

# WATERSHED ALLIANCE OF ADAMS COUNTY SUMMER 2022 PATHOGEN-TESTING INITIATIVE

## Introduction

Most people know it can be unsafe to drink unfiltered water out of a stream or lake, even if the water is visibly clear. This is true almost anywhere, including Adams County. Places where public swimming is encouraged are required to test the water to make sure it isn't overly contaminated. But in Pennsylvania we have many waterways—more than 1,000 miles in Adams County alone—and most of them are not tested regularly.

Many common animal pathogens are invisible to the eye, but can cause sickness in humans, sometimes even death. Generally, these pathogens come from inside the guts of animals like humans, cows, deer, etc. They get into the water mainly through feces, or from dead animals.

The usual way people become infected with pathogens is by ingesting contaminated water. However, some pathogens can enter your bloodstream through cuts or sores on your skin. People often get infected swimming in a polluted river or lake, especially during warm months.

In 2020 the Watershed Alliance board of directors received a report that one of Adams County's popular fishing creeks appeared to have high levels of *E.coli*. That same year another source told us that someone had become ill after entering the water at a different popular fishing spot.

These reports led us to begin looking into the issue of pathogen levels in our waters, particularly the areas where we fish, play, or swim. Our first efforts were centered on the biannual [Water Quality Monitoring Report](#) produced by the Pennsylvania Department of Environmental Protection (PADEP), which is truly an impressive amount of work and contains a wealth of valuable information. Unfortunately, we found that there wasn't much recent information in this report about Adams County's streams with respect to recreational use. Pennsylvania has an enormous number of creeks and streams, which makes it very difficult for the PADEP's information to be as comprehensive and up-to-date as one would like.

With this in mind, in 2021 we began an effort to see if we could collect bacteriological data ourselves. In August and September, we conducted a pilot sampling program in which two volunteers collected stream-water samples at five locations, with each site sampled five times, following [PADEP Water Quality Monitoring Protocols](#). We had [Laboratory, Analytical, and Biological Services, Inc. \(LABS\)](#) in New Oxford analyze the samples for *E.coli*. The [Adams County Conservation District](#) helped us obtain favorable fees from the lab, and Watershed Alliance board members donated funds to cover the costs.

At two of these original sampling sites, we found average pathogen levels that met the state's Water Quality Standards<sup>1</sup> for Water Contact Sports Recreation. These were at the Conewago Creek at the Conewago Creek Campground just northwest of Arendtsville, and Swamp Creek at the first trail crossing from Strawberry Hill Nature Center.

However, at the other three sites we sampled, we found average pathogen levels that did not meet the state's Water Quality Standards for Water Contact Sports Recreation because of pathogens. These sites were at Toms

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<sup>1</sup> <https://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/025/chapter93/s93.4.html>

Creek in Carroll Valley Park, the Conewago Creek fly fishing area along Narrows Road, and Middle Creek at Gordon Road.

These results were interesting enough that we felt it worthwhile to seek funding to pursue a more extensive bacteriological sampling project, and we were aided by a grant through the [South Mountain Partnership](#), for which we are deeply grateful.<sup>2</sup>

Through this grant, we were able to conduct an expanded bacteriological sampling project in August 2022. A corps of volunteers collected stream-water samples from 21 sites across Adams County where folks like to fish, wade, swim, or otherwise play in the water. We again followed PADEP's water-quality monitoring protocols, and again LABS in New Oxford analyzed our samples for the presence of *E.coli*.

The data we've captured to date appear to validate the anecdotal reports we had received regarding pathogen issues in some of Adams County's waters. The data also appear to warrant follow-up efforts in the coming year, assuming we can find funding sources to help cover the costs of lab work.

Why test for *E.coli*? *E.coli* is one of many different kinds of fecal coliform bacteria, and like all such bacteria occurs naturally in the digestive tract of humans and other mammals, where it aids in the digestion of food. Fecal coliform bacteria such as *E.coli* are also excreted in the feces of humans and other mammals, which is how they make their way into our streams and rivers. *E.coli* can be washed into our streams through agricultural or stormwater runoff, through failing or inadequate septic systems, and through animal feces deposited directly in the stream, which happens naturally among wild animals, but is exacerbated when herd animals are allowed open access to streams. An animal dying in a stream is another possible source of *E.coli* contamination downstream. It's important to note that *E.coli* and other fecal coliform bacteria do not necessarily cause disease (i.e., they are not necessarily *pathogenic*). However, *E.coli* is considered an *indicator bacterium* because it typically occurs in association with more pathogenic organisms. Thus, the higher the *E.coli* levels in water, the greater the risk of humans becoming ill. (Of course, there are species of *E.coli* that are dangerous to varying degrees.<sup>3</sup>)

## Results at a Glance

Of the 21 sites we sampled, 4 are "attaining" and 17 are "not attaining" for Water Contact Sports Recreational Use based on *E.coli* geometric means. This means that 4 sites met PADEP's Water Quality Standards for recreational use, 15 did not, and 2 require more study. In other words, the sites "not attaining" for recreational use are considered impaired because of pathogens. The bacteriological data will be submitted to PADEP for inclusion in the 2024 Pennsylvania Integrated Water Quality and Assessment Report.

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<sup>2</sup> The Watershed Alliance's pathogen-testing project was financed in part by a grant from the Community Conservation Partnerships Program, Environmental Stewardship Fund, under the administration of the Department of Conservation and Natural Resources, Bureau of Recreation and Conservation. The grant was awarded through the South Mountain Partnership, with management oversight by the Appalachian Trail Conservancy.

The Watershed Alliance of Adams County is a partner of the South Mountain Partnership, an alliance of organizations working to preserve and enhance the cultural and natural assets of the South Mountain Landscape in Central Pennsylvania. To learn more about the South Mountain Partnership, visit [SouthMountainPartnership.org](https://SouthMountainPartnership.org).

<sup>3</sup> <https://ask.usda.gov/s/article/Dangers-of-E-coli>

## Data Collection Protocol

### *Volunteer Recruitment and Training*

We recruited volunteers via press releases, newsletters, and direct outreach with the help of [Adams County Trout Unlimited](#) and [Friends of Toms Creek](#). We ultimately recruited 15 volunteers to help us do the sampling. We produced training handouts for the volunteers and held two training sessions. We maintained communication with the sampling volunteers throughout the project, providing them with weekly updates as the results came in. Without the volunteers we could not have completed this project, and we're deeply grateful for their help.

### *Field Methods*

Following PADEP bacteriological data collection protocol, we focused on 21 stream locations throughout Adams County. Altogether we collected stream samples from 10 streams. We followed this guide in hopes that our data will be of some use to PADEP, and because it agrees with the advice from the federal Environmental Protection Agency that we were able to find online.

During the month of August, we sampled each site at least 5 times, several days apart. Each week, our volunteers collected their samples within a day or so of each other. They brought their samples, in coolers on ice, to the Adams County Agricultural and Natural Resources Center in Gettysburg, where another volunteer transported the samples to LABS in New Oxford for analysis. The samples were kept on ice from the point of collection, stream-side, through their delivery to the lab, and were delivered to the lab well within the time limit required by our protocol. We recorded each sample's result and calculated the geometric mean of the samples for each site.

The result for each sample is presented as Most Probable Number of Colony Forming Units per 100 milliliters (MPN/100mL). The convention is to refer to the result as Colony Forming Units per 100 milliliters (CFU/100mL).

In addition to the total of 105 samples tested (21 sites, each tested 5 times) we performed eleven other samples for quality assurance purposes:

1. *Field blank samples:* We collected, labeled, and submitted 5 field blank samples that contained autoclaved sterile water following the same procedures as the environmental stream samples. The laboratory results showed less than 1 CFU/100mL in each of these samples. We thank PADEP for providing us with the autoclaved sterilized water.
2. *Duplicate samples:* We collected, labeled, and submitted 6 duplicate samples on six occasions following the same procedures as the environmental stream samples. In each case the duplicate sample results were similar to the environmental sample, although not exactly the same.

## Detailed Results

The Pennsylvania Code Title 25. Environmental Protection, Chapter 93. Water Quality Standards, section 93.7 Specific water quality criteria for Water Contact Sports is:

(*Escherichia coli* colony forming unit per 100 milliliters (CFU per 100 ml)) During the swimming season (May 1 through September 30), the maximum *E. coli* level shall be a geometric mean of 126 CFU per 100 ml. The geometric mean for the samples collected in the waterbody should not be greater than 126 CFU per 100 ml in any 30-day interval. There should not be greater than a 10% excursion frequency of 410 CFU per 100 ml for the samples collected in the same 30-day duration interval. (Fecal coliforms/100 ml) For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 CFU per 100 ml based on a minimum of five consecutive samples collected on different days during a 30-day period.<sup>4</sup>

PADEP's bacteriological assessment method states a site is "attaining" when the *E. coli* geometric means is less than 126 CFU/100mL. A site is "not attaining" when *E. coli* geometric mean is greater than 126 CFU/100mL. A site is considered not meeting criteria when 10% of sample results are greater than 410 CFU/100mL. These sites require additional samples and information before an assessment decision is made.

Table 1 provides the site locations and *E. coli* geometric means. The "Site #" is internal to the Watershed Alliance for our record-keeping. We give a brief "Site Description" and then the latitude/longitude coordinates, so each site should be easy to find. We collected samples during August 2022, when weather is typically warmest and people are most likely recreating in our creeks and streams.

The four sites highlighted in green were the only ones for which the five samples returned a geometric mean less than 126 CFU/100mL and had no single sample measure above 410. These are the PADEP (and EPA) criteria for water being designated **attaining** for recreational use.

The two sites highlighted in light yellow returned geometric means less than 126 CFU/100mL, but one sample was above the 410 CFU/100mL limit, which means that the PADEP and EPA would consider these waters **possibly not attaining** for recreational use, **with further study required to make a determination.**

The five sites highlighted in deep yellow have geometric means between 130 and 200. Three also had at least one measurement greater than the 410 CFU/100mL limit. These sites are considered **not attaining** for recreational use and impaired from pathogens.

The ten sites highlighted in red have geometric means greater than 200, and all ten also had at least one measurement greater than the 410 CFU/100mL limit. These sites are clearly **not attaining** for recreational use and are impaired because of pathogens. Unfortunately, we observed very high recreational use by the public at several of these sites during our sampling and at other times. The three locations with the highest *E. coli* results are very popular recreational areas. (Anonymized raw data are available upon request to [adamswatersheds@gmail.com](mailto:adamswatersheds@gmail.com).)

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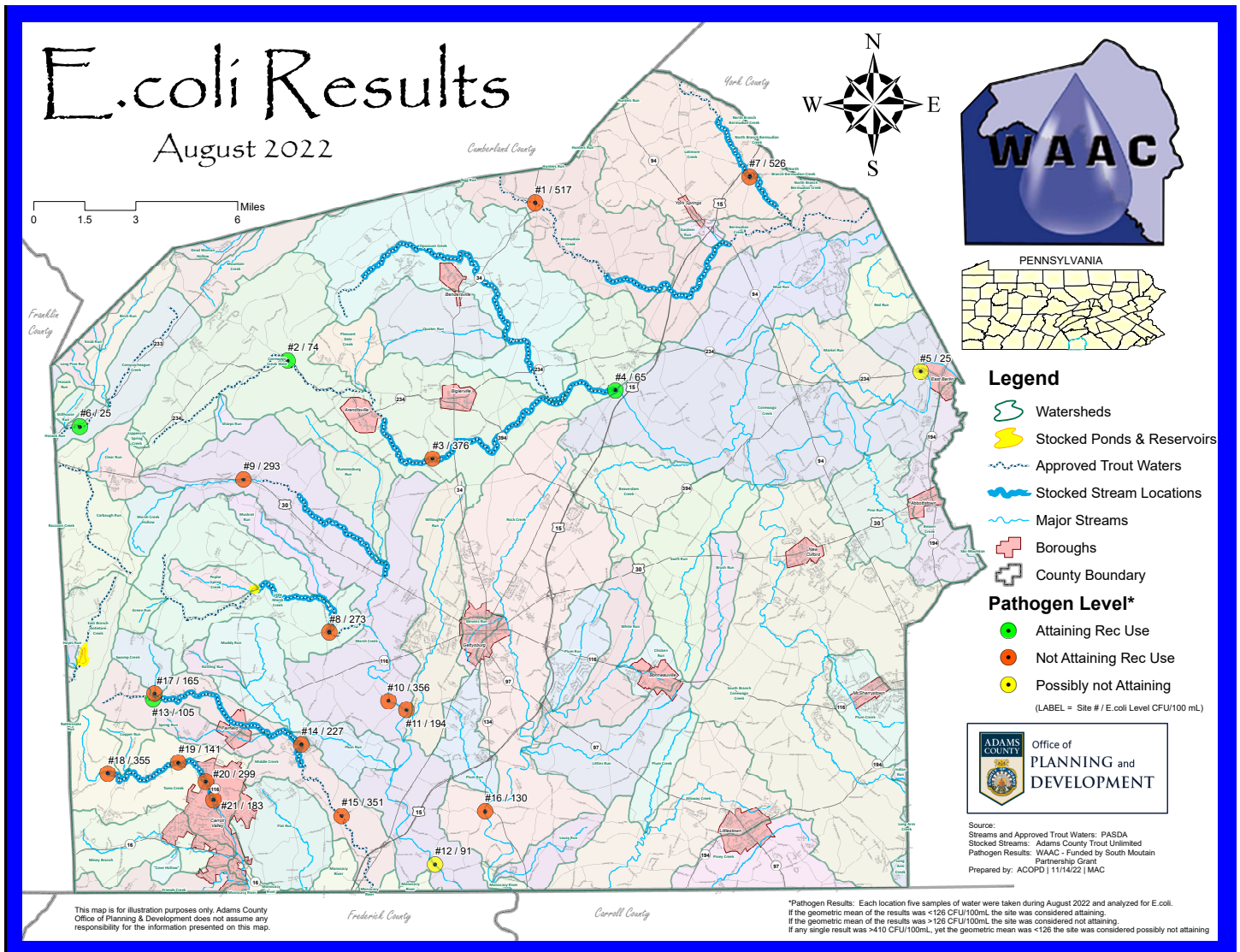
<sup>4</sup> See Commonwealth of Pennsylvania, Pennsylvania Code Title 25. Environmental Protection, Chapter 93. Water Quality Standards, section 93.7, [online](#).

**Table 1: Adams County Watershed Alliance Bacteriological Sites and *E.coli* geometric means.**

Site #	Site Description	Site Location: Lat, Long	<i>E.coli</i> CFU/100mL Geometric Mean
<b>Best Four—Attaining Recreational Use in August, 2022</b>			
6	Conococheague below drained reservoir	39.918741, -77.455400	25
4	Conewago Creek Game Lands	39.933185, -77.158919	65
2	Conewago Creek Campgrounds	39.946562, -77.340207	74
13	Middle Creek at Strawberry Hill	39.802465, -77.415365	105
<b>Low Means, One High Sample—Status Unclear for Recreational Use in August, 2022</b>			
5	Conewago Creek East Berlin	39.940166, -76.989900	25
12	Marsh Creek below Natural Dam	39.73143, -77.26018	91
<b>Five Middling—Not Attaining Recreational Use in August, 2022</b>			
16	Rock Creek	39.753939, -77.232347	130
19	Toms Creek at old Swimming Hole	39.775353, -77.401602	141
17	Swamp Creek at first path crossing	39.804907, -77.414576	165
21	Toms Creek at Carroll Valley Park	39.759381, -77.382254	183
11	Marsh Creek at Sachs Covered Bridge	39.79744, -77.27550	194
<b>Ten Worst—Not Attaining Recreational Use in August, 2022</b>			
14	Middle Creek near Stoops Road	39.782867, -77.333653	227
8	Little Marsh Creek at Iron Bridge	39.830637, -77.317838	273
9	Marsh Creek at Lions Club Area	39.89595, -77.36491	293
20	Toms Creek at Covered Bridge	39.767181, -77.386421	299
15	Middle Creek at Gordon Road	39.752234, -77.311597	351
18	Toms Creek above Mt. Hope Road Bridge	39.770826, -77.440634	355
10	Marsh Creek near Scott Road	39.80120, -77.28544	356
3	Conewago Creek Fly Fishing Area	39.904465, -77.260329	376
1	Bermudian Creek at Old Carlisle Road	40.013226, -77.202653	517
7	Latimore Creek	40.023762, -77.083770	526

We are particularly concerned with the 10 worst sites, because we believe the public interacts heavily with these waters. The three very worst sites are very popular fly fishing locations, and our volunteer samplers noticed many people in the water at all three places every time they visited. Most of the other top ten sites seem to be popular places for fishing and other recreational activity.

The map below shows how our volunteer team traveled all over Adams County to gather samples.



## Discussion

As mentioned above, a waterbody is considered attaining for Water Contact Sports Recreational use when the *E. coli* geometric mean is less than 126 CFU/100mL. Our data show that only 4 of 21 sites are attaining for recreational use during the month of August 2022, which is sobering and disappointing.

It's worth noting that we intentionally chose to conduct our testing during the month of August, when our waters are typically at their warmest and their lowest flow, as well as when we expect the heaviest period of recreational use. (These are *summery* as well as *summary* results.)

It's also worth noting that we observed very high variances across our samples at several of the sites throughout the month. Some of the sites were quite consistent, but others were startling in their variability. For example, Marsh Creek at Sachs Covered Bridge tested as low as 36 CFU/100mL (week 5) and as high as

1,414 CFU/100mL (week 3). Conewago Creek at East Berlin varied between 2 CFU/100mL and 451 CFU/100mL. We are not sure what to make of this wide variation; we need to investigate further.

After obtaining our initial results, we decided to follow up with more testing sites on the Conewago, with the idea that we might be able to identify possible sources of pathogens. Unfortunately, the weather turned cold much earlier than we expected, and we did not get enough samples to draw conclusions.

These results seem to indicate a need for follow-up testing to try to understand the pathogen problems in Adams County streams. With a clearer understanding we hope we can help find mitigation measures to improve our streams.

An important matter to keep in mind is that *E.coli* is referred to as an *indicator bacterium* and is not necessarily harmful by itself. During sampling we observed many people interacting with the water at several sites, yet our hospitals do not seem to be full of people who have become sick from playing in our waters. We would like to pursue follow-up testing to see if we can differentiate between different levels of impairment at various sites. This may not be affordable or practical to do widely, but we will investigate. **In the meantime, the public should be aware that there may be invisible pathogens in many of our creeks and streams.**

Another observation that we made during this study is that the *E.coli* levels varied in ways that were unexpected to us. For example, the Conewago Creek had low levels at the most upstream location, high at the next location downstream, and low again farther downstream. It appears that bacteria concentrations can be diluted as they are carried downstream, and can vary widely from site to site.

According to the EPA's [2021 fact sheet on \*E.coli\* contamination](#), if the geometric mean of a series of water samples measures over 126 CFU/100mL, 36 people out of every 1,000 who come into contact with the water may become ill. (Note: Results are reported as Most Probable Number of Colony Forming Units per 100 milliliters (MPN/100mL) and often written as CFU/100mL.)

We have seen water-quality studies that use different numeric criteria (both higher and lower). We used 126 CFU/100mL to be in keeping with PADEP's criteria for water contact sports recreational use.

Without further analysis we cannot say exactly how risky it would be for people to be recreating in any of the waters we tested. The greater the pathogens in waterbodies, the greater the risk of illness. One of our main goals was to be able to inform the public of the facts as we found them, so that each person can make an informed decision about how they use Adams County waters.

## Next Steps

Next year we would like to choose a small number of sites and focus more resources on them to see what we can learn. We plan to focus on places where we observed the highest use by the public, and which also had the highest levels of *E.coli*.

We think we should spread the analysis over a longer period of time, possibly sampling weekly from May to September, to develop a better understanding of the contamination profile and how it changes with respect to temperature and water levels.

We also think we should sample sites upstream of the popular locations to help narrow down where pollutants may be entering the water.

Finally, we would like to learn as much as we can about what pathogens are actually present in the water, and just how risky the water is for people to recreate in. Ideally this will involve DNA analysis of the samples, which will tell us the source of the pathogens in the samples. For example, did the *E.coli* come from human waste (which might point to failing septic systems), storm water and storm drains, cattle (which might point to improper grazing and manure practices), or deer or other animals?

If we succeed, we should be able to give the public more information about potential risks of recreating in some popular spots in Adams County streams. Ideally, we can help inform efforts to mitigate pathogen pollution as well.

## Acknowledgements

### *Volunteers*

We offer our gratitude to these volunteers, and others who have requested not to be included in this list: Richard Bates, Cliff Frost, Jeff Glahn, Joan Horak, Robin Hsu, Bill Koch, David Kuhn, Richard Lewis, Chris Little, Rich Luquette, Kay MacDowell, Hugh Matthews, John Messeder, Pat Naugle, Bruce Rowland, Russell Stewart, Deb Wentling, and Blythe Woods.

### *Partner Organizations*

We also offer our gratitude to our partner organizations:

- The [Adams County Conservation District](#) provided valuable advice and feedback, as well as access to their volume discount on laboratory testing.
- [Adams County Trout Unlimited](#) provided valuable advice, feedback, outreach for volunteers, and information distribution.
- [Friends of Toms Creek](#) provided valuable advice, feedback, outreach for volunteers, and information distribution.
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- [Pennsylvania Department of Environmental Protection, Bureau of Clean Water, Water Quality Division.](#)