

Obed Wild and Scenic River and Big South Fork National River and Recreation Area

National Park Service
U.S. Department of the Interior

Inventory and Monitoring Division
Appalachian Highlands Network



Continuous Water Quality Monitoring: Water Year 2022

Overview

Renowned for their rivers and aquatic species diversity, Big South Fork National River and Recreation Area (BISO) and Obed Wild and Scenic River (OBRI) are important park units protecting water resources. Water quality is an important indicator of ecosystem health and reflects the human activities, land use, and natural factors occurring throughout the BISO and OBRI watersheds. River and stream conditions influence aquatic and riparian habitats and the flora and fauna they support, as well as recreational activities and park visitation.

Big South Fork National River and Recreation Area and Obed Wild and Scenic River support the largest concentration and most pristine examples remaining of the globally imperiled Cumberlandian cobble bar. This habitat supports 27 rare plant species, including two threatened species, Cumberland rosemary (*Conradina verticillata*) and Virginia spirea (*Spiraea virginiana*), and depends on natural flood regimes and unpolluted water, like the fish and mussels that inhabit the rivers. Big South Fork National River and Recreation Area is a global hotspot for freshwater mussel diversity with 42 species, 11 of which are federally endangered. Of the two threatened fish species found at Big South Fork, the tuxedo darter (*Etheostoma lemniscatum*) occurs nowhere else in the world. Obed Wild and Scenic River sustains several threatened aquatic species, including the Alabama lampmussel (*Lampsilis virescens*) and the purple bean (*Villosa perpurpurea*), as well as the spotfin chub (*Erimonax monachus*). These aquatic species and rare habitat are dependent upon the health of the BISO and OBRI watersheds.



Maintenance of a continuous water quality sonde on Daddys Creek. NPS photo / APHN staff.

Summary

- In FY2022, five water quality parameters were measured at 30-minute intervals from five sites.
- Dissolved oxygen levels met Tennessee state standards with the exception of two instances at one site.
- Temperature met Tennessee state criteria with the exception of two violations at two sites.
- pH violations were observed at three sites for limited periods.
- Specific conductance reached elevated levels at two sites.
- With the exception of flood events, turbidity was low except at one site where conditions were turbid.
- Overall, water quality conditions were generally good with a few exceptions.

Objective

Water resources within Big South Fork National River and Recreation Area and Obed Wild and Scenic River are influenced by natural conditions and anthropogenic factors that occur upstream of park boundaries, including coal mining, oil and gas extraction, logging, agriculture, municipal development, wastewater discharge, and increased water demands.

The Appalachian Highlands Network (APHN) monitors water quality at five integrator sites (see maps, page 2). Sonde is paired with USGS stations to monitor a suite of parameters, in addition to gage and streamflow, at 30-minute intervals. The objective is to determine annual status and long-term trends for five core parameters:

- Temperature
- Dissolved Oxygen
- Specific Conductivity
- Turbidity
- pH

For detailed methods, see Hughes et al. 2018.

Big South Fork National River & Recreation Area

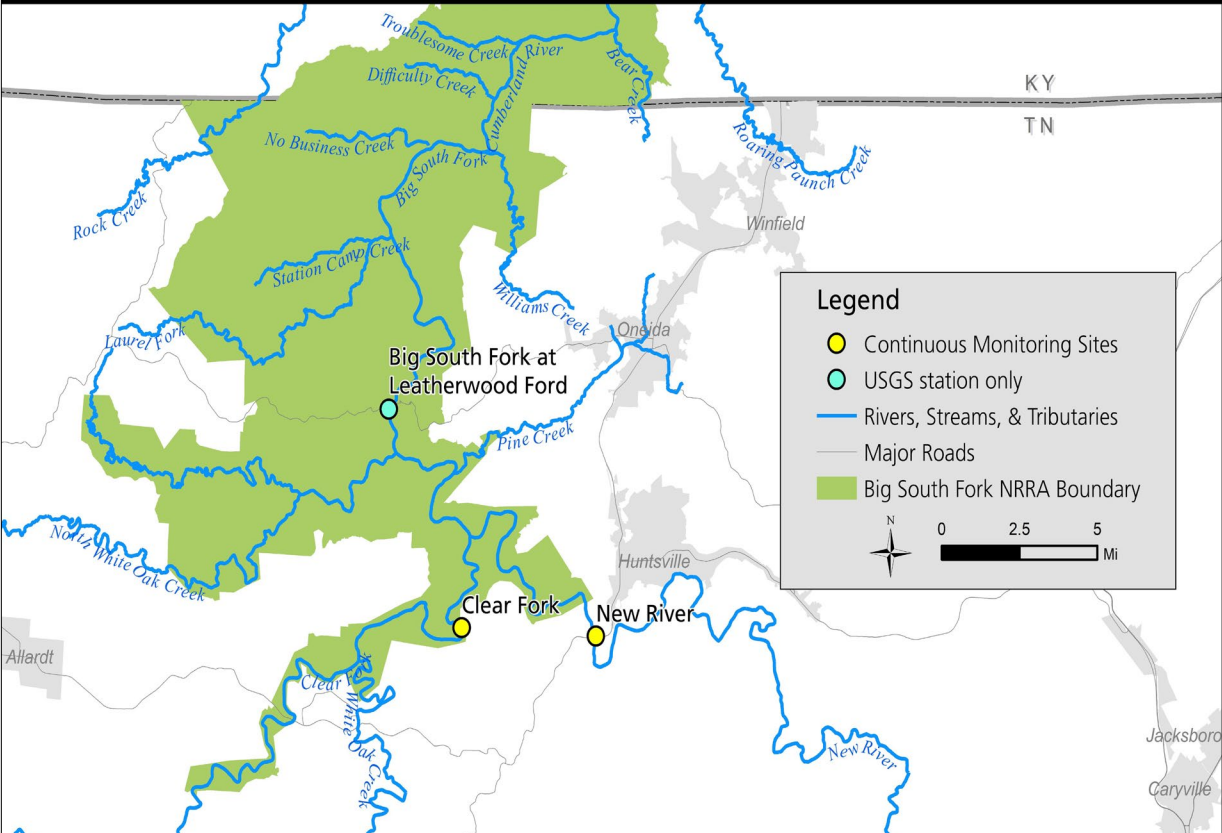


Figure 1. Map of the continuous monitoring sites and USGS stations at Big South Fork National River and Recreation Area.

Obed Wild & Scenic River

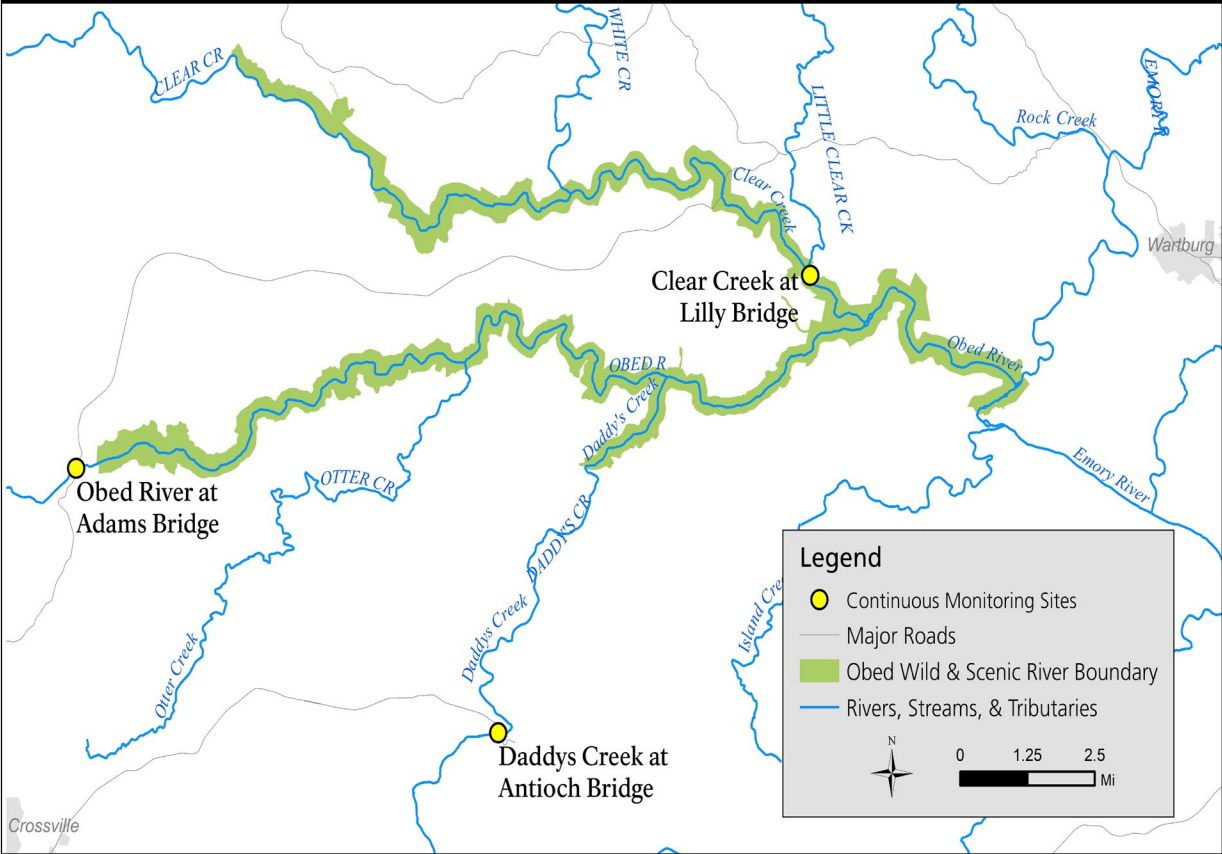


Figure 2. Map of the continuous monitoring sites at Obed Wild and Scenic River.

Water Year 2022

During water year 2022 (WY22), water quality sondes collected data at 30-minute intervals from October 1, 2021 to September 30, 2022 at five locations: two at Big South Fork NRRA and three at Obed WSR. At Big South Fork NRRA, the sondes were installed on the two main tributaries, New River at the New River Bridge and Clear Fork at Burnt Mill Bridge (see BISO map). At Obed WSR, the sondes were installed on the main stem of the Obed River at Adams Bridge, and the two main tributaries, Daddys Creek at Antioch Bridge and Clear Creek at Lilly Bridge (see OBRI map). Aggregating five water quality parameters across five sites, over 431,700 measurements were collected in WY22 and included in this summation (Figures 3–7).

There were nine violations of Tennessee State Water Quality Standards: two violations of dissolved oxygen, two temperature exceedances, one violation of the higher pH criteria, one below the lower pH criteria, and three violations in pH fluctuation standards.

Water temperature attained Tennessee state standards at most sites (<30.5°C/86.9°F) with the exception of two sites. At Clear Fork, temperatures exceeded this standard, reaching a maximum of 32.6°C during peak at mid-day, for 11 days in June and July (Figure 3). At Daddys Creek, temperature exceeded the standard for one day, reaching 30.9°C in July (Figure 4). Overall, mean temperature was 15.1°C, ranging from 0.2 to 32.6°C at all sites (Table 1).

Table 1. Minimum, maximum, and mean water temperatures for water year 2022. Values highlighted in red denote state water quality standard (< 30.5°C/86.9 °F) was not attained.

Site	Minimum (C°)	Maximum (C°)	Mean (C°)
Clear Fork	0.2	32.6	15.4
New River	0.6	30.2	15.5
Obed River	0.2	27.6	14.4
Daddys Creek	0.5	30.9	15.0
Clear Creek	0.6	30.4	15.2

All dissolved oxygen measurements were above Tennessee state standards of 5.0 mg/l, with the exception of two occurrences. At Clear Fork, dissolved oxygen declined below state criteria for seven nightly events during low flow in June 2022 and at Obed River there was one instantaneous event in September. However, mean dissolved oxygen levels at all sites indicate generally healthy conditions (Table 2).

Table 2. Minimum, maximum, and mean dissolved oxygen levels for water year 2022 at continuous monitoring sites. Values highlighted in red denote state water quality standard (> 5.0 mg/l) was not attained [mg/l=milligrams per liter].

Site	Minimum (mg/l)	Maximum (mg/l)	Mean (mg/l)
Clear Fork	4.78	14.28	9.78
New River	6.09	13.72	9.51
Obed River	4.50	14.10	9.84
Daddys Creek	5.64	13.89	9.74
Clear Creek	5.46	14.04	9.88

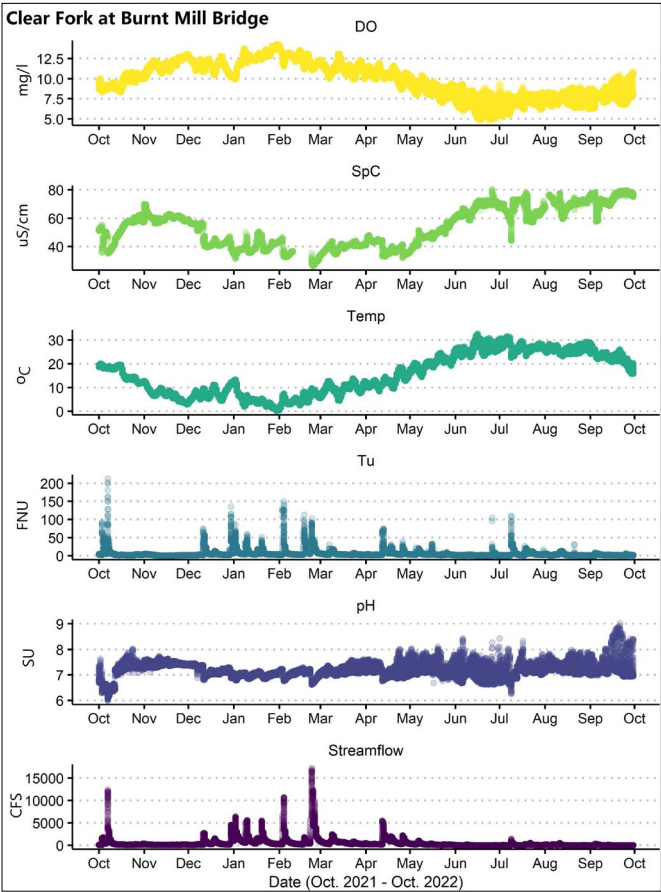


Figure 3. Continuous water quality data at Clear Fork.

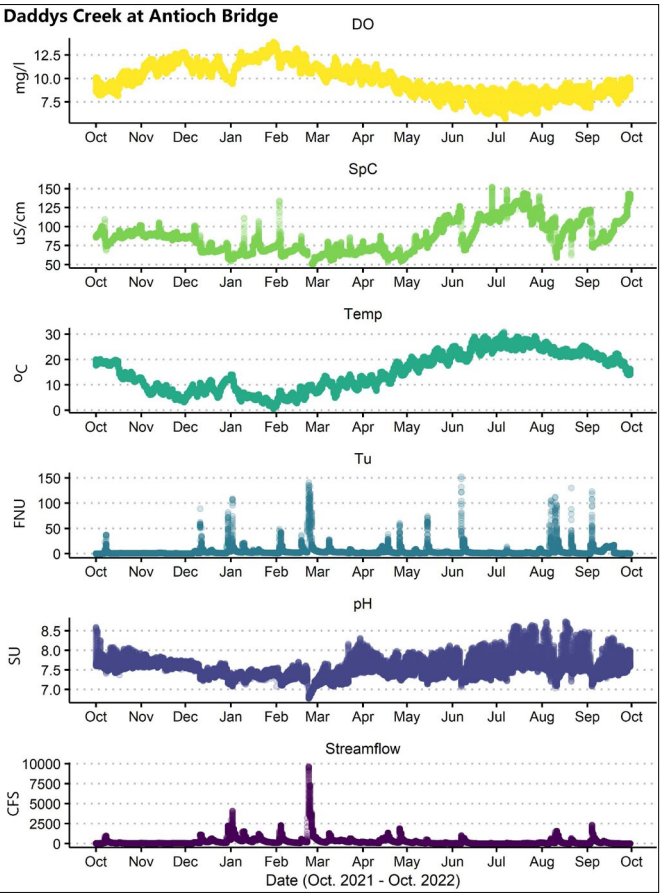


Figure 4. Continuous water quality data at Daddys Creek.

Water Year 2022 (continued)

Tennessee water quality criteria for fish and aquatic life states the pH value shall not be outside 6.0–9.0 in wadeable streams and not fluctuate more than 1.0 unit for 24 hours. There were two instantaneous events at Clear Fork where pH did not fall in the specified range; pH declined to 5.98 SU at the onset of a flood event in October 2021, and pH reached 9.02 SU (standard units) in September 2022 during low flow (Figure 3, Table 3). pH fluctuated greater than 1.0 SU in 24 hours at three sites; pH criteria was not attained for 45 days at Clear Fork, 21 days at Daddys Creek, and 26 days at Obed River. At Clear Fork, 24-hour changes in pH occasionally neared 2.0 SU.

Table 3. Minimum, maximum, and mean pH values for water year 2022 at continuous monitoring sites. Values highlighted in red denote state water quality standards (6.0–9.0 SU) were not attained [SU=standard units].

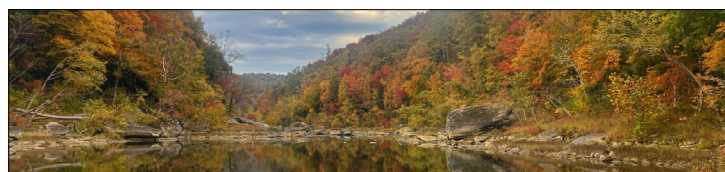
Site	Minimum (SU)	Maximum (SU)	Mean (SU)
Clear Fork	5.99	9.02	7.18
New River	6.89	7.95	7.48
Obed River	6.95	8.47	7.57
Daddys Creek	6.76	8.73	7.56
Clear Creek	6.10	8.14	7.07

There is no state standard for turbidity. Most sites were low except New River (Table 4). In WY22, New River had mean turbidity levels of 23 FNUs, and reached a maximum of 1,184 FNUs (Figure 5).

Table 4. Minimum, maximum, and mean turbidity values for water year 2022 at continuous monitoring sites. Values highlighted in red denote exceedances of natural reference conditions [FNU=Formazin Nephelometric Unit].

Site	Minimum (FNU)	Maximum (FNU)	Mean (FNU)
Clear Fork	0.3	213.0	6.1
New River	1.3	1,184.4	23.0
Obed River	0.0	179.4	5.6
Daddys Creek	0.0	152.8	4.6
Clear Creek	0.0	247.2	2.7

Natural reference conditions for specific conductance, as there are no state standards, are below 100 $\mu\text{S}/\text{cm}$ in the rivers on the Cumberland Plateau and below 50 $\mu\text{S}/\text{cm}$ in smaller streams (Table 5). At New River, specific conductance reached 350 $\mu\text{S}/\text{cm}$ and was above 200 $\mu\text{S}/\text{cm}$ for 46 days (Figure 5). At Obed River, specific conductance was above 200 $\mu\text{S}/\text{cm}$ for 16 days, and reached 270 $\mu\text{S}/\text{cm}$ (Figure 6). Low conductance (mean = 50 $\mu\text{S}/\text{cm}$) was observed at Clear Creek (Figure 7) and Clear Fork.



Clear Fork in the fall. NPS photo / APHN staff.

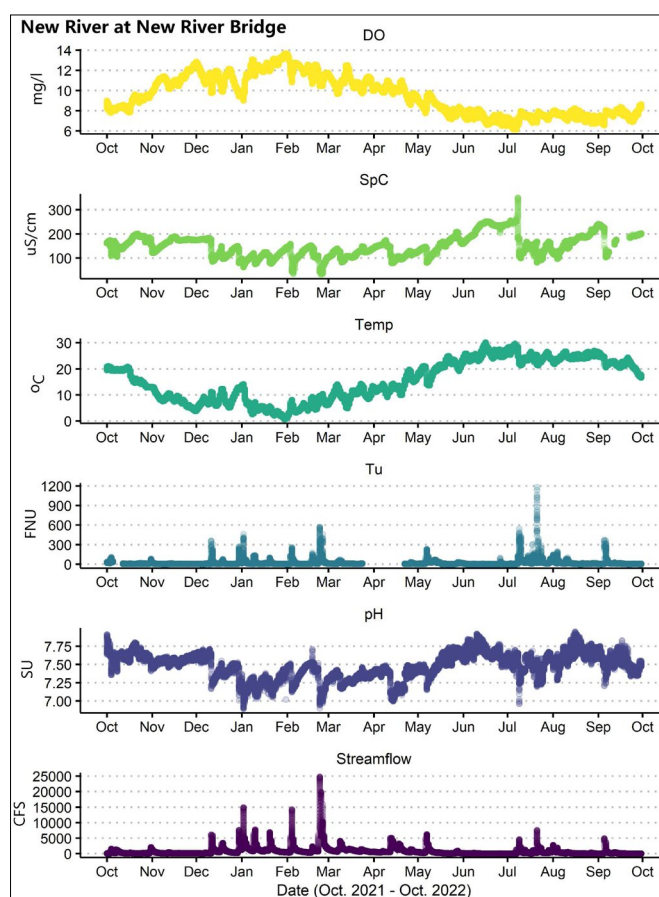


Figure 5. Continuous water quality data at New River.

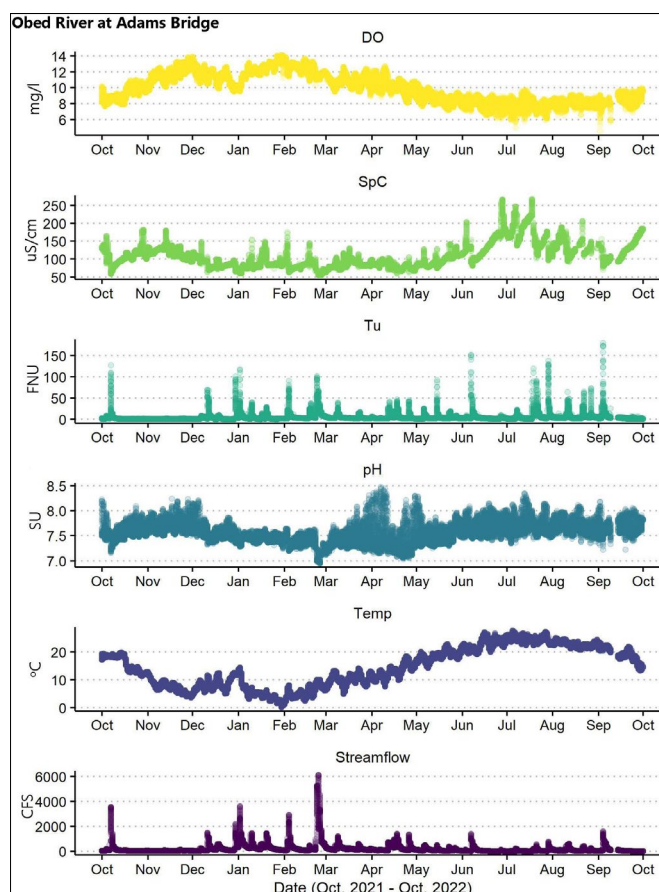


Figure 6. Continuous water quality data at Obed River.

Table 5. Minimum, maximum, and mean specific conductivity levels for water year 2022 at continuous monitoring sites. Values highlighted in red denote high exceedances of natural reference conditions [$\mu\text{S}/\text{cm}$ =siemens per centimeter].

Site	Minimum ($\mu\text{S}/\text{cm}$)	Maximum ($\mu\text{S}/\text{cm}$)	Mean ($\mu\text{S}/\text{cm}$)
Clear Fork	26.1	80.5	53.8
New River	31.0	350.9	150.4
Obed River	54.4	267.6	108.7
Daddys Creek	50.6	152.4	86.0
Clear Creek	25.1	64.4	43.0

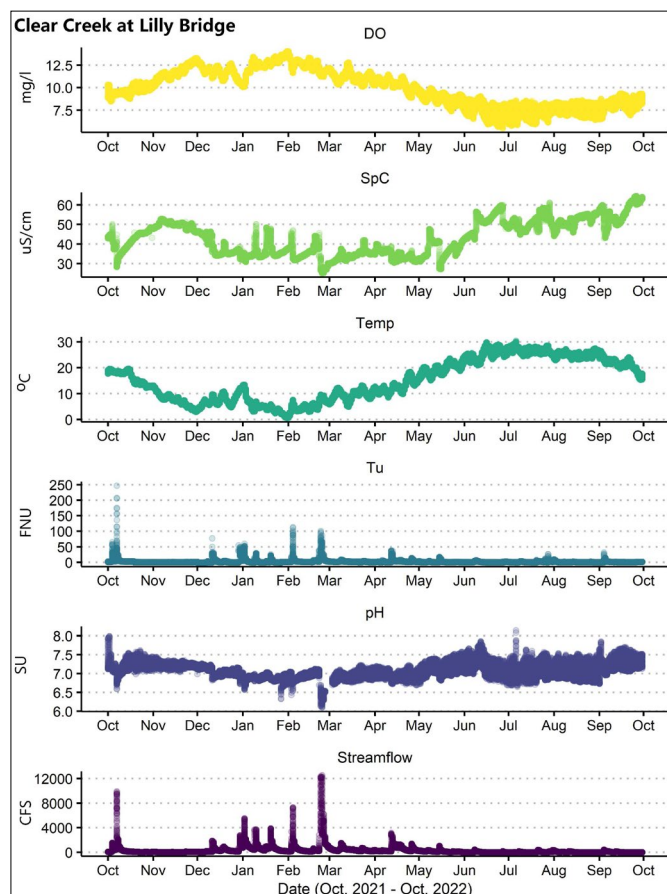


Figure 7. Continuous water quality data at Clear Creek.

Water Year 2022 (Continued)

Continuous water quality monitoring in Water Year 2022 indicated park waters were in good condition. However, there were short durations and events where conditions varied at the five monitoring sites. Clear Creek was demonstrative of near reference conditions and good water quality. New River continues to be the most heavily impacted watershed, influenced from historic resource extraction and current human activities. There are early indicators at Clear Fork and ongoing signs of human influence at Obed River that may warrant further assessment. The Obed River, from origin to the confluence with Daddys Creek, is on the TN 303d list for nitrogen, phosphorous, and *Escherichia coli* impairments stemming from probable collection system failures, urbanized high density areas, sanitary sewer overflows, grazing in riparian areas, and discharges from biosolids. In September 2020, a TMDL (Total Maximum Daily Load) was prepared by the



Site visit to Clear Fork Creek. NPS photo / APHN staff.

Tennessee Department of Environment and Conservation to address *E. coli* impairments in the Emory River watershed, including upstream of the Obed River (TDEC 2020). Daddys Creek is also on the 303d list, for mercury impairments attributed to atmospheric deposition.

Water quality data are available upon request to the Appalachian Highlands Network. Past water quality reports and briefs are available on the [Appalachian Highlands Network website](https://www.nps.gov/im/aphn/reports-publications.htm) (<https://www.nps.gov/im/aphn/reports-publications.htm>).

Literature Cited

- Hughes, J., R. Emmott, N. Murdock, P. Flaherty, and E. M. Raskin. 2018. Long-term continuous water-quality monitoring at Big South Fork National River and Recreation Area and Obed Wild and Scenic River: Protocol narrative. Natural Resource Report NPS/APHN/NRR—2018/1722. National Park Service, Fort Collins, Colorado. Available at: <https://irma.nps.gov/DataStore/Reference/Profile/2255929>
- Tennessee Department of Environment and Conservation (TDEC). 2020. *E. coli* TMDL Emory River Watershed (HUC 06010208). State of Tennessee, Department of Environment and Conservation, Division of Water Resources. Available at: <https://tdec.tn.gov/FileNetServices/FileNetServices/downloadfile/%7BB0DF7C6B-A1E8-C4FE-878F-752D1D400000%7D>

Appalachian Highlands Network

Emma Brinley Buckley, Hydrologist: emma_brinleybuckley@nps.gov

Brian Witcher, Program Manager

Amanda Monteverde, Hydrology Intern

Natalie Stone, Hydrology Intern

Evan Raskin, Biologist/Assistant Data Manager

Tim Fotinos, Data Manager

For More Information

[APHN Water Quality Monitoring](https://www.nps.gov/im/aphn/water-quality.htm)
(<https://www.nps.gov/im/aphn/water-quality.htm>)