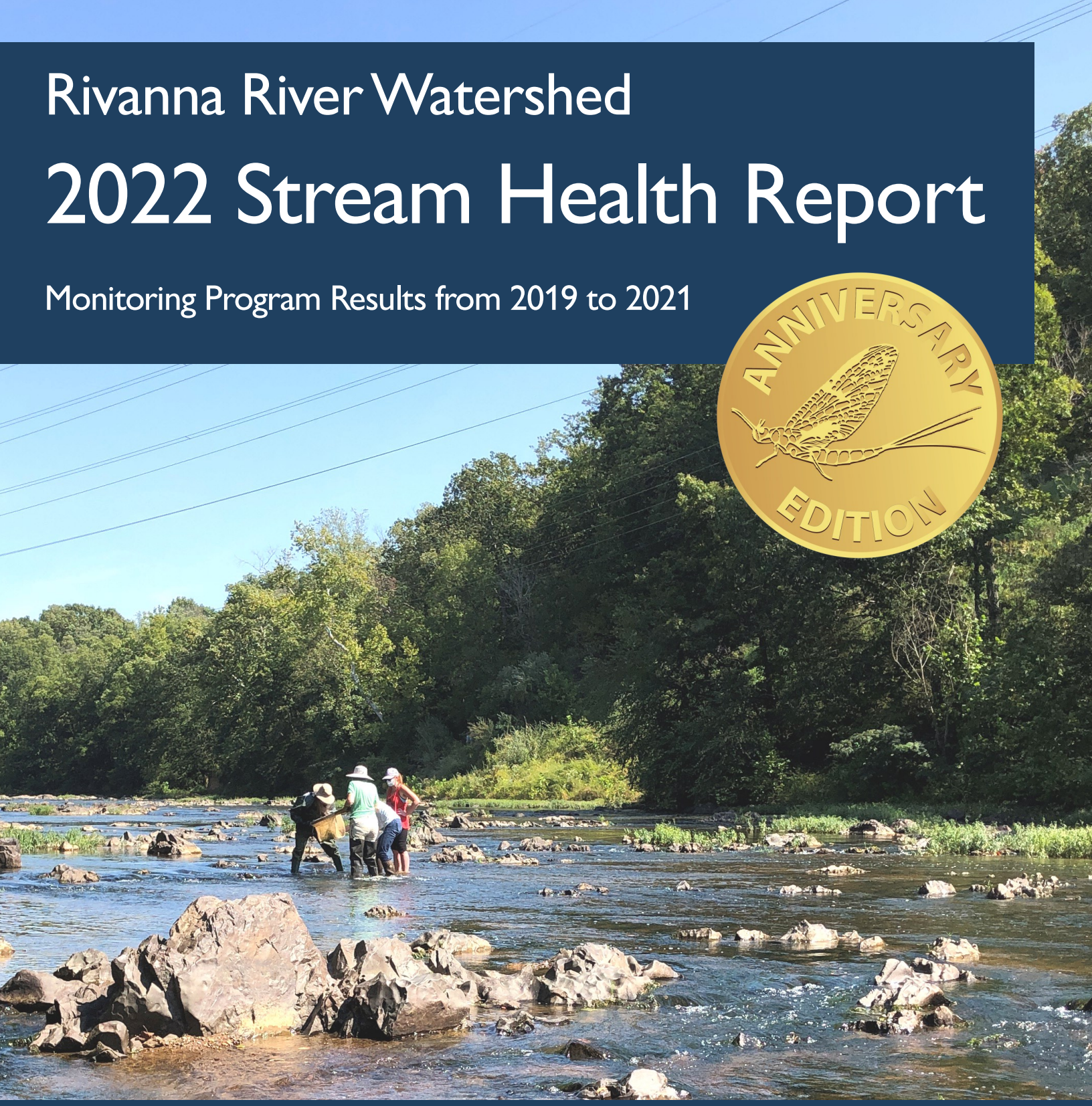
Rivanna River Watershed

2022 Stream Health Report

Monitoring Program Results from 2019 to 2021

ANNIVERSARY EDITION



RIVANNA
CONSERVATION ALLIANCE

Our Mission Working with the community to conserve the Rivanna River and its tributaries through monitoring, restoration, education, and advocacy.

Our Vision We envision a healthy Rivanna River and watershed that benefits an engaged community.

Water Quality Monitoring in 2021

Stories help us understand the world and pass on knowledge. They also connect us, inspire us, and give us hope. Water quality monitoring is a form of storytelling, with the plot moving forward with every water sample collected and analyzed. Like in any good novel, milestones are integral in shaping the outcome of the narrative. This year, the Rivanna Conservation Alliance (RCA) celebrates two such milestones that have helped shape water quality monitoring within the Rivanna River watershed: the 50th anniversary of the Clean Water Act and the 20th anniversary of StreamWatch. As such, this year's Stream Health Report is not just about sharing RCA's 2021 monitoring results — it is also about highlighting pieces of the larger story of water quality monitoring and the continuing changes within the Rivanna River watershed.

While bacteria and biological monitoring are RCA's main methods for recording the story of water quality, it can also be assessed visually. For the Cuyahoga River in Cleveland, Ohio, it was obvious something was terribly amiss, not just because of the large algal blooms and recurring fish kills, but because the river was on fire. In 1969, it was the 13th time the Cuyahoga had been up in flames, but it would be its last.

Following this catalyzing event, pressure grew to overhaul the country's existing, weak laws that left industrial and sanitary wastewater discharges essentially unchecked. Concerned citizens and policy makers took action, and on October 18, 1972, a bipartisan group of U.S. Senators and Representatives overrode President Nixon's veto of the Federal Water Pollution Control Act Amendments. What we now know as the Clean Water Act (CWA) became the law of the land, ushering in a new era of environmental protections, and renewing hope for the nation's waterways.

From the beginning, water quality monitoring was an essential component of implementing the CWA, and states were tasked with this responsibility. In Virginia, the Virginia Department of Environmental Quality (VADEQ) took the lead. In 2002, the Virginia General Assembly established the Virginia Citizen Water Quality Monitoring Program to also encourage and promote the use of water quality data collected by community-led programs. It was in this same year that John Murphy founded StreamWatch, one of RCA's predecessor organizations.

In 2021, RCA's monitoring volunteers resumed working together with some precautions. Here, bacteria volunteers analyze turbidity samples collected during a sampling event.

"The essence of a monitoring program is sampling again and again to generate data with enough longevity and enough geographic breadth so that it tells a story."
— John Murphy, StreamWatch founder

Right of Way by Henry Strauss

The legacy of StreamWatch lives on today as we write the current chapter of RCA's water quality monitoring story. This report features the most recent biological stream health scores and RCA's bacteria data from within the Rivanna River watershed. These data are direct measures of whether our waterways are meeting the CWA's goal of being "fishable and swimmable."

This year's report finds that 82 percent of RCA's 50 biological sites and 58 percent of RCA's 19 bacteria sites are not meeting water quality standards. These results, coupled with growing challenges inadequately addressed or unanticipated by the CWA, like nonpoint source pollution and climate change, may be disheartening. But, like in any good narrative, there are signs of hope too. Only the passage of time, and continued collection of essential water quality data, will reveal where the story goes. Even 50 years of progress is just a moment in the life of a river.

Happy Anniversary!

Lisa Wittenborn,
Executive Director

Claire Sanderson,
Monitoring Program Manager

50th Anniversary of the Clean Water Act

In celebration of the CWA's 50th anniversary, we want to reflect upon how the law works to reduce pollution and how RCA's monitoring helps. We also want to spotlight a few CWA successes in the Rivanna River watershed.

In addition to strengthening the regulation of industrial discharges and providing more funding for improvement of sanitary wastewater management, the CWA formalized the use of water quality standards (WQS) to drive pollution limits. This approach requires robust water quality data, which RCA's monitoring program helps provide. The figure below illustrates how WQS work, and with white water droplets, identifies where RCA supports the process.

Step 1. The CWA directs states to designate uses to all waterbodies. In Virginia, all waters are designated for recreational use (e.g., swimming) and support of aquatic life. States then adopt WQS that are used to determine if a waterbody is supporting its designated use(s). The WQS for recreation in freshwater is based on *E. coli* counts and the WQS for aquatic life is based on benthic macroinvertebrate samples. See pages 5-8 for more details.

Step 2. In Virginia, VADEQ and volunteer groups then monitor the waterbodies. RCA's volunteer monitoring program is unique in being certified by VADEQ at Level III. This means RCA's and VADEQ's data are interchangeable.

Steps 3 and 4. VADEQ uses six years of water quality data to determine if WQS are being supported for each waterway. VADEQ places waterways that do not support WQS on the list of impaired waters (CWA 303(d) list) and submits it to the EPA and Congress every two years.

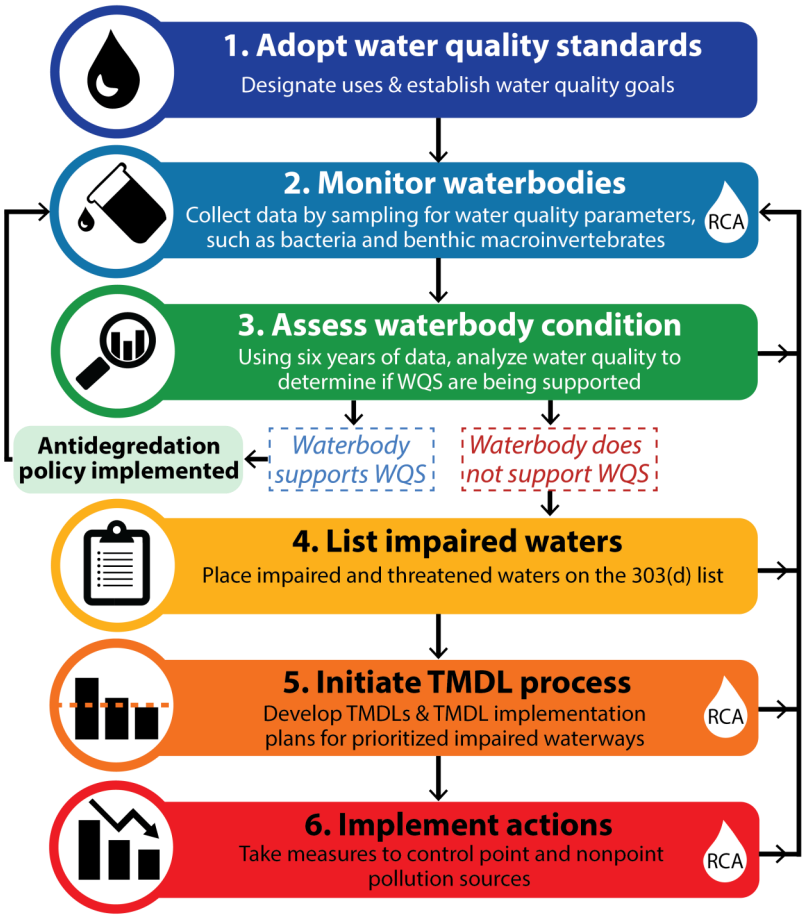
Step 5. VADEQ prioritizes impaired waterways and develops Total Maximum Daily Load (TMDL) plans for those of most concern. A TMDL looks at what is causing a waterbody to be impaired and determines the maximum amount (load) of the pollutant that can enter the waterway and have it still meet WQS. Then, VADEQ works with stakeholders, like RCA, to identify sources and divide this allowable pollution load up among them.

For "point sources," where pollution discharges from discrete pipes, "wasteload allocations" are written into and enforced through VPDES* discharge permits. For "nonpoint sources," where pollution is diffuse and land-based, "load allocations" are addressed through a TMDL Implementation Plan that identifies voluntary actions, like planting trees.

Step 6. In the final step, VADEQ, dischargers, watershed landowners, and other stakeholders work to implement the required discharge limits and identified voluntary actions. Impaired waterways remain on the CWA 303(d) list until monitoring determines that WQS are being met.

Local CWA Success Stories

- In 2022, Buck Island Creek was taken off the impaired waters list due to RCA's monitoring data showing the stream now meets WQS. Improvements might be related to significant tree planting efforts in its watershed.
- In urban portions of the Rivanna watershed, stormwater is regulated under the Virginia Pollution Discharge Elimination System (VPDES)* program. Municipal Separate Storm Sewer System "MS4" entities are covered by stormwater discharge permits requiring reductions in the amount of nutrients and sediment entering the Rivanna River. These required reductions have driven investments in stream restoration efforts, among other actions, that improve water quality and provide other benefits.
- The Rivanna Water and Sewer Authority's Moores Creek Water Resource Recovery Facility (wastewater treatment plant) is the largest point source in the Rivanna watershed. From 2009 to 2012, the facility implemented upgrades to enhance nutrient removal from wastewater, allowing the plant to exceed its required reductions of nitrogen (N) and phosphorus (P). Stream health is improving below the discharge point in Moores Creek and in the Rivanna.



20th Anniversary of StreamWatch

"Little by little"; that's how StreamWatch founder, John Murphy, describes the progress of one of Virginia's longest running, volunteer-supported, water quality programs. In the early 2000's, John started interning at the Thomas Jefferson Soil and Water Conservation District. It was there he became familiar with the Rivanna River Roundtable; a collaborative, EPA-funded effort that identified conservation priorities and management needs within the Rivanna River watershed.

"One of the recommendations that came out of that effort was that we needed a community-led water quality monitoring program," says John. Long-term, scientific data is critically important in order to track the health of our rivers and streams. Although John will joke that he started StreamWatch because he needed a job, the many challenges he faced when starting the organization, including securing community support and much-needed funding, would have made a less passionate person quickly give up.

"Sometimes what it takes to get something like that started is one person, or a small group of people, that just won't quit."

"I started shopping the idea around in the community and I eventually got a small group of interested people and organizations together. Sometimes what it takes to get something like that started is one person, or a small group of people, that just won't quit," says John. With the support he had garnered from local partners (e.g., City of Charlottesville, Albemarle County, Fluvanna County, The Nature Conservancy, and the Rivanna Water and Sewer Authority), together with a small amount of funding, John formed StreamWatch in 2002.

StreamWatch began with a handful of volunteers monitoring benthic macroinvertebrates at a dozen sites within the Rivanna River watershed. With the help of key people (including volunteer coordinator, Rose Brown; volunteer database manager, Brit Minor; and VADEQ regional biologist, William Van Wart), StreamWatch began to grow, as did media attention for the program. "Early on, I was really excited about the media attention that StreamWatch generated. There were three or four years where our annual report was on the front page of the Sunday Daily Progress. It felt like it was elevating awareness."

Indeed, StreamWatch was highly successful in raising awareness of the state of our streams and rivers, as well as providing much-needed data to track their health. In 2012, StreamWatch expanded its monitoring program to include monthly bacteria sampling at 13 sites in and around Charlottesville. In 2016, StreamWatch merged with the Rivanna Conservation Society to form the Rivanna Conservation Alliance (RCA). Today, 20 years after

John Murphy at Burke Creek Tributary West

StreamWatch formed, RCA and our dedicated volunteers collect benthic data from 50 long-term sites and bacteria data from 21 sites.

Although John retired from StreamWatch in 2011, he is still an active member of RCA's Scientific Advisory Committee (SAC), which provides expertise and guidance on RCA's water quality monitoring program. When asked what he is most proud of, John simply states, "that the program still exists." The longevity of this program is not just a testament to John's vision and tenacity, but also the community support and need for the program. John adds, "The hard thing about a monitoring program is that you're doing the same thing year after year and that can be hard to get funded, and hard to get people excited. It's a real challenge. That's why having a 20-year dataset, covering that kind of geographic area, is rare. I really can't claim credit for all of that, but I'm really happy that it's still going on."

stream WATCH

While John recognizes that raising "awareness and sensibility" about the state of our rivers and streams is the greatest challenge in protecting these vital assets, he adds that, "People really do care about water quality. Instinctively, everybody understands that water is life ... I'm hopeful that there has been incremental growth in political leadership and the community's willingness to make sometimes inconvenient choices to protect something that's critically important for us all." In light of the growing need to protect our freshwater resources, John's hope for RCA is that the water quality monitoring program continues to grow, and indeed it is, little by little.

Volunteers Make it Work

RCA's monitoring programs are built on a model of community ("citizen") science. Trained volunteers, who may or may not have science backgrounds, participate in nearly all aspects of the programs and greatly extend the reach and impact of these efforts.

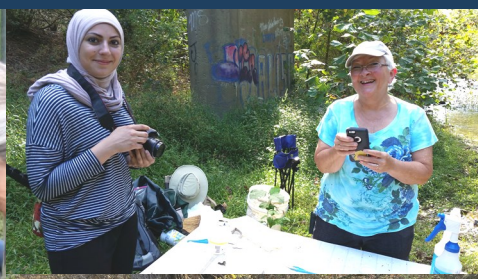
RCA's monitoring efforts align with the CWA's "fishable and swimmable" waters goal, with one team of volunteers assessing biological health and the other testing bacteria in the waterways. All volunteers participate in training sessions and those who wish to adopt their own sites are required to pass written and practical certification tests.

In 2021, RCA had 39 volunteers support the biological monitoring program and 35 participate in the bacteria program. Many also participated in RCA's monitoring-focused student education programs, resulting in 1,120 hours of work valued at $33,544.

Volunteers are at the heart of RCA's monitoring work and we could not do it without these incredible and passionate individuals. A list of all 2021 monitors is found on the back page of the report, but here we show some of the different monitors over the years and spotlight two who played significant roles in 2021.

Marilyn Smith, a retired geologist, completed her first training with StreamWatch in 2011. Like many of our volunteers, her participation in the Rivanna Master Naturalists introduced her to the program. She was immediately drawn to working with benthic macroinvertebrates, with her favorite bugs being dragonflies and case making caddisflies. "I love interacting with people who share the same passion for clean water as well as having the opportunity to learn and grow," Marilyn says. In addition to monitoring, Marilyn enjoys teaching students about watersheds and geology and spending time with her new grandson.

Sam Dupont is a Charlottesville native, who has volunteered with RCA since 2020. Sam became interested in getting involved with RCA's bacteria and benthic monitoring programs after personally removing over 20 tires from the Mechums River and wondering how dumping affects freshwater ecosystems. Sam was excited that RCA "provides an opportunity to get outside and make a difference." When he's not monitoring, Sam enjoys skateboarding, reading science-fiction, and hanging out with his cat, Alps.



Biological Monitoring Results 2019 - 2021

#	Site Name	Change	
1	Doyles River upper at National Park Boundary		
2	Albemarle County reference stream #2		
3	Ballinger Creek downstream of 625	▲	
4	Mechunk Creek upper at 600	▲	
5	Moormans River at 601	▼	
6	Raccoon Creek at 15		
7	Turkeysag Creek at 22		
8	Rivanna River downstream of Palmyra		
9	Cunningham Creek at 15		
10	Cunningham Creek Middle Fork - Bell Farms Ln	▼	
11	Fluvanna County reference stream - A	▼	
12	Mechunk Creek at 759		🦟
13	Buck Mountain Creek upper west of 665 - A		🦟
14	Powells Creek above Lickinghole Creek		
15	Long Island Creek at 601		🦟
16	Doyles River at 674		🦟
17	Rivanna River at Crofton - A		
18	Rivanna River at Darden Towe		
19	Beaverdam Creek East Prong		
20	Buck Island Creek at 729		
21	Lickinghole Creek near Fairwinds Ln		
22	Swift Run at 605		🦟
23	Carys Creek at 15		
24	Mechums River at 601		🦟
25	Ivy Creek in Rosemont		
26	Buck Mountain Creek at 665 - A		
27	North Fork Rivanna River at Advance Mills		
28	Mechums River at 692 - B		
29	Rivanna River at Milton		
30	North Fork at Forks of Rivanna		
31	Lynch River at 603		🦟
32	Stockton Creek at 638 - B		
33	Marsh Run upstream of 641		
34	Burnley Branch at Burnley Station Rd		
35	Ivy Creek at 601		
36	Preddy Creek west of Rosewood Dr		
37	Fishing Creek west of Willwood Dr - B		
38	Parker Branch at 633		
39	Rivanna River at Rivanna Mills		
40	South Fork at Forks of Rivanna		
41	Roach/Buffalo River north of 648		🦟
42	Little Ivy Creek Trib at Kingston Rd	▼	
43	Naked Creek at 844 - B	▼	
44	Stanardsville Run upstream of N Ridge Wy		
45	Quarter Creek in Twin Lakes		
46	Morey Creek south of Bellair		
47	Lake Monticello Trib #1 into Jackson Cove	▼	
48	Moores Creek near Woolen Mills		
49	Meadow Creek west of Locust Lane Ct		
50	Carroll Creek in Glenmore	▼	

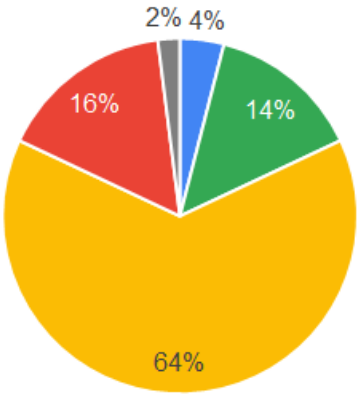
RCA's Level III Biological Monitoring Program collects data at 50 long-term monitoring sites twice annually throughout the Rivanna River watershed. Monitors sample benthic macroinvertebrates, the small organisms that live along the bottom of rivers and streams. As these organisms vary in sensitivity to stressors, studying their abundance and diversity at each site can be used to generate a stream health score. These scores are used to assess water quality and aquatic ecosystem health.

In previous reports, streams primarily scored Fair or Good, with sites commonly switching between these two ratings from report to report. The data from 2019-2021 show that the majority of sites are still considered Fair, however, only three sites moved between these ratings, with two moving up to Good and one moving down to Fair. Six other sites had lower health ratings, with two sites moving down two full categories. All of these sites had a high level of assessment confidence, apart from Site #50 (Carroll Creek in Glenmore). This site lacked data for all three fall seasons included in the assessment, conferring a lower level of confidence. RCA considers a stream score to have a high level of confidence when an assessment has been conducted in at least four of the six sampling seasons. While this site dropped from Poor to Very Poor, more data is needed to determine whether this downward trend is due to deteriorating stream health.

Some 2020 samples were comprised primarily of blackfly larvae*, resulting in low biodiversity and lower scores. These sites are noted in the table with a black fly icon (🦟).

**VADEQ directed RCA to include these as valid samples in our analyses.*

Streams rated as Very Good and Good meet Virginia's water quality standard for aquatic life. Those rated as Fair, Poor or Very Poor fail to meet this standard. From 2019-2021, 82% of streams sampled by RCA failed to meet this important benchmark.



The color and direction of the arrows in the table (▼) show how ratings changed from the previous report. You can find past reports at rivannariver.org.

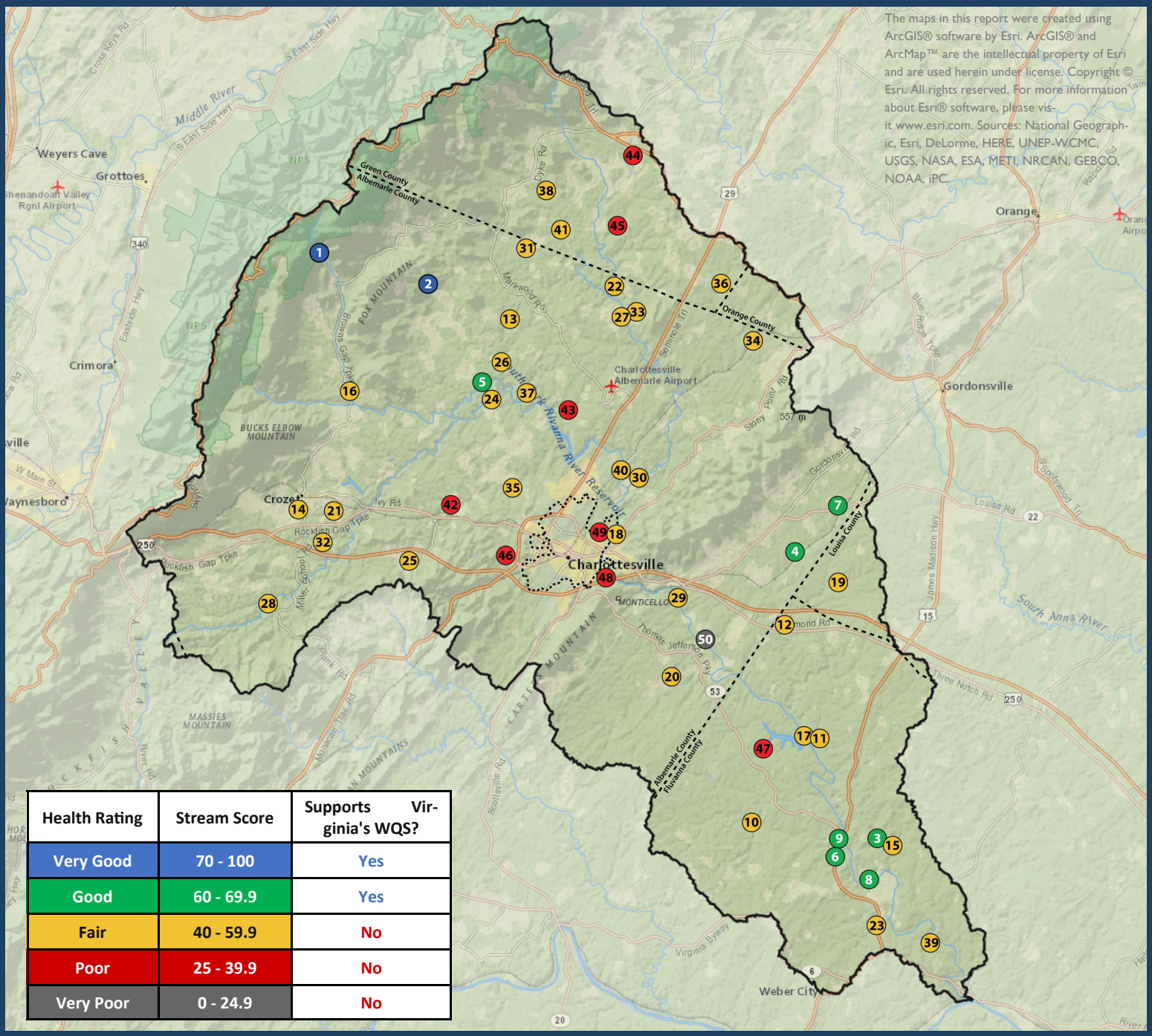
How We Evaluate Stream Health and 2021 Stream Scores

Volunteer monitors follow strict protocols to collect benthic macroinvertebrates with a net.

Volunteers sort, count, and identify the organisms to the family-level.

Each sample produces a score based on the number, types, pollution sensitivity, and diversity of organisms.

RCA analyzes three years of data to determine the overall rating for the site.



Health Rating	Stream Score	Supports Virginia's WQS?
Very Good	70 - 100	Yes
Good	60 - 69.9	Yes
Fair	40 - 59.9	No
Poor	25 - 39.9	No
Very Poor	0 - 24.9	No

Bacteria Monitoring Results 2021

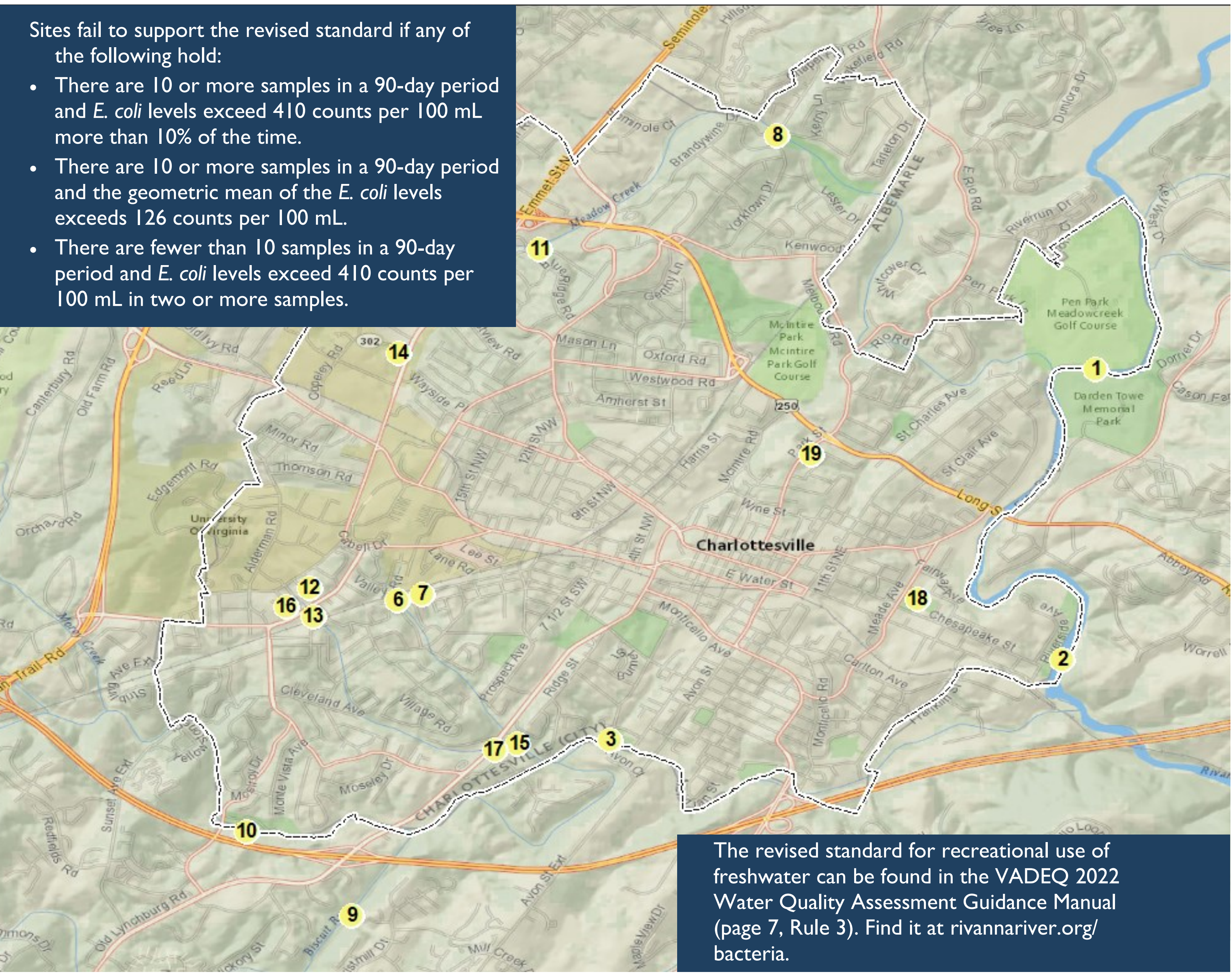
RCA's Level III Bacteria Monitoring Program analyzes *Escherichia coli (E. coli)* levels at 19 locations in the Rivanna River watershed. Samples are collected monthly from March through November. High recreation sites on the Rivanna are also tested weekly throughout the summer.

E. coli are naturally occurring bacteria found in the guts of humans and other animals. They signal the presence of waste pollution and suggest other pathogenic organisms may also be present. When *E. coli* levels are too high, swimming or wading in the water are considered unsafe.

In an urban area like Charlottesville, sewer overflows, damaged sewer pipes, and animal waste are typically the most significant sources of bacteria contamination. Bacteria levels are often correlated with turbidity and rise with heavy rainfall. RCA's bacteria monitoring helps protect public health and water quality by identifying these issues in our local waterways.

In 2020, VADEQ adopted a revised water quality standard for recreational use of freshwater. The new standard allows for higher concentrations of *E. coli,* but requires more frequent monitoring. VADEQ uses a six-year period of data to determine if a site is officially "impaired," but shorter periods of data can be used to evaluate whether a site is failing to meet or "support" the revised water quality standard.

During the 2021 sampling season, RCA's two summer weekly sites had 16 samples collected within a 90-day period: Rivanna River sites at Darden Towe Park and at Riverview Park (Table 1). RCA also collected weekly samples at a new site, Pollocks Branch in Jordan Park.



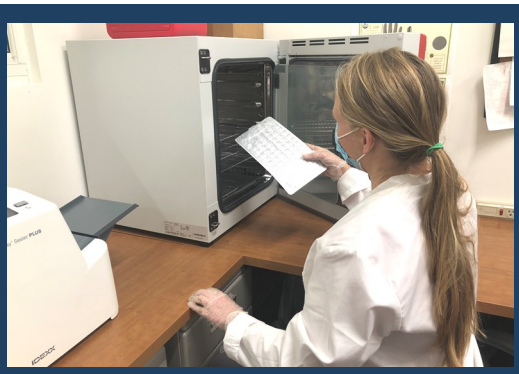
Sites fail to support the revised standard if any of the following hold:

- There are 10 or more samples in a 90-day period and *E. coli* levels exceed 410 counts per 100 mL more than 10% of the time.
- There are 10 or more samples in a 90-day period and the geometric mean of the *E. coli* levels exceeds 126 counts per 100 mL.
- There are fewer than 10 samples in a 90-day period and *E. coli* levels exceed 410 counts per 100 mL in two or more samples.

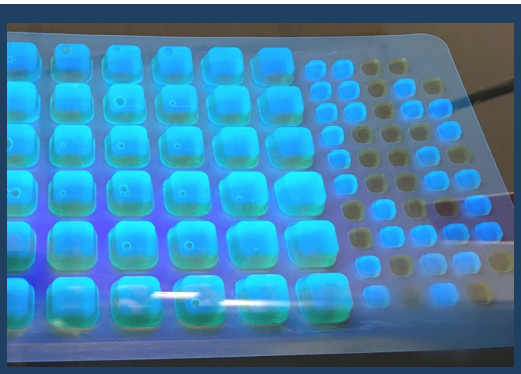
The revised standard for recreational use of freshwater can be found in the VADEQ 2022 Water Quality Assessment Guidance Manual (page 7, Rule 3). Find it at rivannariver.org/bacteria.

How We Measure Bacteria Levels and 2021 Data

Volunteers collect water samples from the monitoring sites using sterile sample bottles, and return the samples back to RCA's certified lab.



Staff then process and analyze the samples. They dissolve a growth medium into the water sample, pour it into a tray, then seal and incubate it.



After 24 hours they read the sample, recording a Most Probable Number (MPN), which is equivalent to the *E. coli* count per 100 mL.

Table 1. Assessment using weekly samples (90-day window)

Site #	Site Code	Samples (#)	Minimum and Maximum** (MPN)	Samples above 410 MPN (#)	Geometric mean* (MPN)	Fails to Support WQS
1	Rivanna River - Darden Towe	16	5.2 - 1413.6	18.8% (3)	87.2	Yes
2	Rivanna River - Riverview Park	16	8.5 - 2419.6	18.8% (3)	88.4	Yes
3	Pollocks Branch - Jordan Park	10	62.1- 2419.6	50% (5)	365.6	Yes

* Both river sites have geometric means below 126 counts per 100 mL (as measured by MPN). These sites meet the geometric mean part of the revised standard, but fail to fully support the standard due to having greater than 10% of samples exceeding 410 counts per 100 mL. Pollocks Branch fails on both criteria.

Table 2. Data from monthly samples (March - November)

Site #	Site Code	Samples (#)	Minimum and Maximum** (MPN)	Samples above 410 MPN (#)	Fails to Support WQS
4	Rivanna River - Crofton (not pictured)	9	15.8 - 365.4	0.0% (0)	Insuf. data
5	Rivanna River - Palmyra (not pictured)	9	15.2 - 157.6	0.0% (0)	Insuf. data
6	Rock Creek - Valley Road Extension	9	36.9 - 325.5	0.0% (0)	Insuf. data
7	Tributary to Rock Creek - Paton St	9	1 - 325.5	0.0% (0)	Insuf. data
8	Meadow Creek - SE of Brandywine Dr	10	38.4 - 613.1	10.0% (1)	Insuf. data
9	Biscuit Run	9	23.8 - 613.1	11.1% (1)	Insuf. data
10	Moores Creek Upper - Azalea Park	9	22.6 - 410.6	11.1% (1)	Insuf. data
11	Meadow Creek - Meadowbrook Rd	9	82.3 - 547.5	11.1% (1)	Insuf. data
12	Eastern Tributary to Lodge Creek	10	18.9 - 2419.6	20.0% (2)	Yes
13	Lodge Creek - South of JPA	9	35.5 - 1119.9	22.2% (2)	Yes
14	Meadow Creek - Copeley Rd	9	125 - 816.4	33.3% (3)	Yes
15	Rock Creek - Southeast of 5th St	9	104.3 - 524.7	33.3% (3)	Yes
16	Western Tributary to Lodge Creek	9	1 - 920.8	33.3% (3)	Yes
17	Lodge Creek - Southeast of 5th St	9	35.5 - 727	44.4% (4)	Yes
18	Meade Creek - Meade Park	16	90.9 - 2419.6	56.3% (9)	Yes
19	Schenks Branch near Rescue Station	14	45 - 2419.6	57.1% (8)	Yes

** The upper detection limit for *E. coli* using the Colilert method is 2419.6 MPN per 100 mL of water.

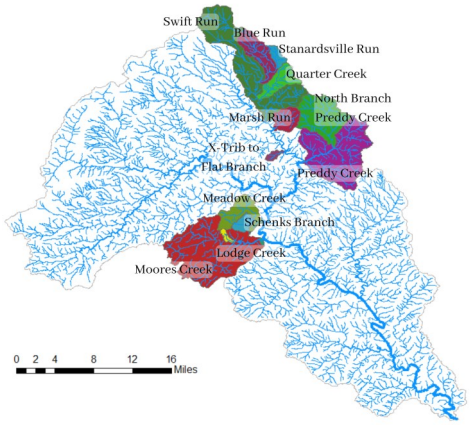
E. coli levels exceeded 410 MPN per 100mL 18.8% of the time at both river sites, and 50% of the time at Pollocks Branch, failing to support the water quality standard.

Of the 16 sites that had fewer than ten samples in a 90-day period (Table 2), eight failed to support the standard because they had two or more samples above 410 MPN per 100mL within 90 days. Eight sites had zero or only one sample above 410 MPN per 100mL within 90 days. For these sites, available data are insufficient to determine if they are supporting the standard.

To help determine if more of these sites support the revised standard, RCA started collecting weekly data at seven additional sites in 2022.

TMDLs in the Rivanna River Watershed

Sub-watershed Benthic TMDL Areas



Sub-watershed Bacteria TMDL Areas

Mainstem Rivanna River TMDL Areas

Many segments of streams and rivers in the Rivanna River watershed are impaired and have TMDLs due to sediment and bacteria (See above). RCA's monitoring data play an important role in identifying impairments and developing TMDLs. According to VADEQ, RCA's data have singularly or together with agency data, contributed to impairment listings for over 175 miles of streams and rivers.

Mainstem Rivanna River TMDLs

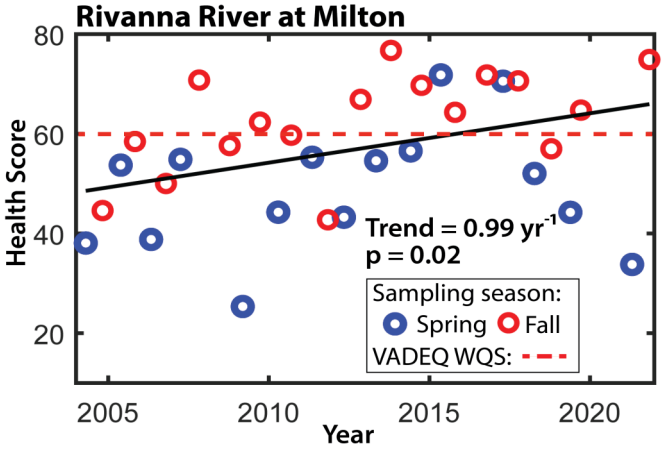
Portions of the Rivanna River's mainstem are impaired for recreation (bacteria) and aquatic life (benthic) and have TMDLs. A Bacteria TMDL starts at the top of the mainstem Rivanna and ends at Moores Creek. The TMDL includes an aggregate wasteload allocation for point sources in the City of Charlottesville, the Virginia Dept. of Transportation, the University of Virginia, Piedmont Virginia Community College, and the Albemarle County MS4 Area. Together, *E. coli* bacteria loads are to be reduced by 95 percent.

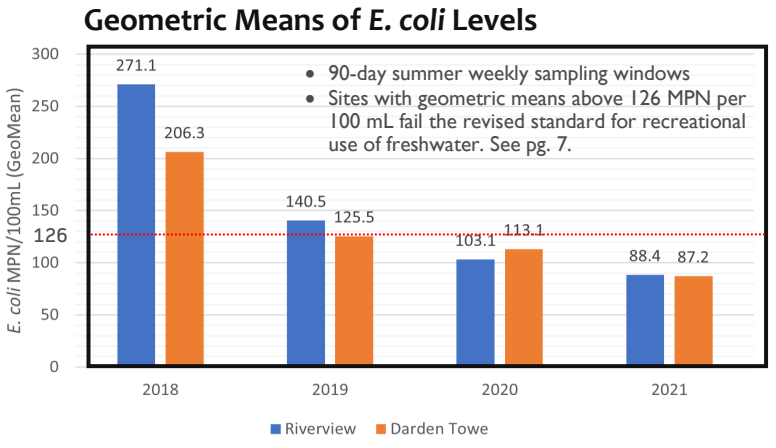
Benthic TMDLs are in place on two sections of the Rivanna River: one overlaps the Bacteria TMDL area and the other extends down to the wastewater treatment plant at Glenmore. Sedimentation from urban runoff is identified as the primary stressor causing the impairments and local MS4 permit holders are each assigned a wasteload allocation to reduce sediment runoff by 59.3 percent.

Are the TMDLs Working?

Conditions on the Rivanna River have not improved sufficiently to remove it from the list of impaired waters. However, RCA's benthic data show that stream health scores are increasing at Milton Landing (See figure below on left). No significant trend is detectable at the Darden Towe site, RCA's other monitoring site in the TMDL area.

RCA's bacteria monitoring methods changed in 2018, making it difficult to evaluate long-term trends. However, the geometric means of *E. coli* levels at RCA's two monitoring stations in the TMDL area, Riverview Park and Darden Towe Park, show a recent decline (See figure below on right). Only time will tell if this is part of a significant trend or an artifact of high rainfall in 2018 and 2019, which tends to increase bacteria levels.



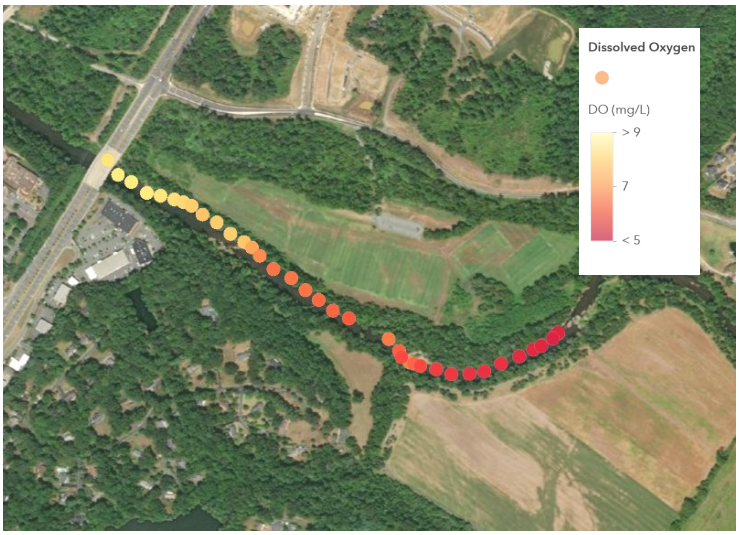


"RCA has played a key role in the TMDL development process in the Rivanna basin, not only in terms of monitoring support, but also in the form of outreach." — Nesha McRae, TMDL Coordinator, VADEQ Valley Regional Office

Steward and Education Impact 2021

RCA integrates water quality monitoring into almost everything we do, including our River Stewards, Restoration, and Education programs.

RCA's River Stewards serve as the organization's eyes on the water and add extra capabilities to our monitoring program. Their visual assessments of the Rivanna River watershed help identify pollution problems and areas that need additional monitoring. Their observations also help direct the locations of our stewardship and restoration projects, including river cleanups and tree plantings.



To help monitor the waterways, the Stewards unveiled a new piece of equipment in 2021 called a *sonde* (French for "probe"). This tool measures pH, dissolved oxygen (DO), turbidity, conductivity, and temperature at regular intervals. It can also connect the readings to geographic coordinates, allowing us to map results and create data transects. The image above shows DO levels in the South Fork Rivanna River dropping downstream of the dam. The Stewards trail the *sonde* through the water as they kayak.

In 2021, the connections between RCA's water quality monitoring and restoration work deepened. RCA began collecting baseline stream health data at the site of two significant restoration efforts, a large tree planting at James Monroe's Highland and a stream restoration at the Botanical Garden of the Piedmont. RCA also partnered on a large tree planting in the Dunlora community along the Rivanna River, a location we have been monitoring for several years. Long-term monitoring at these sites will help evaluate the impacts of the projects over time.

In 2021, RCA continued working with hundreds of youth in the watershed through monitoring-based educational programming. We offered another round of at-home stream testing kits for remote students and returned to some in-person instruction. We partnered with Light House Studio to lead four middle school ESOL (English Speakers of Other Languages) classes in making short films about exploring the watershed, including macroinvertebrate sampling. RCA also teamed up with University of Virginia students to offer a monitoring-themed field experience to Buford Middle School students. Through these hands-on experiences, we hope to increase watershed awareness and begin training the next generation of community scientists.

River Steward and Education Numbers

- 10 steward paddles
- 6 Clean Stream Tuesday paddles
- 39 miles of river cleaned
- 42 river cleanups
- 345 volunteers
- 806 volunteer hours
- 695 students
- 4,075 trees planted

Thank you to all who made this report possible.

Funding for RCA's Monitoring Program and Monitoring Education Program Provided by:

• Albemarle County • Anonymous • Charlottesville Area Community Foundation • Chesapeake Bay Trust •
• Chesapeake Bay Restoration Fund • City of Charlottesville • Fluvanna County • The Nature Conservancy • The Prana Fund •
• Rivanna Water and Sewer Authority • University of Virginia • Virginia Environmental Endowment •
• Virginia Department of Environmental Quality • Individual donors •

Community Partners for RCA's Monitoring Program and Monitoring Education Program:

• Albemarle County • Albemarle County Public Schools • Botanical Garden of the Piedmont • City of Charlottesville •
• Fluvanna County • Greene County • James River Association • Light House Studio • The Nature Conservancy •
• Rivanna Master Naturalists • Rivanna Water and Sewer Authority • Thomas Jefferson Planning District Commission •
• Thomas Jefferson Soil and Water Conservation District • University of Virginia • Virginia Department of Environmental Quality •
• Landowners who allow river access •

RCA's Science Advisory Committee:

• Andrea Bowles • Dan Frisbee • John Murphy • Brian Richter •
• Ami Riscassi • Todd Scanlon • Jeffrey Sitler • Laurel Williamson •

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So Happy Together by Henry Strauss

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The Rivanna River watershed drains 769 square miles of land from Shenandoah National Park to the confluence with the James River at Columbia, Virginia. The Rivanna River is an invaluable asset to the communities in the watershed, providing drinking water and contributing to the cultural, recreational, environmental and economic resources of the region. It also has regional importance because the Rivanna River is a tributary to the James River and the Chesapeake Bay.

Lisa Wittenborn, Ph.D., Executive Director
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Devon Hathaway, River Steward & Program Associate
Sophie Elliott, Development & Communications Coord.
Justin Altice, River Steward

In fall 2021, Rachel Pence, RCA's former Monitoring Program Manager, left RCA to pursue opportunities closer to her home in Roanoke, VA. Rachel oversaw the collection of most of the data included in this report from 2019 to 2021. We owe her a debt of gratitude for lending our watershed her energy and expertise for three years.