

Small streams fuel big insights:

Volunteer monitoring in the Beaver Lake Watershed

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In Northwest Arkansas, Beaver Lake is a vital water resource, supplying drinking water to over 600,000 people—roughly one in every five Arkansans. It also supports outdoor recreation, agriculture, and economic growth in a rapidly developing region. The lake – an impoundment of the White River – is situated in a 1,186-square-mile watershed of forests, pastures, and urban areas, all on top of sensitive karst geology characteristic of the Ozarks. Water quality monitoring across this watershed is a vital pillar of the source water protection plan (SWPP) for Beaver Water District (BWD), the largest of four water utilities on the lake. However, comprehensive monitoring within the watershed is a task no single entity can accomplish alone.

To support monitoring efforts and engage community members, a volunteer-powered water quality monitoring program, StreamSmart, was established in 2013. StreamSmart is coordinated by nonprofit H2Ozarks in partnership with BWD and a state-certified laboratory, the Arkansas Water Resources Center (AWRC). For over 12 years, trained citizen scientists (Figure 1) have been collecting water samples at smaller creeks and streams across the watershed to establish a robust dataset on small tributary sites not monitored by other organizations.

The StreamSmart Citizen Science Program exemplifies how community engagement strengthens watershed protection. By combining volunteer effort with scientific oversight, StreamSmart provides a cost-effective, long-term approach to monitoring the health of Beaver Lake’s tributaries. The result, more than a decade later, is one of the longest and highest-resolution water



Figure 1. StreamSmart Program Manager, Ayla Grace, collecting a water sample during volunteer training.

quality datasets available for the streams that feed one of Arkansas’s most important drinking water reservoirs.

How the StreamSmart program works

StreamSmart manages 37 volunteers across 15 active monitoring sites, with volunteers sampling quarterly – in March, June, September, and December. Volunteers collect water samples (Figure

2) during baseflow conditions, and deliver them to the AWRC Water Quality Laboratory for analysis of the following:

- Total nitrogen (TN)
- Total phosphorus (TP)
- Total suspended solids (TSS)
- Total dissolved solids (TDS)
- Alkalinity
- Conductivity
- pH
- Turbidity



Figure 2. Two volunteers collecting water samples.

Volunteers also collect site observations, temperature, and measure dissolved oxygen (D.O.). During warmer monitoring periods in June and September, they use kick nets to collect and identify macroinvertebrates. These aquatic organisms are excellent indicators of water quality and are many volunteers' favorite aspect of the program. Uncovering small creatures like mayflies and water pennies from seeming obscurity provides the kind of up-close encounter with nature that many volunteers treasure.

All volunteers are trained and follow standard operating procedures outlined in a Quality Assurance Project Plan (QAPP), which ensures data consistency, accuracy, and reliability. These data are eligible for submission to state agencies and have been incorporated into watershed-scale planning efforts such as an EPA-approved Watershed Management Plan.

Volunteer engagement and retention

One of StreamSmart's most effective strategies for recruiting and retaining volunteers is through a strong relationship with the Northwest Arkansas Master Naturalists (NWAMN). The NWAMN is a local chapter of volunteer naturalists who educate and work to protect their local natural areas. H2Ozarks teaches a class to new master naturalist cohorts as part of



Figure 3. A group of new StreamSmart volunteers, many of whom are master naturalists, receiving training on macroinvertebrate identification.

their training curriculum. This class introduces participants to basic water quality concepts, and goes over the StreamSmart program, mission, and impact. Some Naturalists-in-Training choose to join as volunteers upon their graduation, helping sustain the program (Figure 3).

This partnership benefits both organizations. Master naturalists gain reputable educators, technical training, and a unique volunteer opportunity. StreamSmart gains a recurring pipeline of dedicated, passionate volunteers. Not all our volunteers are master naturalists, and our support ranges from college students to retirees, to curious citizens.

Retention, in any volunteer program, is as important as recruitment. The relatively low frequency of monitoring periods (once quarterly) prevents excess demand on volunteers' time which could fuel burnout or disengagement. We see that volunteers who understand their impact and are connected to a community will return year after year. Volunteers work in teams, rather than individually, to ensure their safety and support. We strive to communicate the value of the data they collect. Knowing that their efforts create impactful data used in real management decisions gives volunteers a sense of purpose. Most of our StreamSmart volunteers have been actively involved for many years, some since the program's inception (Figure 4).

Leveraging partnerships to sustain the program

StreamSmart's sustainability rests on strong partnerships. BWD funds the program, with a direct stake in its success: the data support their monitoring efforts and their SWPP. The AWRC provides laboratory infrastructure that is implausible for a small nonprofit to replicate. H2Ozarks provides staff to manage the program. Master naturalists promote the program to their volunteer network. Each partner contributes their expertise to the mutual benefit of one another.

This model – anchoring a volunteer monitoring program within a network of complementary organizations rather than operating independently – has proven successful and could be replicated for programs in other watersheds.

Data help answer questions in War Eagle Creek

The value of volunteer monitoring becomes most apparent when the data are put to work on a real problem. Within the Beaver Lake watershed flows War Eagle Creek (WEC), one of the most beloved waterways in Northwest Arkansas (Figure 5). WEC is known for its scenic bluffs, clear water, and a famous craft fair on its banks. It is also one of the largest tributaries flowing into Beaver Lake. In 2022, the Arkansas Department of Environment Quality (ADEQ) added



Figure 4. A team of StreamSmart volunteers, self-named the “Stream Muskateers.”

Figure 5. War Eagle Creek, Site Photo Taken by a StreamSmart Volunteer, May 2025.

WEC to its 303(d) list of impaired waterways for low D.O. (ADEQ, 2022). Dissolved oxygen is like breathable air for fish, mussels, and other aquatic life. When oxygen levels drop too low, these aquatic organisms struggle to survive. Low D.O. can occur when excess nutrients like nitrogen and phosphorus enter waterways and cause excess algal growth. ADEQ hasn’t fully determined the cause or the subwatersheds contributing most to War Eagle Creek’s impairment, listing it as agricultural and unknown (ADEQ, 2022).

Meanwhile, StreamSmart volunteers have been monitoring six sites in the WEC subwatershed since 2013 – one on the creek itself and five on the smaller streams that drain into it. That tributary-level resolution is the program’s advantage. State monitoring programs typically sample at larger mainstem sites but cannot trace nonpoint source pollution back to individual headwaters or smaller tributaries. StreamSmart data can help pinpoint potential hotspots for nutrient loading.

To analyze the StreamSmart data, linear regression analyses were used to evaluate trends in nutrient concentrations

over time (Figures 6 and 7). For all statistical analyses, a p-value of ≤ 0.05 was considered statistically significant. Overall, StreamSmart data does show clear and statistically significant trends: nitrogen and phosphorus concentrations are increasing at several tributary sites.

At Glade Creek, total nitrogen has nearly doubled since monitoring began in 2013, rising from roughly 2.5 mg/L to close to 5 mg/L. Total phosphorus at the same site has more than tripled. Clear Creek shows statistically significant increases in both nutrients as well. These trends are consistent with nutrient enrichment that can fuel excessive algal growth, deplete D.O., and degrade the aquatic life that WEC is designated to support.

The sources of these increases are still being investigated. It’s well understood that land use impacts water quality, but by its very nature, nonpoint source pollution is difficult to trace (H2Ozarks, 2025). StreamSmart’s data provide key benefits by capturing local, high-resolution insight at headwaters sites. These tributaries can show the earliest signs of potential issues. StreamSmart data can turn a broad,

watershed-wide concern into a set of specific locations to prioritize. Over time, as the data set grows, StreamSmart’s value will only increase.

The broader value of volunteer monitoring

StreamSmart’s role in monitoring in the Beaver Lake Watershed illustrates several principles that can apply broadly to other volunteer monitoring programs: First, citizen scientists and volunteers produce valuable scientific data that supports other agencies’ work. StreamSmart’s QAPP ensures data meet the criteria for inclusion for some management decisions. Across the Beaver Lake watershed, there are 94.5 miles of impaired waters (ADEQ, 2022). As in War Eagle Creek, understanding what is driving those impairments requires data throughout the system, not just at mainstem sites. Citizen scientists can generate data that agencies and managers rely on.

Second, the StreamSmart program is not driven by a single group, but through many strong and dedicated partnerships. It exists because many organizations and volunteers bring their skills and expertise

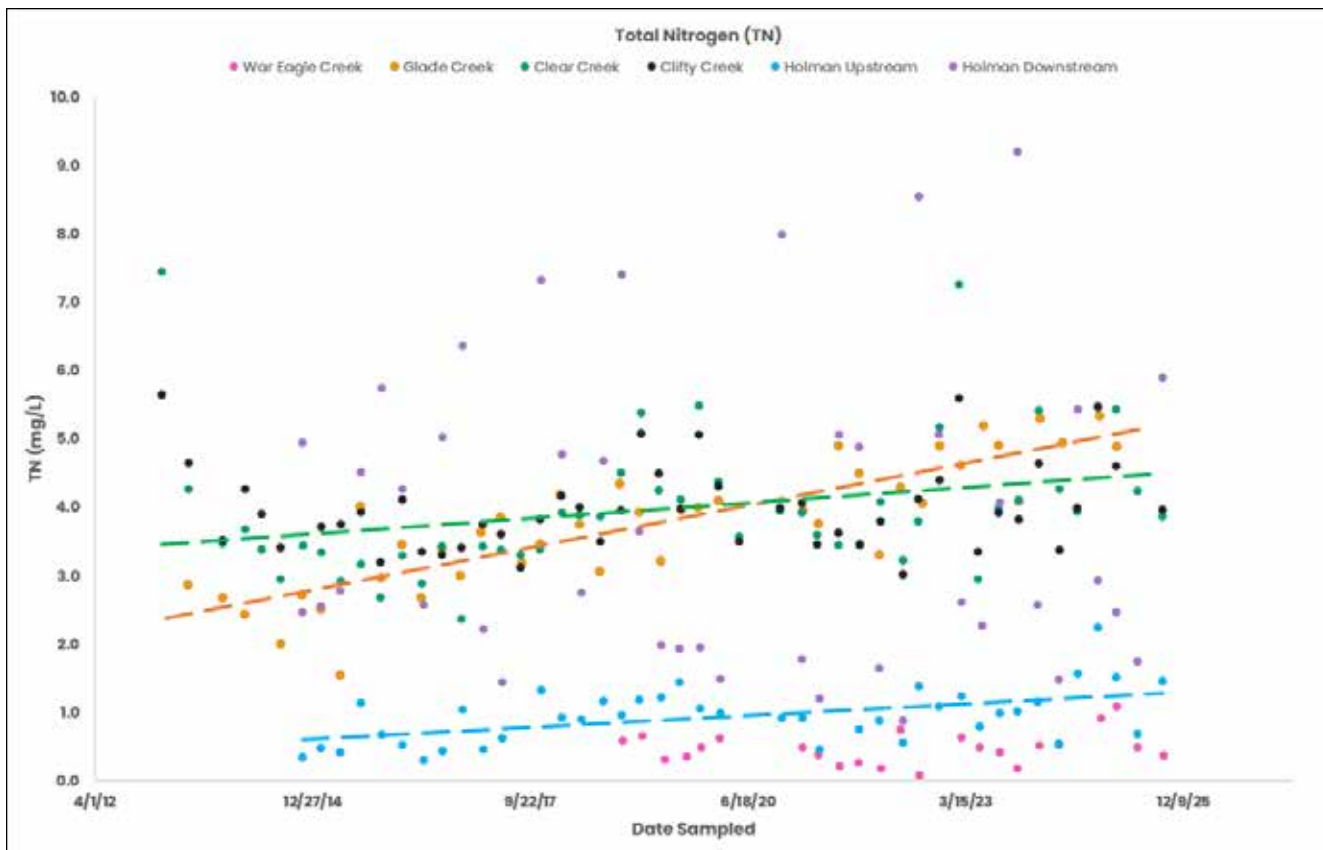


Figure 6. Total nitrogen concentrations over time at each site in the WEC subwatershed. *Dashed lines indicate statistically significant increases over time.

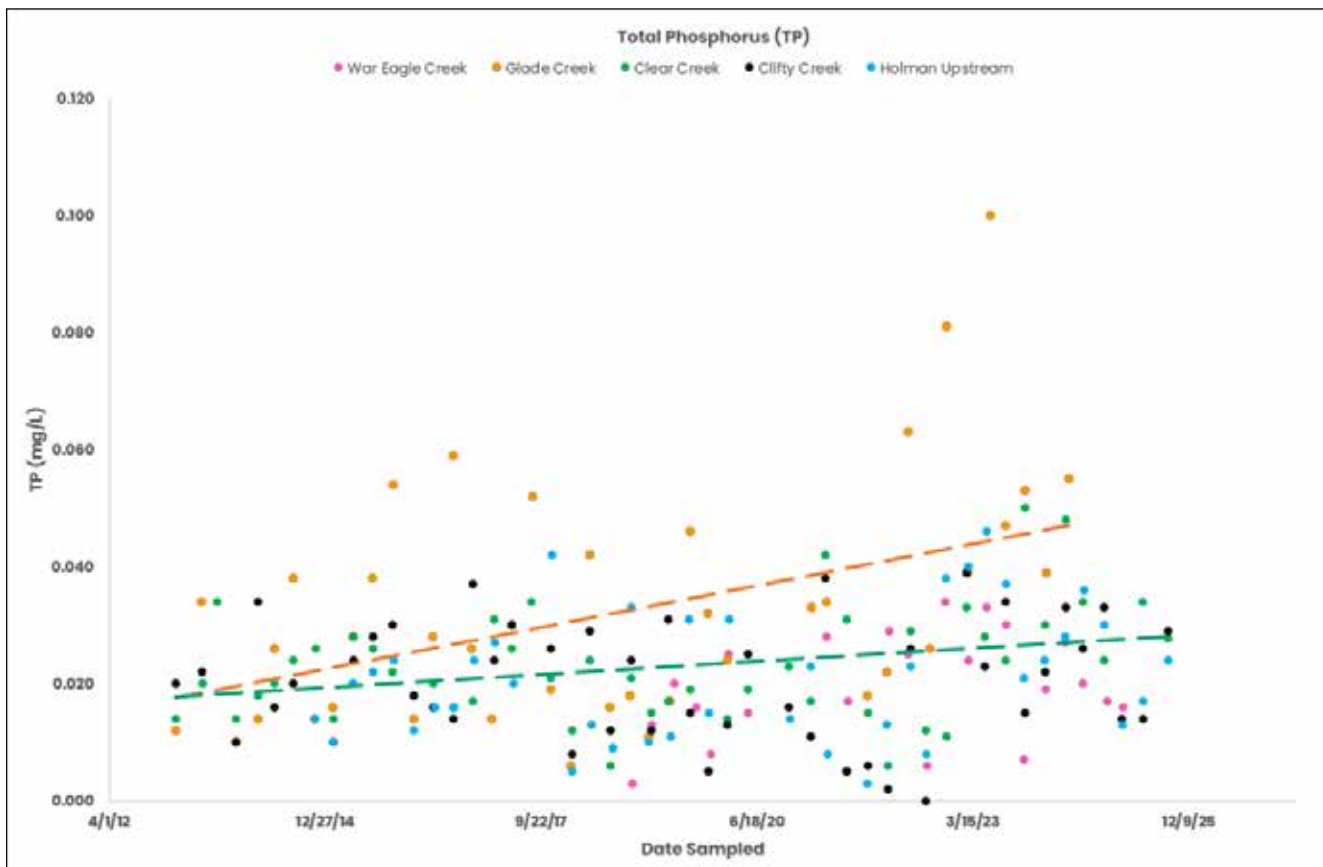


Figure 7. Total phosphorus concentrations over time at each site in the WEC subwatershed. *Dashed lines indicate statistically significant increases over time. **Holman Downstream had such high phosphorus values (0.024-1.042 mg/L) that it was removed to prevent axis distortion.

to benefit one another. These relationships are what make the program possible. Third, community investment in volunteer monitoring becomes an investment in water quality broadly. Volunteers who spend years watching a stream change develop a relationship with it that no agency can replicate. They notice changes. They talk to their neighbors. They show up to public meetings. That first spark of interest in a volunteer program can grow into a community of strong advocates for watershed protection.

As Northwest Arkansas continues its rapid growth, the pressures on Beaver Lake and its watershed will only increase. StreamSmart, strengthened by dedicated volunteers and partners, is positioned to track those changes and help managers respond to them.

For lake and watershed managers interested in launching or strengthening a volunteer monitoring program, StreamSmart offers a replicable model – one with strong partnerships, robust protocols, and data that make a difference. To learn more, visit www.H2Ozarks.org/arkansas-streamsmart.

References

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Erin Scott joined H2Ozarks in 2020 as their Senior Policy and Program Director. Previously, she spent several years working at the Arkansas Water Resources Center at the University of Arkansas and is currently pursuing her PhD in Public Policy. Having spent most of her life in Fayetteville, Erin is passionate about protecting water and environmental quality for the community. She enjoys spending time outdoors with her husband and two children.




Ayla Grace is the StreamSmart Program Manager and joined H2Ozarks in late 2024. Prior to H2Ozarks, she split her career between water quality research and public education. She obtained a Master of Science in Biology, focusing her research on aquatic ecology, and a Master of Arts in Education from the University of Arkansas. In her free time, Ayla enjoys spending time with her family, gardening, coaching, and traveling to National Parks.




Olivia Schaap joined H2Ozarks in early 2025 as their Content Coordinator. Her background is in communications within the water industry, and she takes deep interest in translating complex water topics into accessible and actionable stories for communities. She graduated from the University of Arkansas in 2022 with an English degree. Olivia joined the Northwest Arkansas Master Naturalists chapter in 2025. ✨





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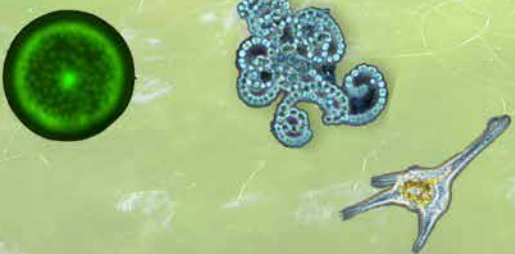

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