling locations.
Total Kjeldahl Nitrogen	The sum of organic nitrogen and ammonia in a water body. High measurements of TKN typically results from sewage and manure discharges in water bodies.
Total Organic Nitrogen (TON)	Total Organic Nitrogen (TON) can represent a major reservoir of nitrogen in aquatic systems during summer months. Similar to phosphorus, this concentration can be related to lake productivity and is used in the calculation of the NCTSI. The concentration listed is a lake-wide average from all sampling stations and is calculated by subtracting Ammonia concentrations from TKN concentrations.

Total Phosphorus (TP)	Total phosphorus (TP) includes all forms of phosphorus that occur in water. This nutrient is essential for the growth of aquatic plants and is often the nutrient that limits the growth of phytoplankton. It is used to calculate the NCTSI. The concentration listed is a lake-wide average from all sampling stations.
Trophic State	This is a relative description of the biological productivity of a lake based on the calculated NCTSI value. Trophic states may range from extremely productive (Hypereutrophic) to very low productivity (Oligotrophic).
Turbidity	A measure of the ability of light to pass through a volume of water. Turbidity may be influenced by suspended sediment and/or algae in the water.
Watershed	A drainage area or catchment in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Purpose and Scope

The North Carolina Ambient Lake Monitoring Program (ALMP) originated under the Environmental Protection Agency's (EPA) Clean Lakes Program and is designed to identify long term trends in water quality for lakes and reservoirs across North Carolina. The water quality data collected is used to calculate the state of nutrient enrichment (trophic state) and determine if lakes meet their designated use(s). Lakes are sampled by river basin on a five-year rotation according to the Division of Water Resources basin sampling schedule. Lakes of 10 acres or greater, that have either public access and/or are used as a drinking supply qualify for sampling metrics. An interactive map of the state showing the locations of the ALMP sampling locations by the Division of Water Resources (DWR) may be found here (https://www.deq.nc.gov/about/divisions/water-resources/water-sciences/intensive-survey-branch-isb/ambient-lakes-monitoring)

Overview

The Hiwassee River Basin is in the remote southwestern corner of North Carolina. This mountainous basin covers approximately 640 mi^2 in Cherokee and Clay counties. The largest rivers are the Hiwassee River and the Valley River. Many of the streams in the basin are located within the US Forest Service Nantahala National Forest. This basin contains the Level IV ecoregions of the High Mountains, the Southern Crystalline Ridges and Mountains, and The Broad Basin.

The High Mountains ecoregions include northern portions of Clay County and contain the drainages of Big Tuni Creek and Fires Creek. Land use in this area is mostly forest and the terrain is rugged. The Southern Crystalline Ridges and Mountains ecoregions are in the eastern portion of Clay County and include the Shooting Creek catchment. While elevations are still significant, the overall terrain is less steep than those seen in the High Mountains, and there is slightly more overall agricultural land use. The Broad basin is in the southern half of Clay County and includes most of the Tusquitee and Brasstown Creek drainages. The lessened relief allows for more agricultural and residential land use in these areas. The predominant land use in this subbasin is forest, with lesser amounts of agricultural and residential impacts.

Three lakes were sampled in this river basin by DWR staff in 2024 – Hiwassee Reservoir, Chatuge Lake, and Appalachia Lake. All three reservoirs are managed by the Tennessee Valley Authority (TVA), which monitors these lakes every other year and information regarding TVA water data can be found at www.tva.com/environment/lake-levels.

A statewide fish consumption advisory for multiple fish species due to mercury contamination was issued by the NC Department of Health and Human Services, Division of Public Health. This advisory includes lakes in the Hiwassee River Basin. Go to https://epi.dph.ncdhhs.gov/oee/fish/advisories.html for specific fish consumption details.

Assessment Methodology

For this report, data from Jan. 1, 2024, through Dec. 31, 2024, were reviewed. Lake monitoring and sample collection activities performed by DWR field staff remained in accordance with the Intensive Survey Branch (ISB) Standard Operating Procedures Manual (https://www.deq.nc.gov/water-quality/environmental-sciences/isu/isb-sop-version2-1-final/download)

Generally, ISB samples during the growing season from May through September; however, due to construction upgrades at the DWR Water Quality Laboratory in Raleigh, NC, sampling was postponed and collected from June to October in 2024. Additionally, due to these renovations, samples collected for Chlorophyll *a* (Chl *a*) were sent to a certified third-party laboratory to complete the analysis so that these data points would not be lost for June and July. The sampling season was then extended by one month, due to Hurricane Helene limiting sampling in October. The sampling season ended with the last samples collected at the beginning of November.

Data were assessed for deviations from the state Class C water quality standards for chlorophyll *a*, pH, dissolved oxygen, water temperature, and turbidity. Other parameters discussed in this report include Secchi depth and percent dissolved oxygen saturation. Secchi depth provides a measure of water clarity and is used in calculating the trophic or nutrient enriched status of a lake, as well as determining the photic zone which is used as the sampling depth. Percent dissolved oxygen saturation gives information on the amount of dissolved oxygen in the water column and may be increased by photosynthesis or depressed by oxygen-consuming decomposition.

Nutrient data is collected to determine the trophic status of a lake or reservoir and is calculated by the North Carolina Trophic State Index (NCTSI) score. The NCTSI score was specifically developed for North Carolina Lakes as part of the state's original Clean Lakes Classification Survey. It utilizes the nutrients present along with chlorophyll *a* and Secchi depth to calculate a lake's biological productivity. When an analyte was analyzed for but not detected above the PQL (Practical Quantitation Limit), this PQL value was utilized in the NCTSI score calculation. It should be noted that prior to 2023 half of the PQL was utilized in this calculation when an analyte was not detected above the PQL. This decision to use the whole PQL value came out of an abundance of caution to ensure the most conservative estimate of the NCTSI score. The ranges for classification are as follows:

Oligotrophic	< -2.0
Mesotrophic	-2.0 to 0.0
Eutrophic	0.0 to 5.0
Hypereutrophic	> 5.0

For algae collection and assessment, water samples were collected from the photic zone, preserved in the field, and taken concurrently with chemical and physical parameters. Samples were quantitatively analyzed to determine assemblage structure, density (units/ml) and biovolume (m^3/mm^3).

For the purpose of reporting, algal blooms were determined by the measurement of unit density (units/ml). Unit density is a quantitative measurement of the number of filaments, colonies, or single celled taxa in a waterbody. Blooms are considered mild if they are between 10,000 and 20,000 units/ml.

Moderate blooms are between 20,000 and 30,000 units/ml. Severe blooms are between 30,000 and 100,000 units/ml and extreme blooms are those 100,000 units/ml or greater. An algal group is considered dominant when it comprises 40% or more of the total unit density or total biovolume. An algal genus is considered dominant when it comprises 30% or more of the total unit density or total biovolume.

Quality Assurance of Field and Laboratory ALMP Data

Data collected in the field via multiparameter water quality meters were uploaded into the Labworks® database within a month of the sampling date.

Chemistry data from the DWR Water Quality Laboratory were uploaded into Labworks®. If there were data entry mistakes, possible equipment, sampling, and/or analysis errors, these were investigated and corrected, if possible. Chemistry results received from the laboratory that were given a qualification code were entered along with the assigned laboratory code. Laboratory qualification codes are listed in Appendix B.

Information regarding the WSS Chemistry Laboratory Quality Assurance Program is available on the ISB website (https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/microbiology-inorganics-branch/methods-pqls-qa).

The Ambient Lakes Monitoring Program (ALMP) Quality Assurance Project Plan can be found on the Intensive Survey Branch Website (https://www.deq.nc.gov/about/divisions/water-resources/water-sciences/intensive-survey-branch-isb).

Weather Overview for Summer 2024

Weather conditions were considered wet for the basin in the sampling season of June - November 2024, highlighted by Hurricane Helene passing through the Hiwassee River Basin.

A dry and warm June started the delayed sampling season, with a minor drought occurring at the end of June. The minor drought ended in July with a statewide average precipitation of 8.29 inches for the month. August was an overall wet month as well, with Tropical Storm Debby being a large contributor to precipitation totals. Following that saturating month, Hurricane Helene occurred from September 25th – September 27th, hitting the western mountains of North Carolina the hardest. The Hiwassee River basin received on average 6 to 12 inches of rain over the 3-day period. Access to sampling locations was disrupted by this hurricane, and therefore the October sampling event was postponed, and the final sampling event was conducted in early November. October and November weather brought general dryness and warm temperatures after the flooding that occurred in September.

Detailed weather information can be found through the NC State Climate Office Blog (https://climate.ncsu.edu/climateblog) and the Southeast Regional Climate center (https://sercc.com/periodic-reports-monthly).

Lake and Reservoir Assessments

HUC 03020002

Chatuge Lake

Image Source: Joe Mohn (ISB)

Ambient Lakes Program Name	**Chatuge Lake**	
Season Average Trophic Status (NC TSI)	**Mesotrophic (-1.9)**	
Mean Depth (meters)	**11**	
Volume ($10^6 m^3$)	**305**	
Watershed Area (mi^2)	**484**	
Classification	**B**	
Stations	**HIW00B**	**HIW00D**
Number of Times Sampled	**5**	**5**
Stations Cont'd	**HIW00F**	**--**
Number of Times Sampled	**5**	**--**

Chatuge Lake Monthly Snapshot		
Sample Period	**Monthly NC TSI Score**	**Trophic State**
June	-1.8	Mesotrophic
July	-1.7	Mesotrophic
August	-1.9	Mesotrophic
September	-2.2*	Oligotrophic
November	--	--

* Chl a data marked by lab staff as having a dry blank filter, despite field staff documentation confirming DI was run through the blank filters.
-- No NC TSI score calculated due to chlorophyll samples exceeding hold time after receipt by the lab

Chatuge Lake is a large reservoir located in the southwestern portion of the state. The lake is situated adjacent to the Nantahala National Forest and is an impoundment of the Hiwassee River upstream from Hiwassee Lake and Apalachia Lake. Approximately half of the lake lies within the state of Georgia. The lake is owned by the Tennessee Valley Authority (TVA) and was constructed in 1942 to provide hydroelectric power.

This lake has a maximum depth of 44 meters. Chatuge Lake is long (13 miles), with 212 kilometers of shoreline. The drainage area of the lake is primarily forested. Major tributaries to the Chatuge Lake include the Hiwassee River and Shooting Creek.

DWQ staff monitored Chatuge Lake monthly from June through November 2024. Secchi depths ranged from 2.6 to 5.0 meters, indicating very good water clarity (Appendix A). Surface dissolved oxygen ranged from 7.3 to 8.5 mg/L and surface water temperatures ranged from 18.7 C° to 31.3 C°. Surface pH values ranged from 5.7 to 7.3 s.u.

Nutrient concentrations in Chatuge Lake were low in 2024. Total phosphorus, total Kjeldahl nitrogen, ammonia, and nitrite plus nitrate were less than the DWR Laboratory detection levels for these nutrients (Appendix A). Chlorophyll *a* values ranged from 2.0 to 8.2 µg/L. Based on the calculated NCTSI scores for 2024, Chatuge Lake was determined to exhibit low biological productivity (mesotrophic conditions). This lake had previously been designated oligotrophic since it was first monitored by DWR in 1981. Starting in 2023, NCTSI scores are calculated using the more conservative whole PQL substitution method for values below the detection limit, aligning with other DWR branches. Before 2023, a less conservative half PQL substitution method was used. This shift to a more conservative approach may partly explain the change in trophic status.

Hiwassee Reservoir

Image Source: Joe Mohn (ISB)

Ambient Lakes Program Name	**Hiwassee Reservoir**	
Season Average Trophic Status (NC TSI)	**Mesotrophic (-0.9)**	
Mean Depth (meters)	**47**	
Volume ($10^6 m^3$)	**119**	
Watershed Area (mi^2)	**2507**	
Classification	**B, C**	
Stations	**HIW009A**	**HIW009B**
Number of Times Sampled	**5**	**5**
Stations Cont'd	**HIW009D**	**HIW009F**
Number of Times Sampled	**5**	**5**
Stations Cont'd	**HIW009G**	**--**
Number of Times Sampled	**5**	**--**

Hiwassee Reservoir Monthly Snapshot		
Sample Period	**Monthly NC TSI Score**	**Trophic State**
June	-1.2	Mesotrophic
July	-0.9	Mesotrophic
August	-1.0	Mesotrophic
September	-0.8	Mesotrophic
November	-0.7	Mesotrophic

Hiwassee Reservoir lies in the western tip of North Carolina on the Hiwassee River near the Tennessee border. Built by the TVA between 1936 and 1940 to provide hydroelectric power, Hiwassee Lake is the second largest TVA lake in North Carolina. The maximum depth of the lake is 94 meters, while the length is 35 kilometers, providing 262 kilometers of shoreline at full pool. The major inflows to the lake are Hiwassee River, Nottely River, Persimmon Creek, Valley River, Hanging Dog Creek, and Beaverdam Creek. The steeply sloped watershed area is mostly forested.

Hiwassee Reservoir was monitored monthly from June through November 2024 by DWR staff. Surface dissolved oxygen ranged from 7.7 to 9.1 mg/L and surface water temperatures ranged from 18.4 °C to 31.0 °C (Appendix A). Surface pH values ranged from 7.2 to 9.1 s.u. Secchi depths for Hiwassee Reservoir ranged from 1.4 to 4.5 meters.

Nutrient concentrations in 2024 were similar to those previously observed for this reservoir. Total phosphorus, total Kjeldahl nitrogen, ammonia, and nitrite plus nitrate were less than the DWR Laboratory detection levels for nearly all these nutrients (Appendix A). Chlorophyll *a* values were low, ranging from 3.1 to 21.0 µg/L. Hiwassee Reservoir exhibited slightly mesotrophic conditions indicating low biological productivity in 2024 based on the calculated NCTSI scores for June through November. This reservoir had previously been designated oligotrophic since it was first monitored by DWR in 1981. Starting in 2023, NCTSI scores are calculated using the more conservative whole PQL substitution method for values below the detection limit, aligning with other DWR branches. Before 2023, a less conservative half PQL substitution method was used. This shift to a more conservative approach may partly explain the change in trophic status.

Apalachia Lake

Image Source Lee & Carol Barbour Lee & Carol Barbour-Mountain Living Team

Ambient Lakes Program Name	**Apalachia Lake**	
Season Average Trophic Status (NC TSI)	Oligotrophic (-2.03)	
Mean Depth (meters)	**18**	
Volume ($10^6 m^3$)	**8**	
Watershed Area (mi^2)	**2605**	
Classification	**B**	
Stations	**HIW011A**	**HIW011C**
Number of Times Sampled	**5**	**5**
Stations Cont'd	**HIW012**	**--**
Number of Times Sampled		**--**

Apalachia Lake Monthly Snapshot		
Sample Period	**Monthly NC TSI Score**	**Trophic State**
June	-1.9	Mesotrophic
July	-2.1	Oligotrophic
August	-2.2	Oligotrophic
September	-1.8	Mesotrophic
November	-2.1	Oligotrophic

Apalachia Lake is a run-of-the-river reservoir located within the Nantahala National Forest in the mountains of western North Carolina. It is situated immediately downstream of Hiwassee Lake on the Hiwassee River. The lake is owned by the Tennessee Valley Authority and was constructed to generate hydroelectric power. Construction of the dam began in 1941 and completed in 1943. Apalachia Lake has a maximum depth of 36 meters, a length of 10 miles (16 kilometers) and 31 miles (50 kilometers) of shoreline at full pool level. Major tributaries to the lake include Hiwassee River, Camp Creek, and both North and South Shoal Creeks. The drainage area consists of forested, mountainous terrain.

DWR staff sampled Apalachia Lake monthly from June through November 2024. Surface dissolved oxygen ranged from 5.5 to 9.1 mg/L and surface water temperatures ranged from 18.2 °C to 28.3 °C (Appendix A). Surface pH values were greatest in August (7.7 s.u.) and the lowest value (6.1 s.u.) was observed near the upper end of the reservoir (HIW011A) in September. Secchi depths for Apalachia Lake ranged from 3.3 to 5.0 meters.

Total phosphorus, total Kjeldahl nitrogen, ammonia, and nitrite plus nitrate were less than the DWR Laboratory detection levels for nearly all these nutrients (Appendix A). Based on the calculated NCTSI scores, Apalachia Lake was determined to have very low biological productivity or oligotrophic conditions. This reservoir has been oligotrophic since it was first monitored by DWR in 1981.

Appendix A - Hiwassee River Basin Data

January 1, 2024 Through December 31, 2024

Lake	Date	SURFACE PHYSICAL DATA							PHOTIC ZONE DATA						Total Suspended Solids mg/L	Turbidity NTU
		Sampling Station	DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Depth Secchi meters	Percent SAT	TP mg/L	TKN mg/L	NH3 mg/L	NOx mg/L	Chla µg/L	Total Solids mg/L		
HUC 03020002																
LAKE CHATUGE	June 20, 2024	HIW000B	7.6	27.0	7.1	21	3.6	100.7%	0.03 U	0.4 U	0.05 U	0.03 U	4.5	20	2.5 U	1.8
	June 20, 2024	HIW000D	7.7	27.3	7.3	23	5.0	103.4%	0.03 U	0.4 U	0.05 U	0.03 U	4.3	22	2.5 U	1.4
	June 20, 2024	HIW000F	7.5	27.3	6.9	22	3.6	100.3%	0.03 U	0.4 U	0.05 U	0.03 U	4.4	17	2.5 U	1.5
	July 8, 2024	HIW000B	7.4	30.2	6.6	22	3.5	105.0%	0.03 U	0.4 U	0.05 U	0.03 U	2.8	23	2.5 U	2.7
	July 8, 2024	HIW000D	7.5	30.4	7.2	23	4.1	106.6%	0.03 U	0.4 U	0.05 U	0.03 U	7.5	23	2.7	1.9
	July 8, 2024	HIW000F	7.4	31.3	6.8	23	3.3	106.7%	0.03 U	0.4 U	0.05 U	0.03 U	2.5	25	2.5 U	1.6
	August 12, 2024	HIW000B	7.3	29.1	6.4	23	2.7	102.2%	0.03 U	0.4 U	0.05 U	0.03 U	2.0	12 U	2.5 UJ2	1.2
	August 12, 2024	HIW000D	7.3	29.6	6.3	24	2.6	103.1%	0.03 U	0.4 U	0.05 U	0.03 U	3.2	18	2.5 UJ2	1.3
	August 12, 2024	HIW000F	7.3	29.4	6.5	23	3.1	102.3%	0.03 U	0.4 U	0.05 U	0.03 U	2.0	15	2.5 UJ2	1.2
	September 9, 2024	HIW000B	7.6	26.8	6.5	23	3.3	101.3%	0.03 U	0.4 U	0.05 U	0.03 U	2.0 J4	27	2.5 U	1.7
	September 9, 2024	HIW000D	7.5	27.0	6.2	24	3.6	100.3%	0.03 U	0.4 U	0.05 U	0.03 U	2.5 J4	26	2.5 U	1.3
	September 9, 2024	HIW000F	7.6	26.7	6.6	23	3.6	100.9%	0.03 U	0.4 U	0.05 U	0.03 U	2.0 J4	25	2.5 U	2.1
	November 4, 2024	HIW000B	8.5	18.7	6.2	23	2.8	96.3%	0.03 U	0.4 U	0.05 U	0.03 U	7.3 Q2	19	2.5 U	1 U
	November 4, 2024	HIW000D	7.9	18.8	5.7	23	3.0	90.1%	0.03 U	0.4 U	0.05 U	0.03 U	8.2 Q2	17	2.8 U,Y	1 U
	November 4, 2024	HIW000F	8.5	18.7	6.2	23	3.0	96.3%	0.03 U	0.4 U	0.05 U	0.03 U	7.8 Q2	12	2.5 U	1 U
HIWASSEE RESERVOIR	June 19, 2024	HIW009A	8.8	27.2	8.3	31	3.1	116.0%	0.03 U	0.4 U	0.05 U	0.03	6.5	12 U	2.5 U	2.0
	June 19, 2024	HIW009B	9.1	26.6	8.0	30	3.1	118.2%	0.03 U	0.4 U	0.05 U	0.03 U	8.9	22	2.5 U	1.6
	June 19, 2024	HIW009D	8.7	27.4	8.3	29	3.1	114.5%	0.03 U	0.4 U	0.05 U	0.03 U	7.4	23	2.5 U	1.8
	June 19, 2024	HIW009F	8.6	27.4	7.4	28	3.5	113.5%	0.03 U	0.4 U	0.05 U	0.03 U	6.8	25	2.5 U	1.4
	June 19, 2024	HIW009G	8.4	27.4	7.5	26	4.5	110.5%	0.03 U	0.4 U	0.05 U	0.03 U	7.1	22	2.5 U	1.8
	July 9, 2024	HIW009A	8.7	30.3	8.7	32	3.0	122.3%	0.03 U	0.4 U	0.05 U	0.03 U	9.1	27	2.5 U	2.0
	July 9, 2024	HIW009B	8.6	30.4	8.7	32	3.0	121.2%	0.03 U	0.4 U	0.05 U	0.03 U	9.7	26	2.5 U	1.7
	July 9, 2024	HIW009D	8.3	30.3	8.4	30	3.3	116.2%	0.03 U	0.4 U	0.05 U	0.03 U	9.8	24	2.5 U	1.6
	July 9, 2024	HIW009F	8.1	30.3	7.8	28	3.3	113.3%	0.03 U	0.4 U	0.05 U	0.03 U	7.6	19	2.5 U	1.9
	July 9, 2024	HIW009G	7.7	31.0	7.4	26	3.2	109.4%	0.03 U	0.4 U	0.05 U	0.03 U	7.1	24	2.5 U	1.5
	August 13, 2024	HIW009A	8.5	29.4	8.9	32	2.4	117.5%	0.03 U	0.4 U	0.05 U	0.03 U	9.5	19	2.5 UJ2	1.6
	August 13, 2024	HIW009B	8.4	29.3	8.7	32	2.5	116.1%	0.03 U	0.4 U	0.05 U	0.03 U	7.8	13	2.5 UJ2	1.3
	August 13, 2024	HIW009D	8.6	28.9	8.6	30	2.6	117.4%	0.03 U	0.4 U	0.05 U	0.03 U	5.7	25	2.5 UJ2	1.5
	August 13, 2024	HIW009F	8.4	29.0	8.3	29	2.8	115.6%	0.03 U	0.4 U	0.05 U	0.03 U	4.7	19	2.5 UJ2	1.3
	August 13, 2024	HIW009G	8.5	29.2	8.5	27	3.5	117.1%	0.03 U	0.4 U	0.05 U	0.03 U	4.5	20	2.5 UJ2	1 U
	September 10, 2024	HIW009A	9.0	26.6	9.0	33	1.6	117.2%	0.03 U	0.4 U	0.05 U	0.03 U	9.8	34	2.5 U	2.3
	September 10, 2024	HIW009B	8.9	26.6	8.9	33	2.0	116.1%	0.03 U	0.4 U	0.05 U	0.03 U	9.8	37	2.5 U	2.0
	September 10, 2024	HIW009D	8.6	26.8	8.6	31	2.5	112.5%	0.03 U	0.4 U	0.05 U	0.03 U	6.3	30	2.5 U	1.3
	September 10, 2024	HIW009F	8.9	27.0	8.7	31	2.6	117.6%	0.03 U	0.4 U	0.05 U	0.03 U	6.2	28	2.5	1.4
	September 10, 2024	HIW009G	8.9	27.0	8.5	29	3.5	117.4%	0.03 U	0.4 U	0.05 U	0.03 U	3.9	26	2.5 U	1.1
	November 5, 2024	HIW009A	8.9	18.4	6.7	32	1.5	99.4%	0.03 U	0.4 U	0.05 U	0.03 U	21.0	24	3.7	1 U
	November 5, 2024	HIW009B	8.6	18.5	7.1	15	1.4	95.7%	0.03 U	0.4 U	0.05 U	0.03 U	13.0	12 U	3.6	1.1
	November 5, 2024	HIW009D	8.0	19.3	6.8	30	3.6	91.0%	0.03 U	0.4 U	0.05 U	0.03	8.3	12 U	2.5 U	1 U
	November 5, 2024	HIW009F	7.2	19.3	6.7	30	3.5	81.9%	0.03 U	0.4 U	0.05 U	0.04	5.0	24	2.5 U	1 U
	November 5, 2024	HIW009G	7.2	19.3	6.6	30	4.3	81.6%	0.03 U	0.4 U	0.05 U	0.06	4.6	27	2.8 U,Y	1 U
APALACHIA LAKE	June 19, 2024	HIW011A	8.7	24.2	7.0	24	3.4	107.7%	0.03 U	0.4 U	0.05 U	0.10	2.5	23	2.5 U	1 U
	June 19, 2024	HIW011C	8.8	26.7	6.9	23	3.5	113.6%	0.03 U	0.4 U	0.05 U	0.06	3.5	21	2.5 U	1.1
	June 19, 2024	HIW012	8.3	27.2	6.6	24	4.2	107.6%	0.03 U	0.4 U	0.05 U	0.05	3.5	22	2.5 U	1 U
	July 9, 2024	HIW011A	7.7	26.3	6.6	25	4.8	99.9%	0.03 U	0.4 U	0.05 U	0.10	1.9	23	2.5 U	1 U
	July 9, 2024	HIW011C	8.2	26.8	6.6	25	3.8	106.8%	0.03 U	0.4 U	0.05 U	0.05	4.0	22	2.5 U	1.3
	July 9, 2024	HIW012	7.8	28.3	6.7	25	4.3	104.0%	0.03 U	0.4 U	0.05 U	0.04	3.7	20	2.5 U	1 U
	August 13, 2024	HIW011A	7.3	23.5	7.5	27	5.0	90.0%	0.03 U	0.4 U	0.05 U	0.12	2.0	20	2.5 UJ2	1 U
	August 13, 2024	HIW011C	8.3	25.4	7.7	26	4.0	105.7%	0.03 U	0.4 U	0.05 U	0.09	3.0	15	X3	1 U
	August 13, 2024	HIW012	8.7	25.0	7.4	26	4.0	110.3%	0.03 U	0.4 U	0.05 U	0.07	3.0	19	2.5 UJ2	1 U
	September 10, 2024	HIW011A	7.1	21.0	6.1	29	4.3	82.6%	0.03 U	0.4 U	0.05 U	0.10	2.7	28	2.5 U	1 U
	September 10, 2024	HIW011C	8.4	23.1	6.4	28	3.3	102.6%	0.03 U	0.4 U	0.05 U	0.08	4.0	31	2.8 U,Y	1 U
	September 10, 2024	HIW012	9.1	22.8	6.4	28	3.5	109.2%	0.03 U	0.4 U	0.05 U	0.05	4.3	29	2.5 U	1 U
	November 5, 2024	HIW011A	5.5	18.2	6.7	31	4.0	60.3%	0.03 U	0.4 U	0.06	0.07	1.0 U	12 U	2.5 U	1 U
	November 5, 2024	HIW011C	6.0	18.3	6.9	26	3.8	66.6%	0.03 U	0.4 U	0.05 U	0.10	3.7	15	2.5 U	1 U
	November 5, 2024	HIW012	7.5	18.5	6.5	30	4.5	82.9%	0.03 U	0.4 U	0.05 U	0.12	4.2	25	2.5 U	1 U

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Symbol		Definition
A		Value reported is the mean (average) of two or more determinations. This code is to be used if the results of two or more discrete and separate samples are averaged. These samples shall have been processed and analyzed independently (e.g. field duplicates, different dilutions of the same sample). This code is not required for BOD, coliform or acute/chronic metals reporting since averaging multiple results for these parameters is fundamental to those methods or manner of reporting.
	1	The reported value is an average, where at least one result is qualified with a "U". The PQL is used for the qualified result(s) to calculate the average.
B		Results based upon colony counts outside the acceptable range and should be used with caution. This code applies to microbiological tests and specifically to **membrane filter (MF)** colony counts. It is to be used if less than 100% sample was analyzed and the colony count is generated from a plate in which the number of colonies exceeds the ideal ranges indicated by the method. These ideal ranges are defined in the method as: *Fecal coliform or Enterococcus bacteria: 20-60 colonies Total coliform bacteria: 20-80 colonies*
	1	Countable membranes with less than 20 colonies. Reported value is estimated or is a total of the counts on all filters reported per 100 ml.
	2	Counts from all filters were zero.
	3	Countable membranes with more than 60 or 80 colonies. The value reported is calculated using the count from the smallest volume filtered and reported as a greater than ">" value.
	4	Filters have counts of both >60 or 80 and <20. Reported value is estimated or is a total of the counts on all filters reported per 100 ml.
	5	Too many colonies were present; too numerous to count (TNTC). TNTC is generally defined as >150 colonies. The numeric value represents the maximum number of counts typically accepted on a filter membrane (60 for fecal or enterococcus and 80 for total), multiplied by 100 and then divided by the smallest filtration volume analyzed. This number is reported as a greater than value.
	6	Estimated Value. Blank contamination evident.
	7	Many non-coliform or non-enterococcus colonies or interfering non-coliform or non-enterococcus growth present. In this competitive situation, the reported value may under-represent actual density.
		Note: A "B" value shall be accompanied by justification for its use denoted by the numbers listed above (e.g., B1, B2, etc.). Note: A "J2" should be used for spiking failures.
C		Total residual chlorine was present in sample upon receipt in the laboratory; value is **estimated**. Generally applies to cyanide, phenol, NH3, TKN, coliform, and organics.
G		A single quality control failure occurred during biochemical oxygen demand (BOD) analysis. The sample results should be used with caution.
	1	The dissolved oxygen (DO) depletion of the dilution water blank exceeded 0.2 mg/L.
	2	The bacterial seed controls did not meet the requirement of a DO depletion of at least 2.0 mg/L and/or a DO residual of at least 1.0 mg/L.
	3	No sample dilution met the requirement of a DO depletion of at least 2.0 mg/L and/or a DO residual of at least 1.0 mg/L.
	4	Evidence of toxicity was present. This is generally characterized by a significant increase in the BOD value as the sample concentration decreases. The reported value is calculated from the highest dilution representing the maximum loading potential and should be considered an **estimated** value.
	5	The glucose/ glutamic acid standard exceeded the range of 198 ± 30.5 mg/L.
	7	Less than 1 mg/L DO remained for all dilutions set. The reported value is an **estimated** greater than value and is calculated for the dilution using the least amount of sample.
	8	Oxygen usage is less than 2 mg/L for all dilutions set. The reported value is an **estimated** less than value and is calculated for the dilution using the most amount of sample.
	9	The DO depletion of the dilution water blank produced a negative value.
	10	The cBOD value is greater than the BOD value.
		Note: A "G" value shall be accompanied by justification for its use denoted by the numbers listed above (e.g., G1, G2, etc.).

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J		**Estimated** value; value may not be accurate. This code is to be used in the following instances:
	1	Surrogate recovery limits have been exceeded.
	2	The reported value failed to meet the established quality control criteria for either precision or accuracy.
	3	The sample matrix interfered with the ability to make any accurate determination.
	4	The data is questionable because of improper laboratory or field protocols (e.g., composite sample was collected instead of grab, plastic instead of glass container, the sample's extraction batch did not include a LCS/MS/MSD, etc.).
	5	Temperature limits exceeded (samples frozen or >6°C) during transport or not verifiable (e.g., no temperature blank provided): non-reportable for NPDES compliance monitoring.
	6	The laboratory analysis was from an unpreserved or improperly chemically preserved sample. The data may not be accurate.
	7	This qualifier is used to identify analyte concentration exceeding the upper calibration range of the analytical instrument/method. The reported value should be considered estimated.
	8	Temperature limits exceeded (samples frozen or >6°C) during storage, the data may not be accurate.
	9	The reported value is determined by a one-point estimation rather than against a regression equation. The estimated concentration is less than the laboratory PQL and greater than the laboratory method detection limit.
	10	Unidentified peak; estimated value.
	11	The reported value is determined by a one-point estimation rather than against a regression equation. The estimated concentration is less than the laboratory PQL and greater than the instrument noise level. This code is used when an MDL has not been established for the analyte in question.
	12	The calibration verification did not meet the calibration acceptance criterion for **field parameters**.
	13	Standards used for this analyte are from an uncertified source. These are the only standards currently available for the analyte.
	14	Blank surrogate(s) percent recovery failed low. Potential contamination cannont be ruled out. This means assocated sample results may be biased high. This qualifier is only to be used for samples which have target analyte results ≥PQL.
	15	This result has no supporting QA/QC data.
		Note: A "J" value shall be accompanied by justification for its use denoted by the numbers listed above (e.g., J1, J2, etc.).
M		Sample and duplicate results are "out of control". The sample is non-homogenous (e.g., VOA soil). The reported value is the lower value of duplicate analyses of a sample.
N		Presumptive evidence of presence of material; **estimated** value. This code is to be used if:
	1	The component has been tentatively identified based on mass spectral library search.
	3	This code shall be used if the level is too low to permit accurate quantification, but the estimated concentration is less than the laboratory PQL and greater than the laboratory method detection limit. This code is not routinely used for most analyses.
P		Sample dilution occurred due to either matrix interference or target analytes being present at concentrations greater than the calibration curve. Reported target analyte values are obtained from results which were bracketed by the calibration curve. For example, "P10" in sample comments would indicate that a 10x dilution was performed to obtain the reported result.
Q		Holding time exceeded. These codes shall be used if the value is derived from a sample that was received, prepared and/or analyzed after the approved holding time restrictions for sample preparation and analysis. The value does not meet NPDES requirements.
	1	Holding time exceeded prior to receipt by lab.
	2	Holding time exceeded following receipt by lab.
S		Not enough sample provided to prepare and/or analyze a method-required matrix spike (MS) and/or matrix spike duplicate (MSD).
U		Indicates that the analyte was analyzed for, but not detected above the reported PQL. The number value reported with the "U" qualifier is equal to the laboratory's PQL*. If the "P" qualifier is reported with this "U" qualifier, then the reported PQL is elevated.
UU		Indicates that the analyte result was generated from a screen analysis (i.e., does not have supporting QA/QC data). The value reported with the "UU" qualifier is equal to the laboratory's PQL. The number value was determined by a one-point estimation at the PQL, rather than against a regression equation.

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V	Indicates the analyte was detected in both the sample and the associated blank. Note: The value in the blank shall not be subtracted from the associated samples. 1 The analyte was detected in both the sample and the method blank. 2 The analyte was detected in both the sample and the field blank.
X	Sample not analyzed for this constituent. This code is to be used if: 1 Sample not screened for this compound. 2 Sampled, but analysis lost or not performed-field error. 3 Sampled, but analysis lost or not performed-lab error. Note: an "X" value shall be accompanied by justification for its use by the numbers listed.
Y	Elevated PQL due to insufficient sample size.
Z	The sample analysis/results are not reported due to: 1 Inability to analyze the sample. 2 Questions concerning data reliability. Note: The presence or absence of the analyte cannot be verified.

Supporting Definitions listed below

MDL	A Method Detection Limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the true value is greater than zero and is determined in accordance with 40 CFR Part 136, Appendix B.
ML	Minimum Levels are used in some EPA methods. A Minimum Level (ML) is the lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that all method - specified sample weights, volumes, and cleanup procedures have been employed. The ML is calculated by multiplying the MDL by 3.18 and rounding the result to the nearest factor of 10 multiple (i.e., 1, 2, or 5). For example, MDL = 1.4 mg/L; ML = 1.4 mg/L x 3.18 = 4.45 rounded to the nearest factor of 10 multiple (i.e., 5) = 5.0 mg/L
PQL	The Practical Quantitation Limit (PQL) is defined as the lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. PQLs are subjectively set at some multiple of typical MDLs for reagent water (generally 3 to 10 times the MDL depending upon the parameter or analyte and based on the analyst's best professional judgement, the quality and age of the instrument and the nature of the samples) rather than explicitly determined. PQLs may be nominally chosen within these guidelines to simplify data reporting and, where applicable, are generally equal to the concentration of the lowest non-zero standard in the calibration curve. PQLs are adjusted for sample size, dilution and % moisture. For parameters that are not amenable to MDL studies, the PQL may be defined by the sample volume and buret graduations for titrations or by minimum measurement values set by the method for method-defined parameters (e.g., BOD requires a minimum DO depletion of 2.0 mg/L, fecal coliform requires a minimum plate count of 20 cfu, total suspended residue requires a minimum weight gain of 2.5 mg, etc.). Additionally, some EPA methods prescribe Minimum Levels (MLs) and the lab may set the PQL equal to this method-stated ML. Determination of PQL is fully described in the laboratory's analytical Standard Operating Procedure (SOP) document.