Anacostia RIVERKEEPER®

DC Citizen Science Water Quality Monitoring Report

2020

GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

DEPARTMENT OF ENERGY & ENVIRONMENT
WE ARE WASHINGTON DC

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Dear Friends of the River,

On behalf of Anacostia Riverkeeper, I am pleased to share with you our first Annual DC Citizen Science Volunteer Water Quality Report on Bacteria in District Waters.

This report focuses on 2020 water quality results from all three District watersheds: the Anacostia River, Potomac River, and Rock Creek. The water quality data we collected is critical for understanding the health of the Anacostia River and District waters; as it serves as a gauge for safe recreation potential as well as a continuing assessment of efforts in the District of Columbia to improve the overall health of our streams and waterways.

As a volunteer program, we are dependent on those who offer time out of their daily schedule to work with us and care for the water quality. With extreme gratitude, we would like to thank all our volunteers and staff for the dedication, professionalism, and enthusiasm to execute this program and to provide high quality data to the public. Additionally, support from our partner organizations was crucial to running this program, so we would like to extend an additional thanks to staff at Audubon Naturalist Society, Potomac Riverkeeper, and Rock Creek Conservancy.

We hope you find this annual report a good guide to learning more about our local DC waterways. We believe that clean water is a benefit everyone should experience, one that starts with consistent and publicly available water quality data.

Thank you for making this program possible,

Suzy Kelly
Founding Board Member, Anacostia Riverkeeper

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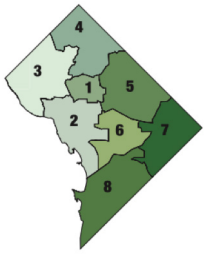
Executive Summary

Established at the confluence of Rock Creek and the Anacostia and Potomac Rivers, the District of Columbia has long been a city impacted by water. From the original Piscataway First Nation inhabitants through the industrial revolution to modern day, the District's local water bodies have been a magnetic force for industry, commerce, and the growth of the nation's capital. Unfortunately, with a growing urban environment comes the associated environmental issues like stormwater pollution, sewage overflows, and increased flooding. Because of these issues, the water quality of the District's surface waters, as it relates to ecological and human health, has been a consistent area of research and concern, not only for District residents but also for the health of the greater Chesapeake Bay population.

While water recreation draws people from in and around the District, swimming in local waters has been illegal since the 1970s due to poor water quality which, at times, can pose a risk to human health. Anacostia Riverkeeper and our partners believe that clean water is a basic human right, one that includes unimpeded and safe access to water for all who seek it. A swimmable Anacostia River is a primary goal of our organization, one that is mirrored by our partners in the Rock Creek and Potomac watersheds—Audubon Naturalist Society, Potomac Riverkeeper Network, and Rock Creek Conservancy. However, we understand that a swimmable Anacostia, Potomac, or Rock Creek cannot be achieved until water quality issues are addressed and the safety of those we would encourage to enjoy those waters is assured. In the past, there has been a lack of publicly available water quality data for DC waters. To address this issue, in 2018 the District Department of Energy and Environment (DOEE) awarded a grant (RFA 2018-1805-WQD-VWQM) to Anacostia Riverkeeper to develop a volunteer-based program to monitor the bacteria levels, specifically *Escherichia coli* (*E. coli*) and fecal coliform, in District of Columbia surface waters. The first of its kind in the District, this project uses trained community scientists to collect water quality samples from 22 sites, in all three watersheds, across the District of Columbia every week during the prime recreating season (May to September). The goal of this volunteer monitoring program is to provide valuable and accessible water quality data for residents and visitors, so they can make informed decisions before recreating in District waters.

This year, due to the outbreak of coronavirus (COVID-19), Anacostia Riverkeeper and partners had to rethink volunteer science in a world with limited face-to-face interaction. To train new volunteers and retrain volunteers from 2019, six virtual volunteer trainings were held. Thirty-plus new volunteers were trained, making a total of 150-plus volunteers trained to date for our DC citizen science program. Between April 29 and September 15, 2020, Anacostia Riverkeeper, partners, and volunteers collected a total of 462 water quality samples over 20 weeks of monitoring, bringing the total number of project samples collected during 2 years of this project to well over 1,000.

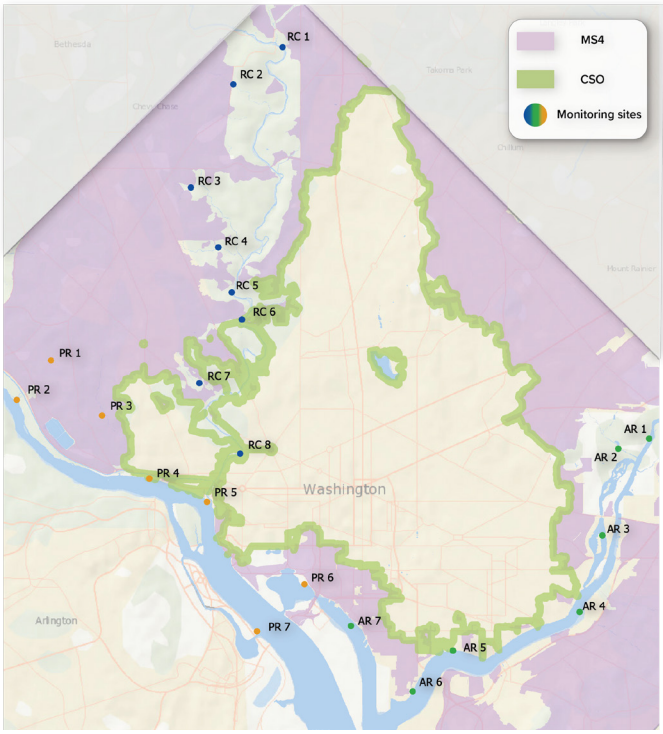
Overview

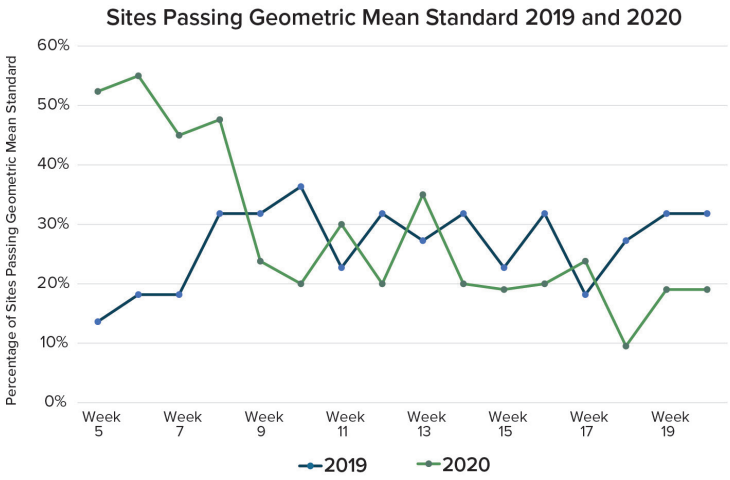


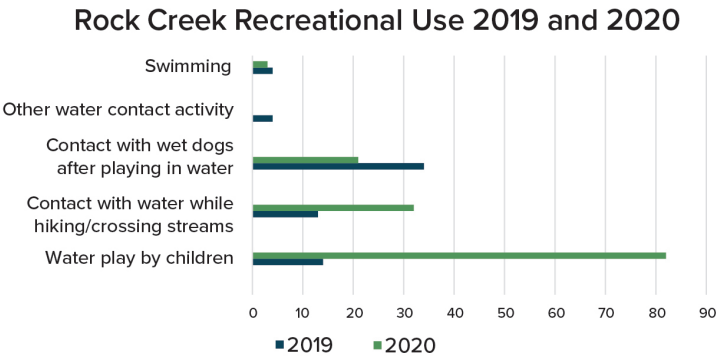
1,000+
samples collected to date

volunteers from all
8
Wards

150+
voluteer's trained to date







As discussed on the following pages of this report, the following trends were identified in 2020 over 20 weeks of monitoring in the Anacostia River, Potomac River, and Rock Creek in DC:

- Recreational water quality along the Anacostia was mixed from 2019 to 2020 as the average single-sample passing rate for *E. coli* fell from 61% to 59% but the average geometric mean passing rate increased from 34% to 41%, indicating an improvement in overall recreational water quality.
- Potomac recreational water quality showed minor change from year-to-year as the single-day passing rate for *E. coli* dipped from 74% to 63%. Geometric mean passing rates for *E. coli* remained mostly unchanged from 2019 to 2020, falling slightly from 49% to 48%.
- Rock Creek recreational water quality showed mixed results from year-to-year, as the single-day passing rate for *E. coli* fell from 44% to 38%, but the geometric mean passing rate increased significantly from 0.8% to 4%. The Rock Creek watershed consistently shows the lowest passing rates of the three watersheds.
- **Turbidity** levels for each watershed exhibited virtually no change as median turbidity values for each watershed were all below 12 NTU and varied by less than 2 NTU from 2019 to 2020.
- Surface water **alkalinity** was virtually unchanged with median pH varying by less than 0.5 between watersheds from 2019 to 2020. Average pH values remained between 6.5 and 7.5 for each watershed.
- Average **air** and **water temperatures** appear to correlate strongly with less developed forested land and lower temperatures. Rock Creek and its surrounding park had the lowest average air and water temperatures with the more developed Anacostia sites having the highest.
- COVID-19 changed the **type of recreation** observed in 2020. There was an increase in individual and small group activities (e.g., fishing, kayaking, contact with water for hiking) vs large group activities. A side-effect of mass public infrastructure closures/lockdowns and decreased access to publicly available pools.

Local rainfall totals and stormwater runoff seem to be the primary driving mechanisms for higher bacteria levels in District waters. Fortunately, the effect of these events are projected to diminish in the coming years due to the impact of local infrastructure projects (i.e., DC Water's Clean Rivers Project) and stormwater reduction programs (i.e., DOEE's RiverSmart Homes) drastically decreasing the amount of sewage and stormwater entering our surface waters each year.

With further funding from DOEE, Anacostia Riverkeeper and our partners will continue our program into year three in the summer of 2021. It is our goal to not only train more volunteer scientists and engage more community members in this project, but to ultimately build a force of river stewards for the District's waters.

Introduction

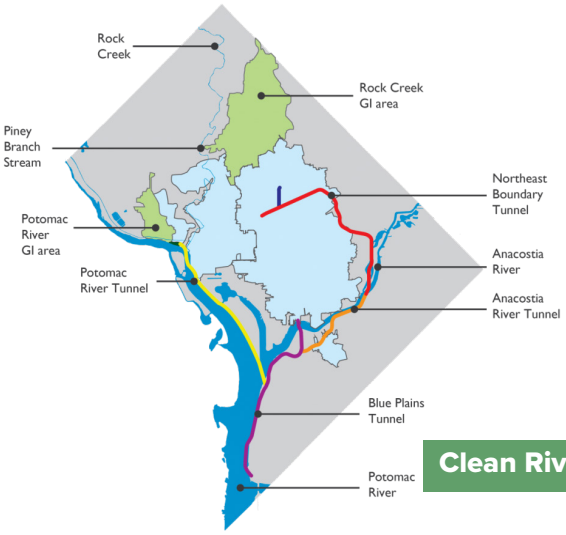
Background

Washington, D.C. truly is a city influenced by water. From the canals that used to flow past the Capitol, to the waterfront communities like Anacostia and Georgetown, surface water in the District has long been a source of recreation and enjoyment for the city's many residents and visitors. Across its 69 mi^2 land area, 39 miles of surface water run through the District, all eventually flowing into the Potomac River estuary. These 39 river miles in the District don't just bring enjoyment to the communities they surround, but can also unintentionally serve as vectors for pollution and environmental contaminants to move throughout the city. With a resident population of over 700,000, and millions of tourists converging on the District each year, the health of the city's surface waters are of the upmost concern not just for aquatic organisms, but for those who wish to recreate on or around these waters as well.

While recreation along the District's surface waters is widely encouraged, swimming has been illegal in DC waters since the 1970s. This ban is considered a human health protection as waters throughout the District have long suffered from poor and lapsing water quality due to antiquated infrastructure, geography, and the nature of urbanized watersheds. By enhancing a city around the Anacostia, Potomac, and Rock Creek, we've increased the amount of impervious surface area throughout the city, building the need to deal with the increased demands that rain, stormwater, and sewage place on our waterways. While the Anacostia, Potomac, and Rock Creek are all listed as Class A waters by the District, designating their use as primary recreation, this ban still exists primarily due to the increased threats that bacteria pose to human health. With stormwater increasing the potential that sewage or animal waste could end up in our waters, recreational water quality can be highly variable from watershed to watershed and even stream to stream.

On DC's main waterbodies, the primary contributor to past and current water quality issues is the combined sewer system. Combined sewer systems were built in many cities in the early 1900s and were seen as effective and safe alternatives to past water management systems like canals, ditches, or wooden pipes. Combined sewer systems have one pipe that carries both stormwater runoff from streets as well as sewage to a wastewater treatment plant. However, during large storm events high volumes of stormwater enter the system which increases the potential for sewer pipe backups or ruptures.

In the District, as well as most cities, the solution to this was to install combined sewer overflow (CSO) points along primary waterbodies that could be opened in the event of a large storm to "overflow" the excess stormwater and sewage mixture with the thought that the river or stream would filter it from the city over time. This brought untold amounts of pollution and raw sewage to District waters, increasing its bacterial loads to the point that the water was hazardous for human or animal contact at times. By the late 2010s, an average of 2 billion gallons of overflow was entering the Anacostia mainstem alone, making it the largest receiver of combined sewer of all three watersheds. Currently, around one-third (12,478 acres) of the District is still served by the combined sewer system, with the other two-thirds being served by the more modern municipal separate storm sewer system (MS4).



Clean Rivers Project

There are still approximately 48 CSO points still active throughout the District today, 15 on the Anacostia, 10 on the Potomac, and 23 on Rock Creek. While stormwater via the MS4 system is still a contributor to bacterial loads in District surface waters throughout the city, remediating the combined sewer system is the first step into increasing the recreation potential of city waters.

To address this issue, in 2005 DC Water entered into a consent decree mandating a solution to the pollution in DC surface waters, which marked the beginning of the Clean Rivers Project. Consisting of a series of grey infrastructure storage tunnels (18 total miles) for combined sewer overflow and green infrastructure (500+ total acres) designed to

mitigate stormwater impacts, the Clean Rivers Project aims to reduce total CSO volume to the Anacostia by 98% and by 96% across all three watersheds. The first tunnel of the project, the Anacostia River Tunnel, was put into service in March 2018 and in its first year of operation captured a total of 4.5 billion gallons of combined sewage that would have otherwise ended up in the Anacostia. Moving forward, three more tunnels are expected to be built with the Northeast Boundary Tunnel currently under construction on the Anacostia, followed soon by the Potomac and Rock Creek tunnels.

With the start of the Clean Rivers Project, DC government's push towards cleaner water, and reinvigorated public interest in DC's recreatable waters, a demand for publicly available water quality data has started to grow among the District's residents and visitors. With funding from DOEE, we at Anacostia Riverkeeper aim to provide this service for District recreators by providing weekly water quality information for the Anacostia, Potomac, and Rock Creek throughout the spring and summer each year.

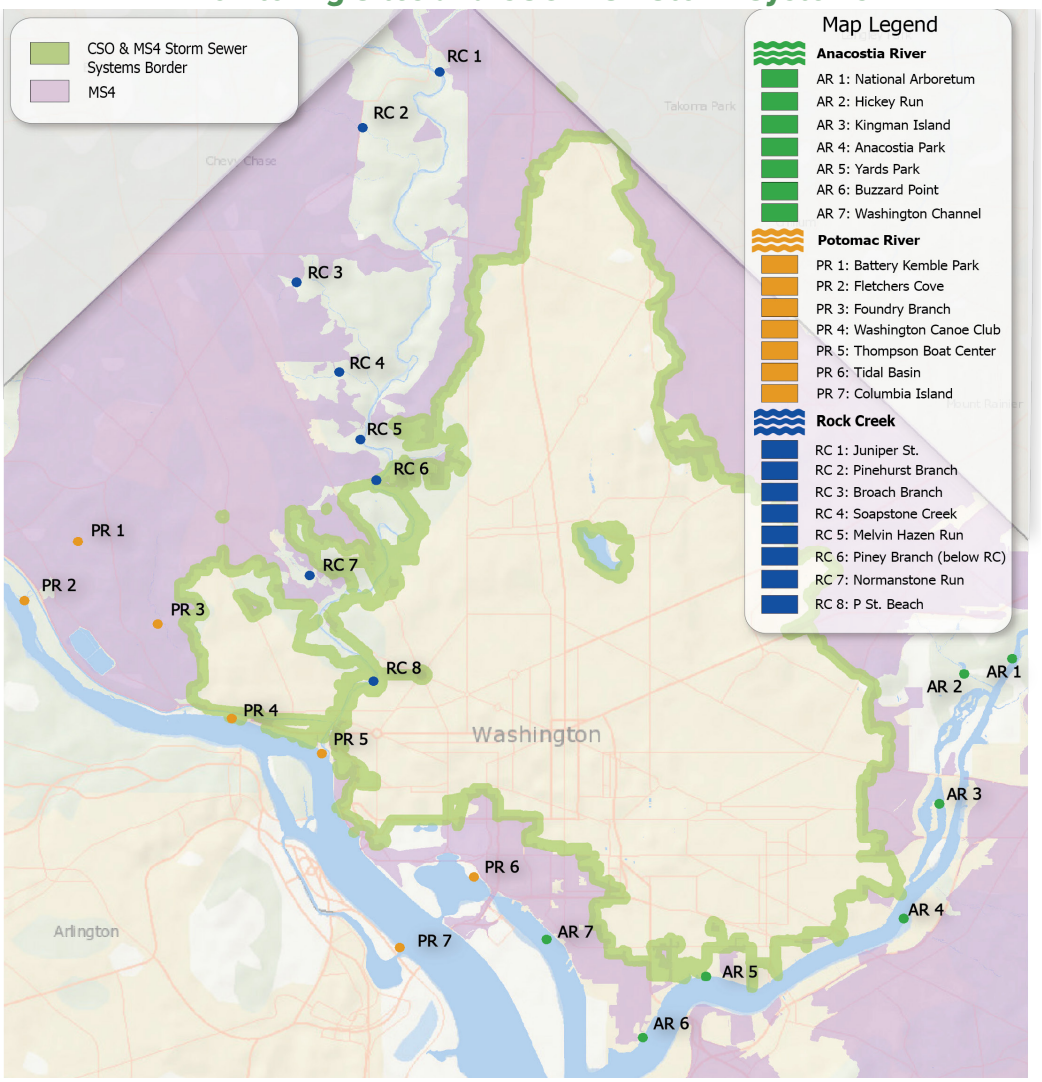
By establishing a baseline in 2019, and continuing to monitor District waters each summer, we hope to continue to observe a step-wise increase in the District's overall water quality, a reduction in bacterial loads, and appropriate updates to recreation policy from the District government reflects these improvements. We all want to see swimmable and fishable waters in the District, and this is one of the first steps in achieving them.

Project Creation and Site Selection

This project was awarded to Anacostia Riverkeeper in 2018 through funding from DOEE via Grant #RFA 2018-1805-WQD-VWQM. A total of 22 monitoring locations were selected across all District surface waters in the Districts three primary watersheds: the Anacostia, Potomac and Rock Creek. Watershed partners were selected based on their in-depth understanding of their select watersheds and ability to choose pertinent monitoring sites, volunteer management expertise, and shared commitment to clean water in DC. Currently, Anacostia Riverkeeper partners with Audubon Naturalist Society and Rock Creek Conservancy to help with sites in Rock Creek and with Potomac Riverkeeper Network, to assist with Potomac River sites. Additionally, Alliance for the Chesapeake Bay assisted in developing the project structure, monitoring procedures, and training regimen.

Monitoring activities took place every Wednesday for 20 weeks from May to September each summer, allowing for water quality data to be available to river recreators for the weekend. To ensure Tier II compliance in the District of Columbia, a Quality Assurance Project Plan (QAPP) was developed to ensure consistency in sample collection and methodology, lab procedures, and data management. DOEE reviewed and approved this QAPP, allowing the data to be certified as Tier II data and to be considered in policy and regulation decisions.

Monitoring Sites and CSO-MS4 Storm Systems



Selected water quality parameters sampled were chosen with recreation as the primary concern. In the District, **fecal indicator bacteria (e.g., *E. coli*), turbidity, and pH** are the three water quality parameters that dictate the recreation potential in a body of water; making them the primary parameters of concern when it comes to potential swimmability and permitted recreation. Water quality parameters monitored for this program include:

Fecal Indicator Bacteria (*E.coli* & fecal coliform)

These bacteria enter our waterways from sewage, runoff, and the waste of warm-blooded animals in the watershed. *E. coli* can be used as an indicator of the presence of more dangerous bacteria that can cause illness in humans and pets.

Turbidity

Turbidity measures water clarity, or how much light can pass through it. Levels can vary in waterways depending on where you are geographically and seasonally in certain waters. It can also serve as a vector for bacteria and other contaminants, increasing its importance to recreational water quality.

Acidity or Alkalinity (pH)

The measure of how acidic or alkaline a waterbody is. For this project pH is measured with a pH litmus paper on a scale of 0 to 14, with anything 0 to 7 considered an acid and anything 7 to 14 considered alkaline.

Water Temperature

Measured ~1ft below the water surface at each site with an armored thermometer.

Air Temperature

Measured over the water at each monitoring location with an armored field thermometer.

Photo credit: ANS

Volunteer Recruitment and Training

All data in this program is collected by volunteers, making them the cornerstone of this citizen science project. Volunteers are continually recruited by watershed partners from all Wards in the District of Columbia, as well as in Maryland and Virginia. In the first year of the program 120+ volunteers were trained with approximately 85 heading into the field to collect samples. This year, in 2020, 35+ volunteers were trained in a combination of virtual trainings and socially-distant in-person demonstrations.

In April, before the commencement of monitoring activities, new and returning volunteers are trained by Anacostia Riverkeeper project staff in a combination of in-class/virtual lessons and an in-person monitoring demonstration to ensure sampling proficiency for all volunteers. Project staff demonstrate proper sampling technique and methodology to all volunteers as well as providing them with pertinent background information like the history of DC waters, pollution, and sampling safety. To become a certified monitor for that season, returning and new volunteers need to complete a certification exam after they attend a full training session. The training regimen for this program was developed by Anacostia Riverkeeper with assistance from Alliance for the Chesapeake Bay and other watershed partners. Additionally, Anacostia Riverkeeper and Alliance for the Chesapeake Bay developed the *DC Volunteer Water Quality Monitoring Training Manual* which is provided to all volunteers as an in-field reference for sampling and project information.

ARK's 2020 Water Quality Monitoring Program by the Numbers

50 volunteers

468 bacteria samples

6 virtual trainings

20 weeks monitored

2,140 data points

21.5 mi. of water monitored

Methodology

Field Methods

Water quality samples are collected on the Wednesday of each week from every site for 20 weeks during the monitoring season. At each site water quality samples are collected according to methods established in the project QAPP for fecal indicator bacteria (*E. coli* and fecal coliform), pH, turbidity, air temperature, and water temperature. Additionally, information about the site (i.e., flow conditions, weather, tide) is recorded on a designated field sheet. To develop a clearer picture of on-water recreation in DC waters a Recreational Use Survey (RUS) was developed for volunteers to complete while at a monitoring site. While monitoring, volunteers make observations on the type of recreation activity witnessed and the number of participants engaged in that activity. Activities included on the survey are recreational activities of interest like boating, swimming, fishing, etc.

All sampling methods are established in the project QAPP, laid out in the *DC Volunteer Water Quality Monitoring Training Manual*, and based on well-used U.S. Environmental Protection Agency (USEPA) water quality sampling methods for tidal and non-tidal waters. Bacteria and turbidity are the only physical water samples taken.

Bacteria samples are collected using a sterilized and sealed 100mL IDEXX sample bottle with sodium thiosulfate preservative inside and stored on ice to be analyzed within 6 hours. **Turbidity** samples are collected in standard 100mL polyurethane sample bottles and analyzed in Anacostia Riverkeeper's water quality lab along with bacteria. **Alkalinity (pH)** is analyzed using *Hydrion* 0-14 pH litmus paper with a colorimetric scale. Finally, **air temperature** and **water temperature** are both collected using annually NIST certified armored glass thermometers.

Photo credit: ANS

Photo credit: ANS

What are the legal water quality standards for DC?

The District has water quality standards that are upheld to meet Clean Water Act requirements and to restore and protect the District waters. They are regularly reevaluated and updated with the latest scientific findings. The most recent iteration of DC's water quality standards in 2013 states these healthy standards for Class A waters:

Bacteria *(E. coli)*	pH	Turbidity
Single-sample value <410 MPN/100 mL Geometric mean <126 MPN/100 mL	6 - 8.5	<20 NTU above ambient

What does geometric mean and single-sample bacteria values mean?

Bacteria standards have two cutoff values considered safe for **"primary contact"** recreation.

Single-Sample Standard: At or below **410** MPN/100 mL. Direct measurement of what is in the water at that place and time, it is very dependent on short term changes in precipitation, temperature, etc.

EXAMPLE

Week 1→AR-4 is 260 MPN/100 mL 👍 *Pass*
Week 2→AR-4 is 566 MPN/100 mL 👎 *Fail*

Geometric mean standard: At or below **126** MPN/100 mL. An average of 5 samples over 30 days (one sample a week) that is not heavily swayed by very high or very low values. The geometric mean gives a broader picture of water quality beyond a single-sample.

EXAMPLE

Week 1→AR-4 is 260 MPN/100 mL
Week 2→AR-4 is 566 MPN/100 mL
Week 3→AR-4 is 123 MPN/100 mL
Week 4→AR-4 is 875 MPN/100 mL
Week 5→AR-4 is 80 MPN/100mL

263 MPN/100 mL geometric mean 👎 *Fail*

Sample duplicates are collected from each watershed each week to ensure quality assurance and check volunteer sampling techniques. All physically collected samples are recorded on a Chain-of-Custody (CoC) form to ensure sample fidelity and provide quality assurance for all samples coming into the Anacostia Riverkeeper lab.

Lab Methods

Field samples are delivered by volunteers to the Anacostia Riverkeeper water quality lab each Wednesday, in addition to site field sheets, recreational use surveys, and chain-of-custody forms. Anacostia Riverkeeper analyzes both *E. coli* and turbidity samples in-lab. Both samples are required to be be stored on ice at approximately 4 °C and delivered to the lab within 6 hours to ensure sample representativeness. All lab activities are recorded in a designated lab notebook specific to the project for quality control and data assurance. Bacteria samples are collected and analyzed using the IDEXX Colilert system (Method 9223 Enzyme Substrate Coliform Test 2017) and results published in "Most Probable Number of Colony Forming Units" or MPN/100mL (comparable to CFUs).

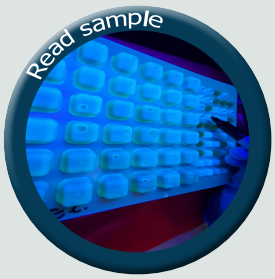
Bacteria

A Colilert chemical reagent is mixed with each sample

Then placed in an incubator at 35 °C for 24 hrs

Lab Processes

Samples are sealed in a sampling tray



After 24 hrs samples are read under a UV blacklight

Turbidity

Turbidity samples are assessed using an in-lab LaMotte 2020we/wi turbidimeter, which uses light attenuation passing through a sample compared to lab standards to determine the turbidity of a sample in nephelometric turbidity units (NTUs). Standards 0 NTU, 1 NTU, 10 NTU, and 100 NTU are run before each week's samples to ensure accurate readings. Lab turbidity samples are run concurrently with bacterial samples so both results are available within 24 hours. Temperature and pH parameters are measured *in-situ* in the field so do not require lab analysis.

Data Methods

Data is recorded 24 hours after sampling and uploaded to multiple platforms for public access: Water Reporter, SwimGuide, Chesapeake Monitoring Cooperative, and a database portal on Anacostia Riverkeeper's website. Full data is primarily accessed via Anacostia Riverkeeper's Water Quality Results Portal, as it is updated weekly with helpful maps, graphs, and general program information. Anacostia Riverkeeper additionally uploads the data to all social media platforms (Twitter, Instagram, and Facebook) when results are reported. Additionally, all project data is reported to DOEE each week as a compliment to DOEE's internal water quality efforts.

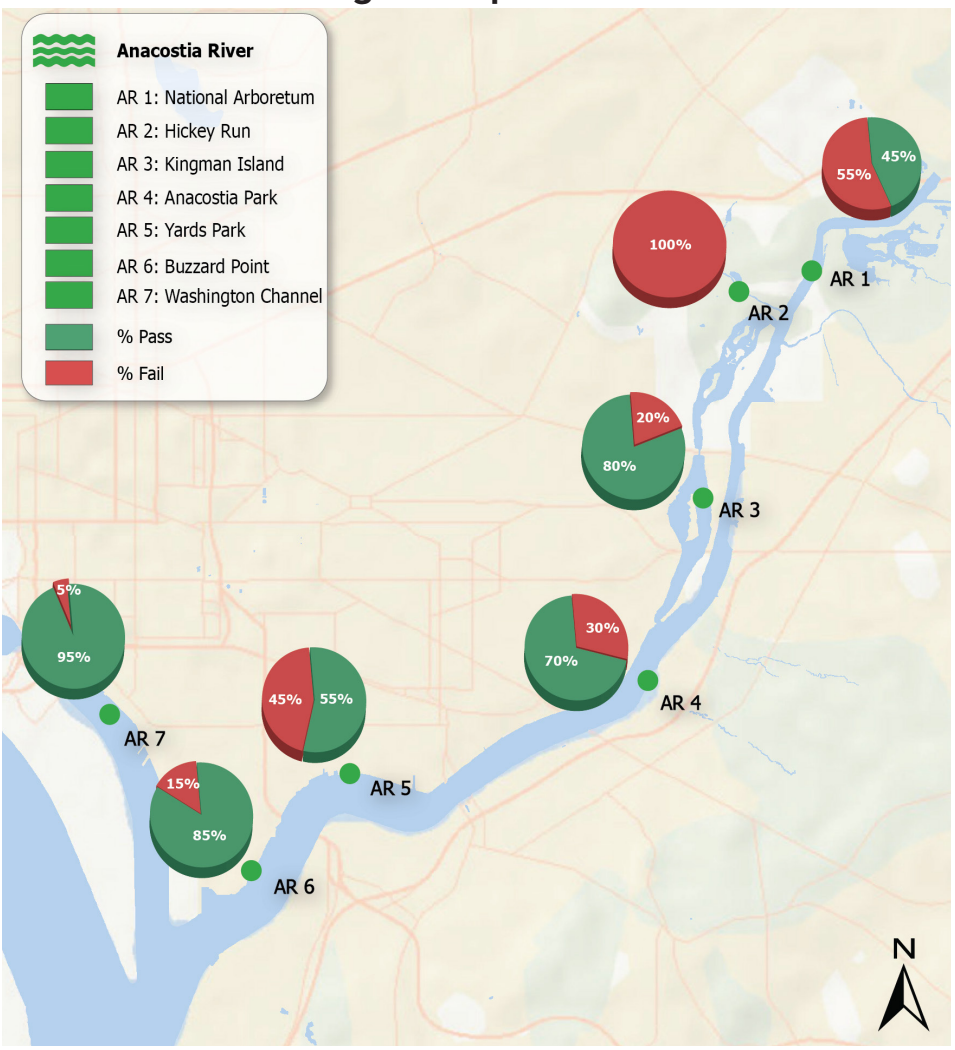
All charts, graphs, tables, and data analysis were created in or performed in Excel. Data was assessed using standard mean, geometric mean, median, and other pertinent statistical analyses such as linear regression with p-value assessment.

Anacostia River

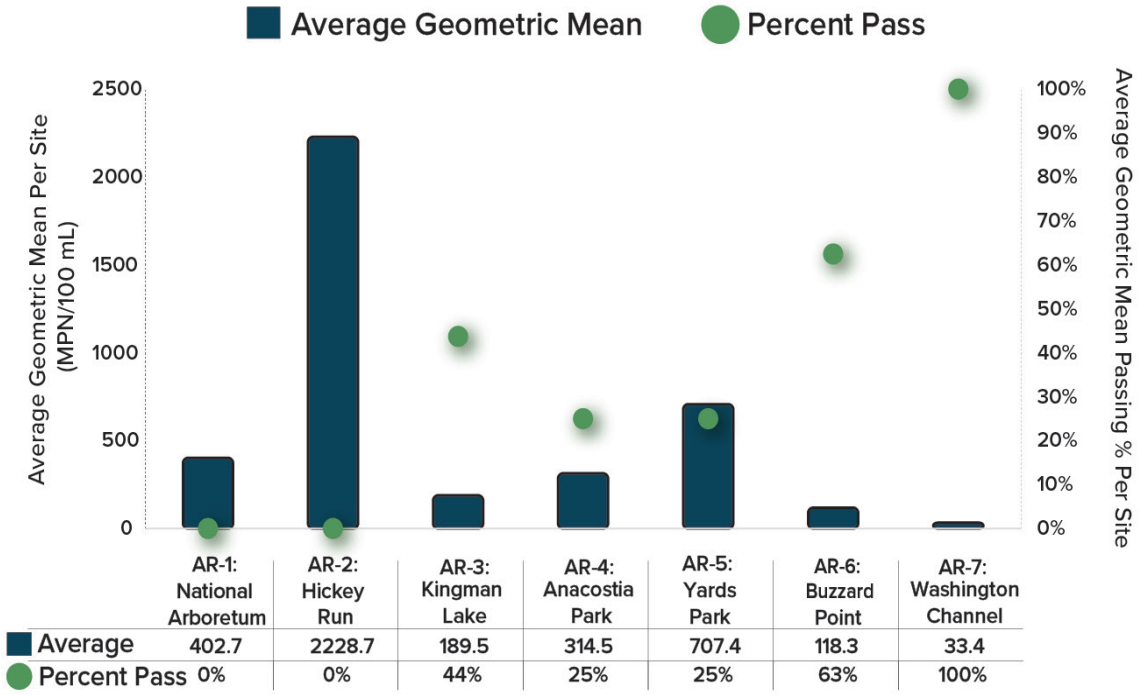
Anacostia River sites span the mainstem from the National Arboretum to the Washington Channel, with one site on a tributary, at Hickey Run. Site results varied significantly revealing a general pattern of **decreasing bacteria levels** moving **down the mainstem** of the Anacostia.

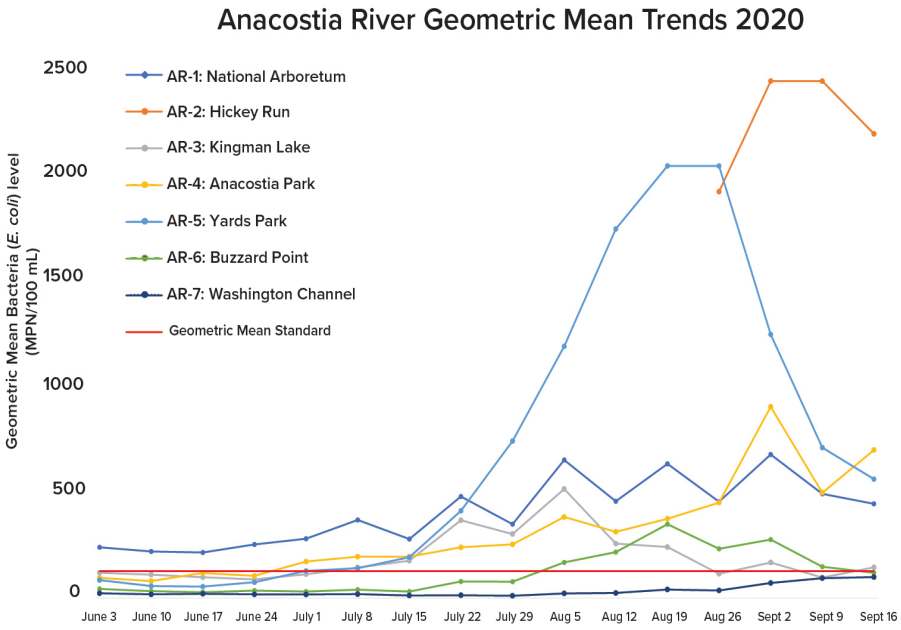
For the bacteria single-sample primary contact standard, all but two sites passed most of the time (>50%); Hickey Run (AR-2) passed 0% of the time and the National Arboretum (AR-1) passed 45% of the time. Kingman Lake, Buzzard Point, and Washington Channel passed 80%, 85%, and 95% of the time, respectively (AR-3, 6, 7). **Geometric mean trends mirrored single-sample trends.** Hickey Run and the National Arboretum passed 0% of the time and Kingman Lake, Buzzard Point, and Washington Channel passed 44%, 63%, and 100% of the time, respectively. The first 8 weeks, June 3 to July 22 2020, exhibited low geometric mean bacteria levels across all sites (excluding Hickey Run due to lack of access until August 2020), with geometric mean values increasing towards the end of July and into August. **Lower geometric mean values** during the first half of the season may be related to less human activity and traffic during the District's stay-at-home order, shut down or lighter precipitation/less heavy rain days.

Bacteria (*E. coli*) Passing Percentage 2020: Single-Sample Value



Anacostia River Bacteria (*E. coli*) Geometric Mean 2020





Trends:

- Healthier bacteria levels down the mainstem
- Lower bacteria and turbidity results in the first months
- Healthy pH, turbidity, water temperature across all sites
- Washington Channel exhibited the lowest bacteria levels consistently, while National Arboretum and Hickey Run were the highest

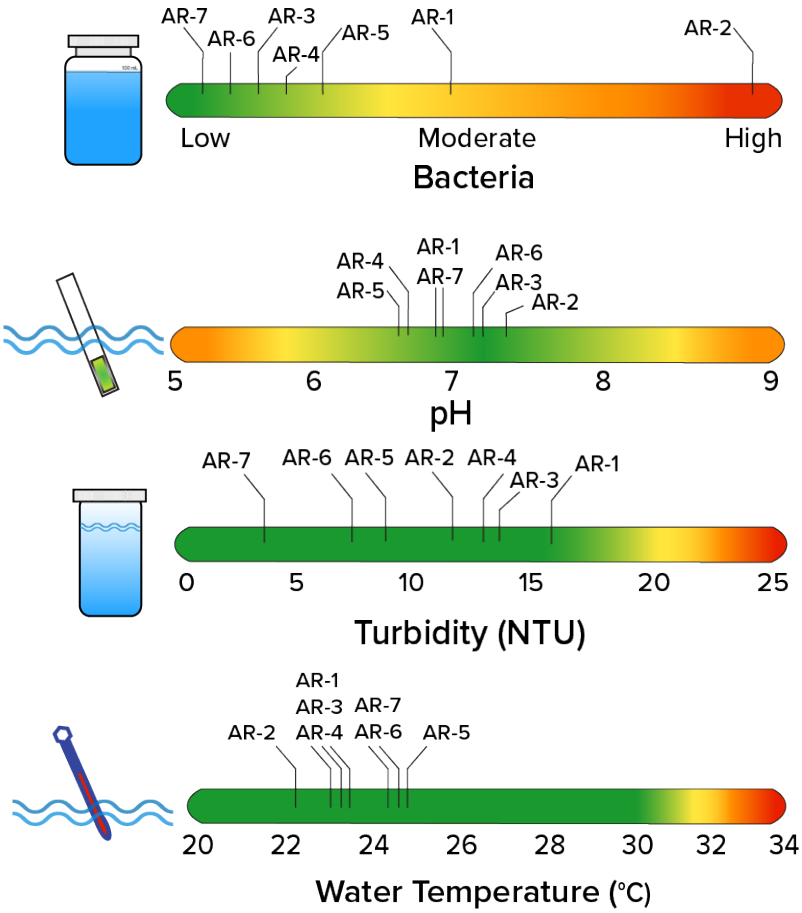
Insights:

- Primary contact recreation appears most viable at Buzzard Point, Washington Channel, and Kingman Island
- Hickey Run needs more investigation and remediation efforts, as the average geometric mean was above 2000 MPN, over 15x the primary contact standard
- Swim signage at docks and popular sites may need to be more abundant and apparent, as recreators may not be aware of high bacteria levels and the swim ban

Turbidity levels also trended lower moving down the mainstem. The highest average turbidity was seen at National Arboretum at 15.8 NTU (median of 12.7 NTU) and the lowest was at Washington Channel at 3.5 NTU (median of 3.1 NTU). The water quality standard is 20 NTU over ambient, setting the average of all sites below the maximum turbidity cutoff of the standard. Average mean and median **alkalinity (pH)** remained constant, around 7, falling within the primary contact range of 6-8.5. pH readings stayed consistent until August, at which time there was more variation across all sites, however most sites varied only by 1 unit or less. Water temperature was within a healthy range, falling well below the water temperature standard of 32.3 °C, with a general median between 22-26 °C. **Water temperature** for all sites rose from May until July, peaking around July 15-29, and began decreasing until the end of the sampling period on September 16. All sites met healthy water quality ranges for pH, water temperature, and turbidity, however some select sites bordered the upper limit for safe turbidity levels.

Recreational use surveys show the highest recreation locations (on Wednesday mornings) were Yards Park and then Anacostia Park and Washington Channel. The most frequently seen recreation activities were power boating, rowing/sculling, fishing, and kayaking. Some swimming was seen, although infrequent, as well as other primary contact activities like wading even though there is still a swim ban across the District. Swimming and wading were only observed at Yards Park and Kingman Lake monitoring sites.

WATERSHED SNAPSHOT 2020

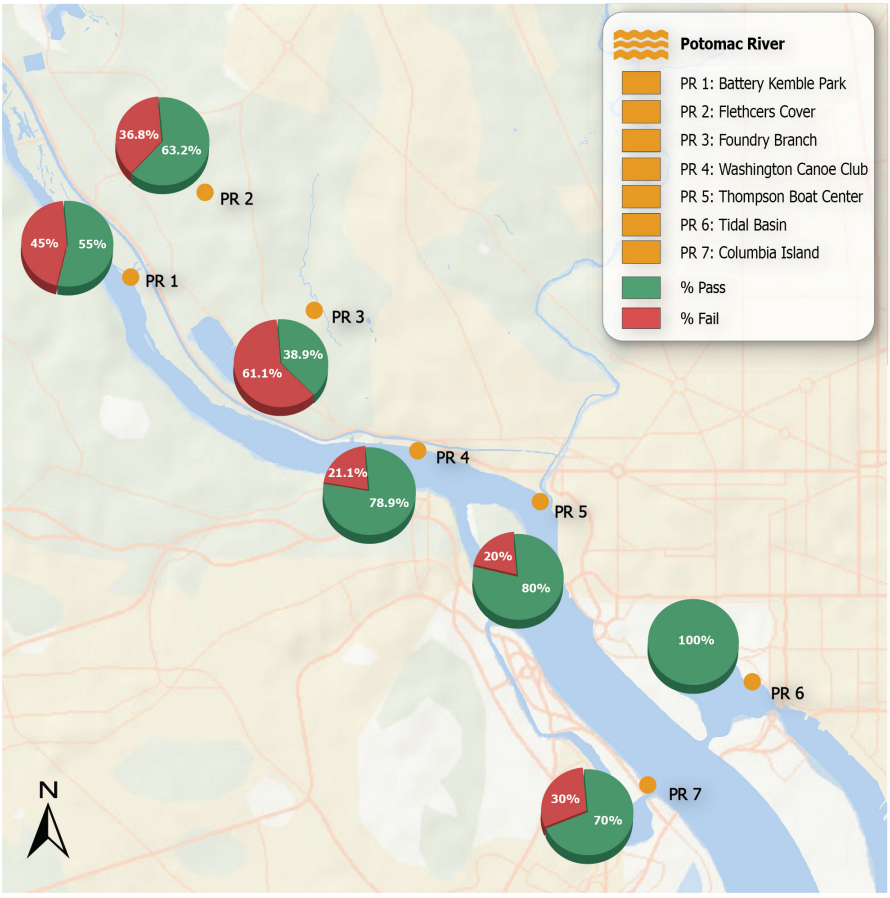


*Values are the average (mean) per site for each water quality parameter throughout the 2020 season

Potomac River

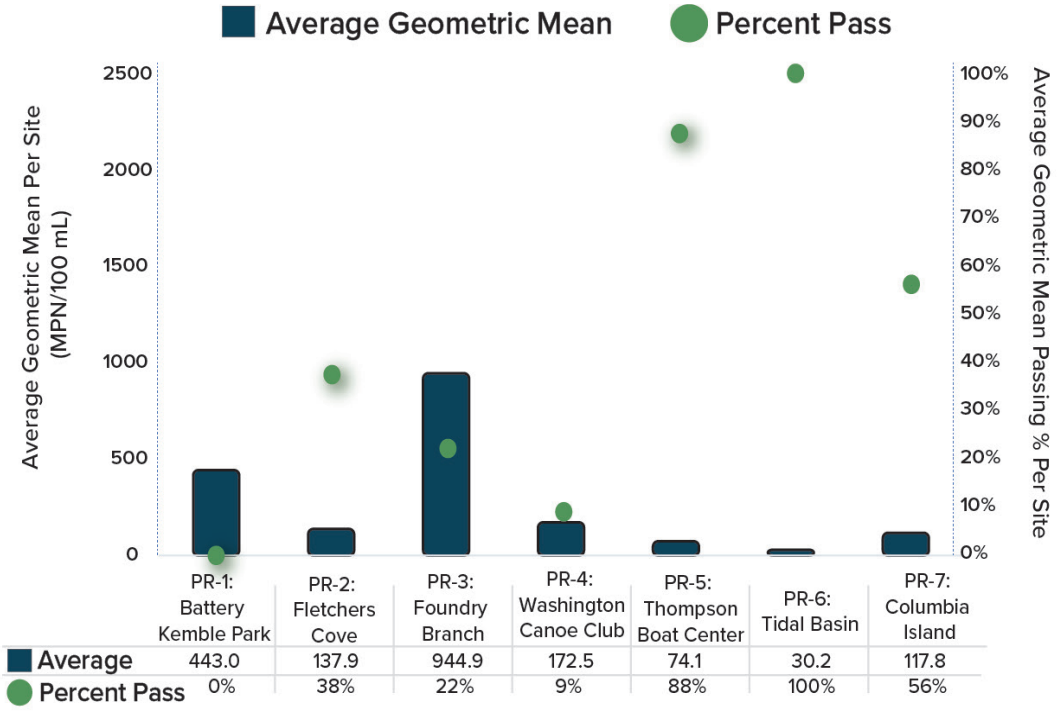
Potomac River mainstem sites start at Fletchers Cove, just south of Chain Bridge Road, down to Columbia Island on the most southern shoreline of DC on the Potomac near the Pentagon. Potomac mainstem sites consistently reported some of the lowest bacteria levels across all three watersheds. The two Potomac tributaries, Battery Kemble Park (Maddox Branch) and Foundry Branch, exhibited higher bacteria loads.

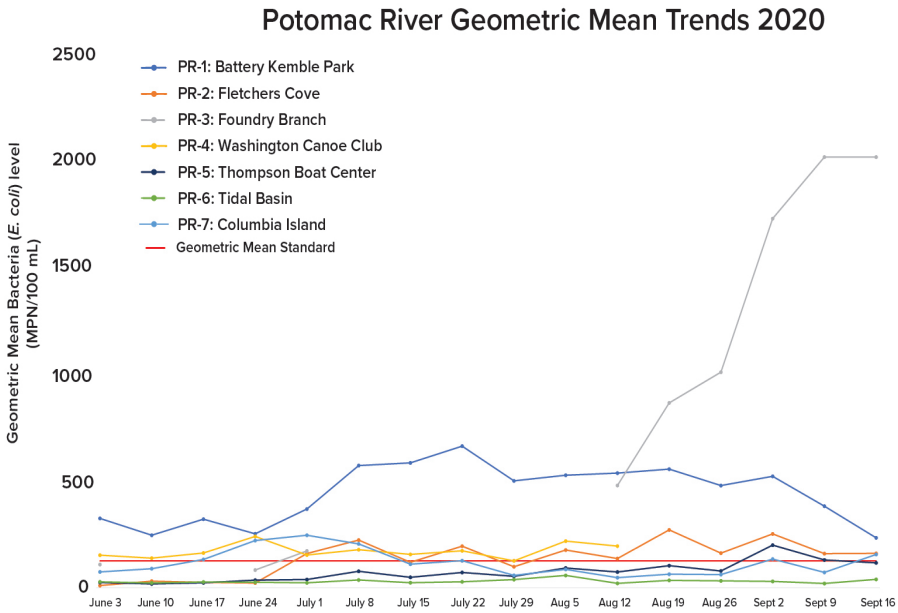
Bacteria (*E. coli*) Passing Percentage 2020: Single-Sample Value



Bacteria single-sample passing percentage was high across all sites, with 6 out of 7 passing over 50% of the time. Only Foundry Branch (PR-3) did not pass over 50% of the time, with a passing percentage of 38.9%. The Tidal Basin (PR-6) passed 100% of the time, and the next highest passing sites were Thompson Boat Center (PR-5) at 80% and Washington Canoe Club (PR-4) at 78.9%. The lowest passing percentages were the two tributary sites, Battery Kemble Park (PR-1) and Foundry Branch (PR-3), at 55% and 38.9% respectively. **Geometric mean** trends mimic the passing percentage for single-sample trends, with two tributary sites having the lowest passing percentages (Battery Kemble Park passing 0% and Foundry Branch passing 22% of the time), while the Tidal Basin had the highest passing site across all watersheds that passed 100% of the time for both the single-sample standard and geometric mean. Thompson Boat Center also passed frequently, with a percentage of 88%. It is of note that Washington Canoe Club passed the single-sample standard almost 80% of the time but only passed the geometric mean standard 9% of the time, showing this site had regularly moderate bacteria levels, above 126 MPN but below 410 MPN most of the time.

Potomac River Bacteria (*E. coli*) Geometric Mean 2020





Trends:

- Consistently low bacteria levels on the mainstem
- More frequent recreation at Thompson Boat Center and Fletchers Cove
- Tributaries pass less frequently

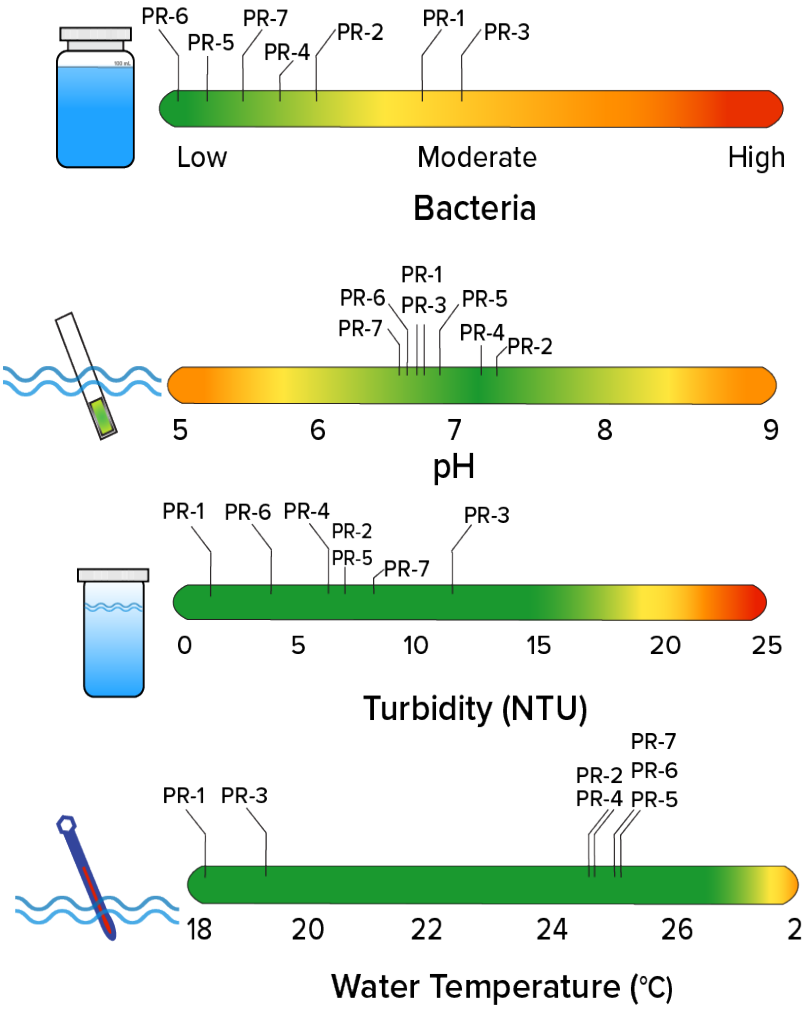
Insights:

- Recreation potential at Tidal Basin and Thompson Boat Center is very high with low bacteria levels over extended periods during the summer
- During periods of dry weather, Foundry Branch and Battery Kimble Creek continue to fail, indicating a source other than runoff and stormwater
- Sites farther from CSOs have generally lower bacteria levels throughout the season

Turbidity levels stayed constant and low across the mainstem, with an average turbidity under 7 NTU. Tributaries were split on turbidity levels: Battery Kemble Park was the lowest overall at 1.7 NTU average and Foundry Branch was the highest overall at 11.8 NTU average. Foundry Branch was often either very shallow or dry, potentially part of the reason for higher average turbidity.
The pH hovered around an average of 7 for all sites, demonstrating a healthy acidity level in the water.
Water temperature were clearly lower at the tributary sites (18-19 °C) compared to the mainstem sites (24 °C+); the difference of about 5 °C demonstrates the cooling effect of tree cover and less sun coverage, especially during the summer months.

There was a clear differentiation between the types of recreation seen at the mainstem sites compared to the tributary sites. While the mainstem sites saw the majority of recreation, particularly at Fletchers Cove and Thompson Boat Center, there was some seen at the tributary sites. Most recreation on the mainstem was secondary contact activities, such as canoeing, kayaking, fishing, rowing, and power boating (with a few instances of water play by children at Fletchers Cove). The tributary sites (Battery Kemble Park and Foundry Branch) saw more high contact activities like contact with water while hiking/crossing streams and contact with wet dogs after playing in water. While the Tidal Basin has the highest recreation potential because it passed both single-sample and geometric mean standards 100% of the time, it was conversely the site that saw the lowest recreation this year. This may be from the lack of normal recreation rental facilities, as they were closed through summer 2020 due to COVID-19.

WATERSHED SNAPSHOT 2020

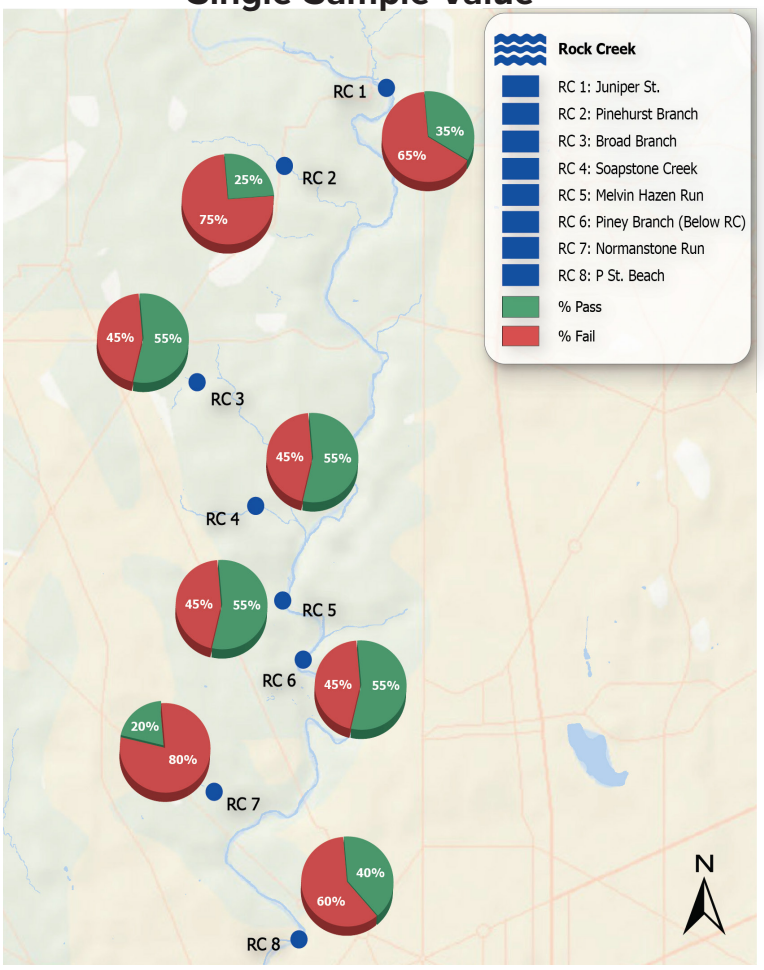


*Values are the average (mean) per site for each water quality parameter throughout the 2020 season

Rock Creek

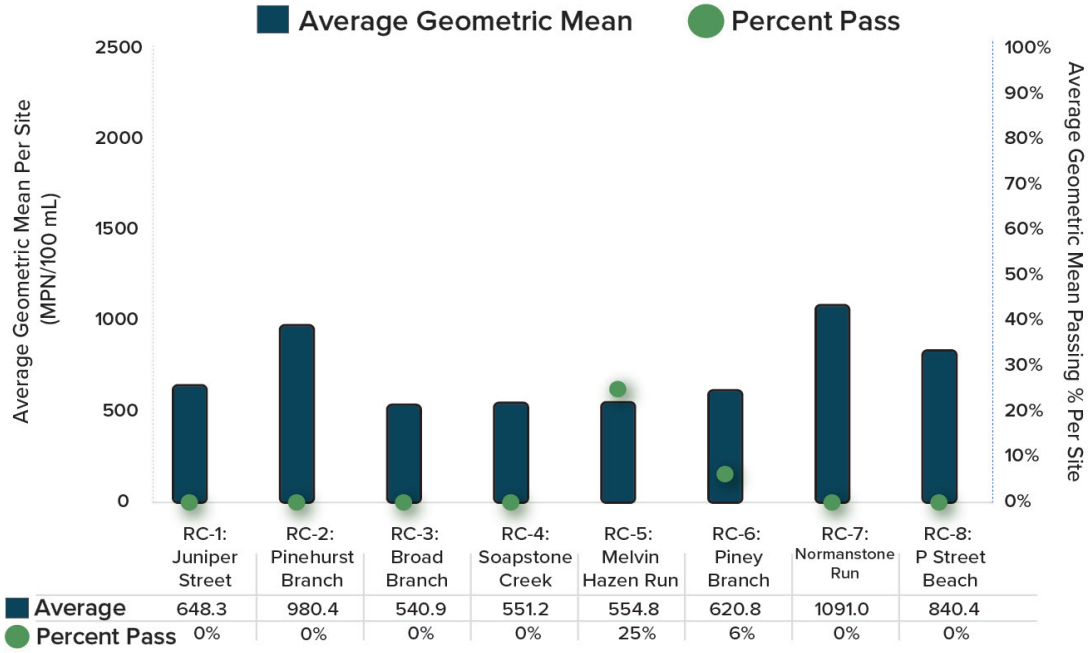
Rock Creek is often referred to as a natural oasis and to the untrained eye appears as a lush green wilderness in the heart of a major city. Spanning from the most northern part of the District at Juniper Street NW, all the way down near the Potomac mainstem at P Street Beach, Rock Creek monitoring sites give full coverage of the watershed in the District. Yet the results of this monitoring project show that the creek itself is more impaired than the Anacostia and Potomac Rivers with regards to bacteria.

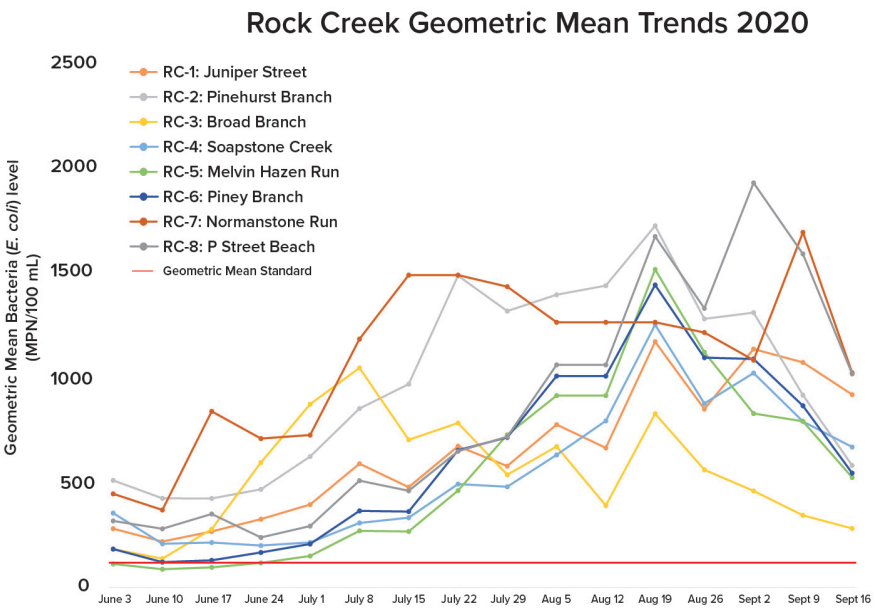
Bacteria (*E. coli*) Passing Percentage 2020: Single-Sample Value



Bacteria single-sample had low passing percentages across most sites, with the lowest passing percentage at Normanstone Run (RC-7), passing only 20% of the season. The highest passing percentage was 55%; which occurred at four out of eight sites: Broad Branch, Soapstone Creek, Melvin Hazen Run, and Rock Creek at Piney Branch (RC-3, 4, 5, 6). **Geometric mean passing percentages are significantly lower than single-sample passing percentages.** Six out of eight sites passed the geometric mean standard 0% of the time, indicating primary contact is generally unsafe from May-September 2020 at those sites. The highest geometric mean passing percentage was at Melvin Hazen Run passing 25% of the time. The consistent failing geometric mean results are a significant indicator of the impairment of the Rock Creek watershed, compared to both the standard and the passing percentages seen in the Anacostia or Potomac Rivers. Geometric mean bacteria levels seem to rise throughout the summer, with the second half of the season higher for most sites compared to the first half of the season. Pinehurst Branch, Soapstone Creek, Melvin Hazen Run, and Piney Branch tracked together over this time, generally showing an increase in geometric mean from July 15 which peaked on the week of August 19. There were sampling periods of heavy rain and peak water temperature (over 20 °C) that may have increased these numbers, but many doubled if not tripled their geometric mean values. Normanstone Run was unique with higher geometric mean levels in the early half of the season but decreased in the later half, suggesting the source may not be rain-related and is constantly flowing into the stream.

Rock Creek Bacteria (*E. coli*) Geometric Mean 2020





Trends:

- Most impaired waterway in the District for bacteria
- High recreational activity with primary water contact during 2020
- Very low passing percentage for geometric mean, low swimmable potential currently

Insights:

- Normanstone may have a bacteria source that is not rain-related
- High water contact activities spurred #RecreateResponsibly signs advising against water contact at common wading and swimming spots along Rock Creek
- Storm drains in Rock Creek should be inspected internally to see if there are sewer lines coming from homes or businesses inadvertently connected to the stormdrains instead of into a sanitary sewer line.

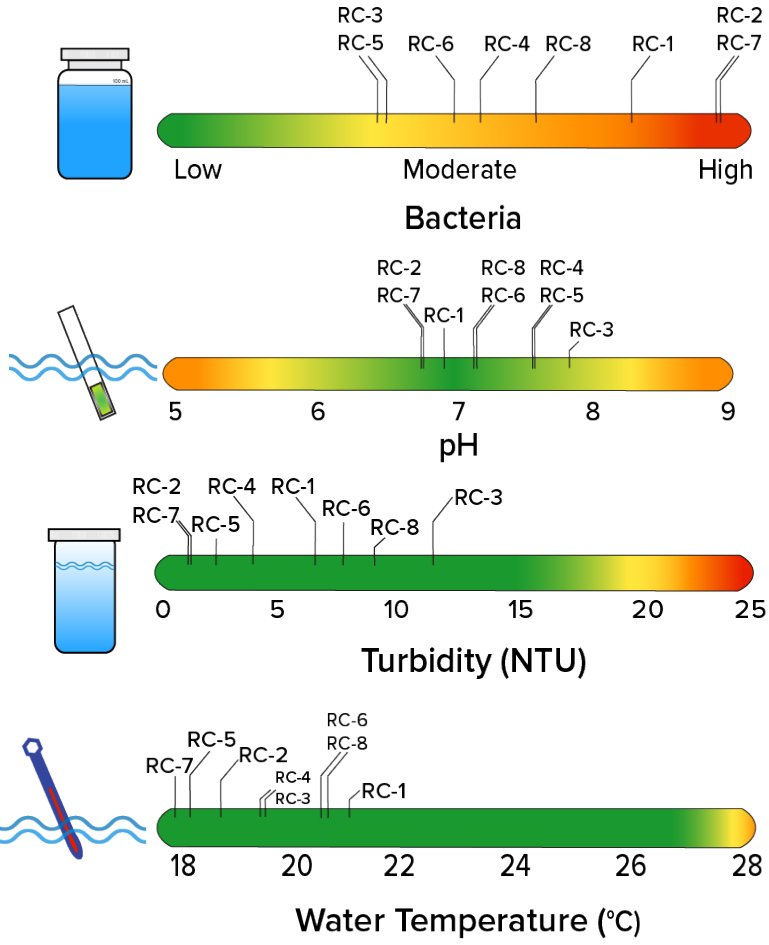
All Rock Creek monitoring sites were within the healthy range for all three water quality parameters: turbidity, pH, and water temperature. All but one site (Broad Branch) had turbidity levels under 10 NTU, making the sites on average relatively clear, even though some weeks sites spiked to 40 or 50 NTU. The lowest average turbidity was 2.0 NTU at Pinehurst Branch (RC-2) and Normanstone Run.

Alkalinity (pH) remained constant, around a 7, with Broad Branch having the highest pH average at 7.78.

Water temperature was also within a healthy zone, falling well below the water temperature standard of 32.3 °C at an average of 18-20 °C, supporting the theory that tree canopy coverage minimizing direct sun on the water will significantly lower water temperature compared to more open water areas (e.g., mainstem Anacostia had water temperature averages of 22-26 °C).

Recreation was mostly seen at Juniper Street (RC-1) and Soapstone Creek (RC-4), with sparse recreation at the other sites. Of the 108 people seen recreating in Rock Creek on Wednesday mornings, the majority were engaged in high contact activites; water play by children was noted 80 times. The next frequently seen recreation was contact with water while hiking/crossing streams and contact with wet dogs after they played in the water. This is consistent with increased park usage during the pandemic and the lack of other local and public water activities available.

WATERSHED SNAPSHOT 2020



*Values are the average (mean) per site for each water quality parameter throughout the 2020 season

Discussion

Water Quality 2019 vs 2020

For this water quality program, 2019 serves as a baseline year (Appendix A), allowing us to assess the progression of overall water quality in District surface waters from year-to-year. With the abundance of capital improvement projects planned and currently underway in the District, we expect to see incremental improvements in overall water quality in all watersheds from year-to-year. To assess the improvements and other watershed changes we focus on the *E. coli* geometric mean (GM) standard for primary contact because, as discussed earlier, it gives a better overview of overall water quality at a site.

In District waters from 2019 to 2020, the 20-week project-wide passing rate for the GM standard rose from 36% to 40%, respectively. This improvement in overall water quality with respect to *E. coli* is attributed to a decrease in bacteria counts in the Anacostia and Rock Creek as well as stable bacteria counts in the Potomac; lending credence to the effectiveness of capital improvement projects in the District like the Anacostia River Tunnel and green infrastructure. The Potomac River GM passing rate only fell from 49% to 48% moving from 2019 to 2020 while both the Anacostia and Rock Creek increased from 34% to 41% and 0.8% to 4%, respectively. While these water quality results still reflect the impact of stormwater and bacteria on our waters, they show a stepwise improvement in bacteria levels over the course of a year, one we hope to continue to see in 2021.

For turbidity, alkalinity, water temperature, and air temperature trends from 2019 to 2020 remained mostly stable over the course of the year for all three watersheds. The Anacostia River continues to record the highest average turbidity across all three watersheds at 11 NTU in 2019 and 10 NTU in 2020, with Rock Creek and the Potomac averages both leveling out at 6 NTU. However, it's important to note that average turbidity values across all three watersheds are still relatively low and all meet the DC primary contact standard for turbidity. Alkalinity remained stable across all watersheds from 2019 to 2020 with all average pH values falling between 6.5 and 7.3, well within DC primary contact standards for pH.

Both air and water temperatures exhibited seasonal trends across the District with the highest temperatures occurring in the summer months and cooler ones bookending the beginning and ending of the sampling season. Both air and water temperatures varied significantly across the watersheds with average Rock Creek water measuring 19-20 °C, the Potomac measuring 22-23 °C, and the Anacostia measuring several degrees higher at 24 °C. This almost 4 °C variation in temperature from Rock Creek to the Anacostia can most likely be attributed to land use within the watershed and the amount of forested vs. exposed land between the watersheds. Rock Creek and its tributaries are typically shaded and surrounded by park land, diminishing the impact of heating from the sun, however warm stormwater can still cause an increase in local water temperatures after rainstorms.

Geometric Mean Passing Percentage: 2019 vs 2020

▲ Increased	▼ Decreased	— Stayed the same
Anacostia Park	**Kingman Lake**	National Arboretum
Yards Park	**Fletchers Cove**	Hickey Run
Foundry Branch	**Washington Canoe Club**	Buzzard Point
Thompson Boat Center	Broad Branch	Washington Channel
Columbia Island		Battery Kemble Park
Melvin Hazen Run		Tidal Basin
Piney Branch		Juniper Street
		Pinehurst Branch
		Soapstone Creek
		Normanstone Run
		P Street Beach

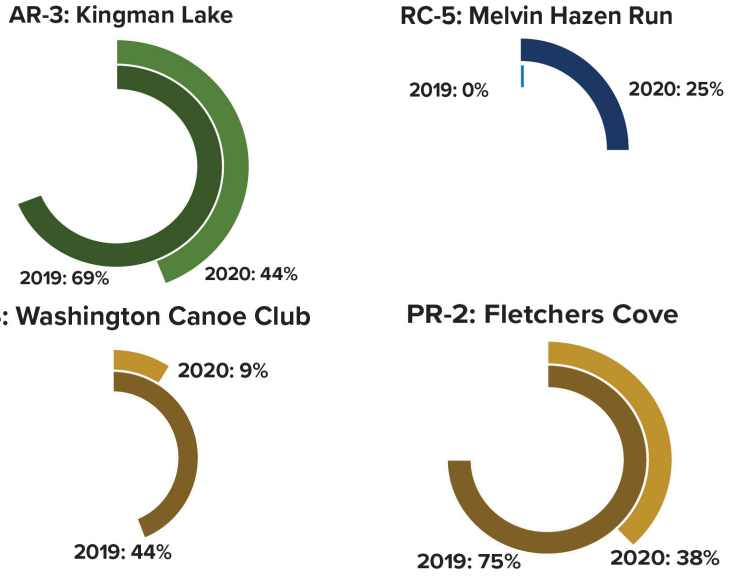
The Anacostia and its tributaries, on the other hand, are more exposed to solar heating due to less tree cover and park land as well as the presence of an increased concentration of impervious surfaces in the Anacostia watershed.

The biggest question that arises from the year-to-year fluctuations in water quality throughout the District is: **What are the primary drivers affecting water quality in the District as a whole and on a watershed scale?**

In a city with an antiquated sewage system and a high amount of impervious surfaces, **precipitation seems to be the largest driving factor in short-term water quality fluctuations** throughout the District. In 2019 and 2020, 61% more sites passed daily recreational standards for bacteria when less than 0.5 inches of rain had fallen within 72 hours of sampling.

When more that 0.5 inches of rain was recorded in the 72 hours before sampling only ~9 sites on average were projected to pass daily recreational standards, while if less than 0.5 inches of rain was recorded 72 hours before sampling ~14 sites on average were projected to pass.

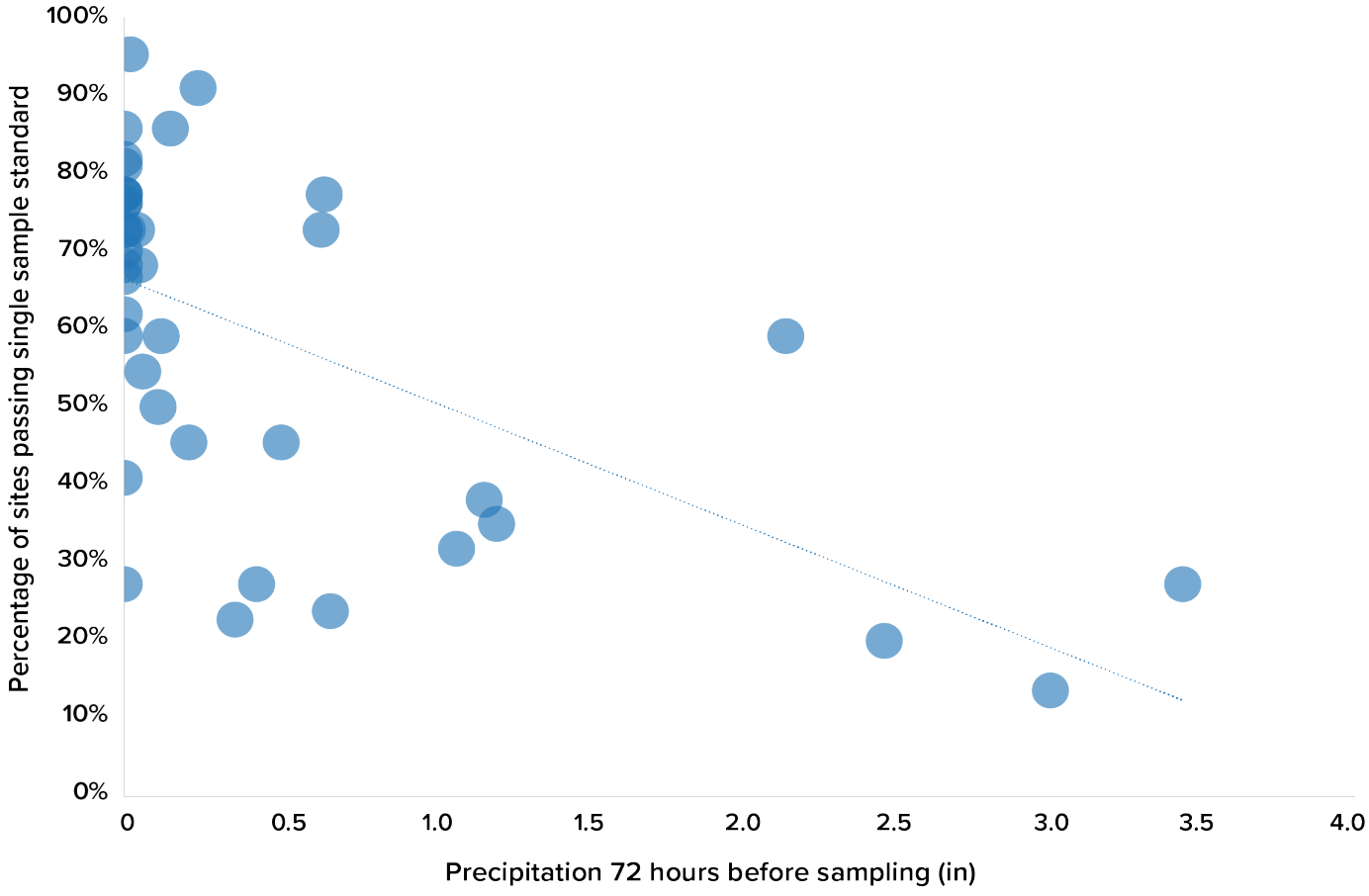
Geometric Mean Passing Percent Change 2019 vs 2020 for Selected Sites



Average Number of Passing Sites with Heavy Rain	8.7
Average Number of Passing Sites with Little-No Rain	14.3

*Passing: Single Sample Standard
Heavy Rain >0.5 in rainfall
2019 and 2020 data combined

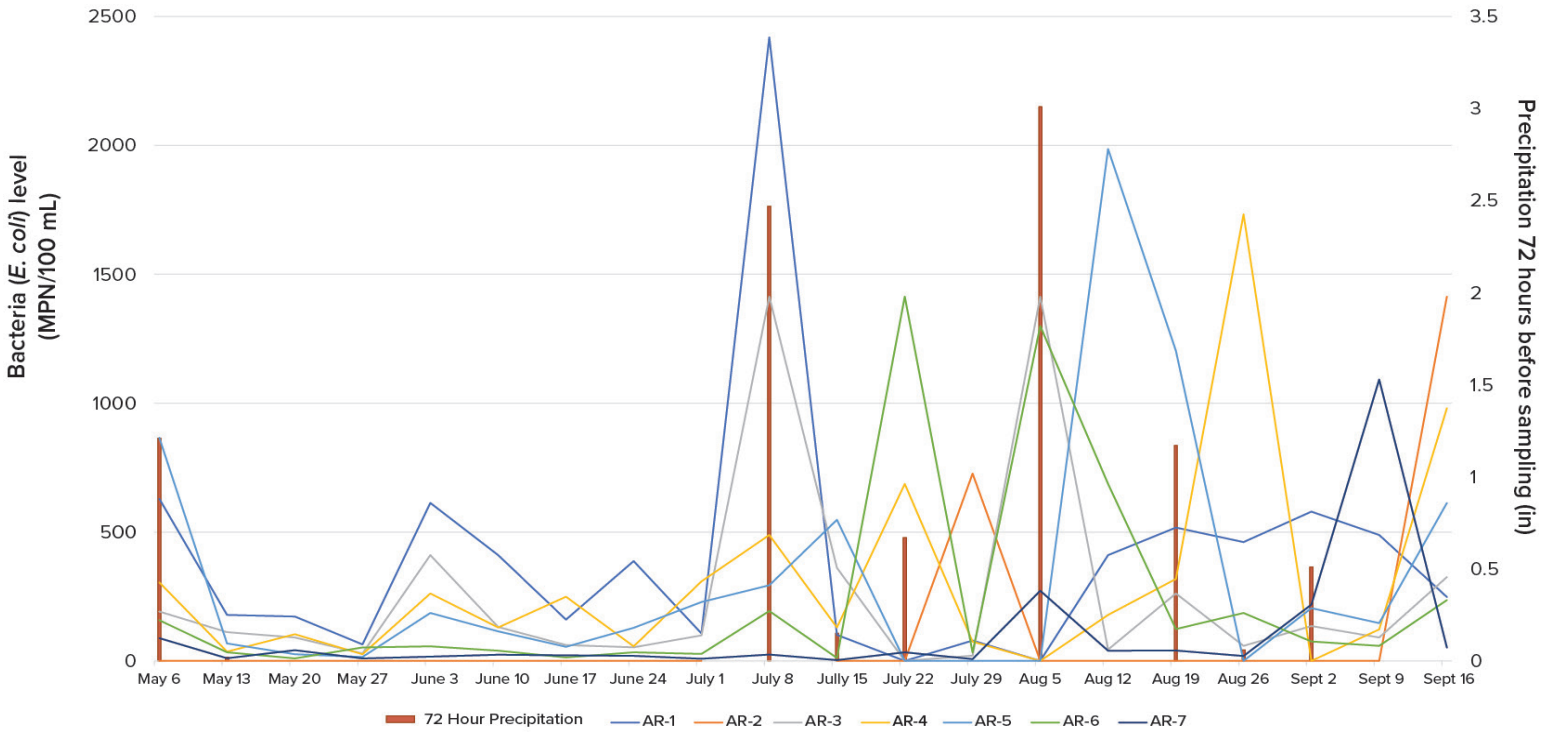
2019 and 2020 Single Sample Passing % vs 72 hour Precipitation



The likewise increase in turbidity values after large precipitation events suggests a link between high turbidity and elevated bacterial counts in District waters. For example, the Tidal Basin (PR-6) has one of the lowest average turbidity values (5.2 NTU) across the District and had a GM passing rate of 100% in both 2019 and 2020; meanwhile, Anacostia Park (AR-4) has one of the highest average turbidity values (14.1 NTU) and GM passing rates of only 6.3% and 25% for 2019 and 2020, respectively.

This clear distinction between wet weather and dry weather water quality across all three watersheds supports our and our partners' recommendation to avoid direct contact with surface waters up to 72 hours after a large precipitation event. Despite 8.8 inches more rain through the 2020 season compared to 2019, the overall GM passing rate still rose from 36% in 2019 to 40% in 2020, giving even more evidence to the effectiveness of the District's stormwater and capital improvement projects. These appear to be mitigating and diverting enough stormwater away from our waterways to boost overall water quality throughout the year.

Anacostia River 2020 Single Sample Bacteria Values vs 72 hour Precipitation (in)



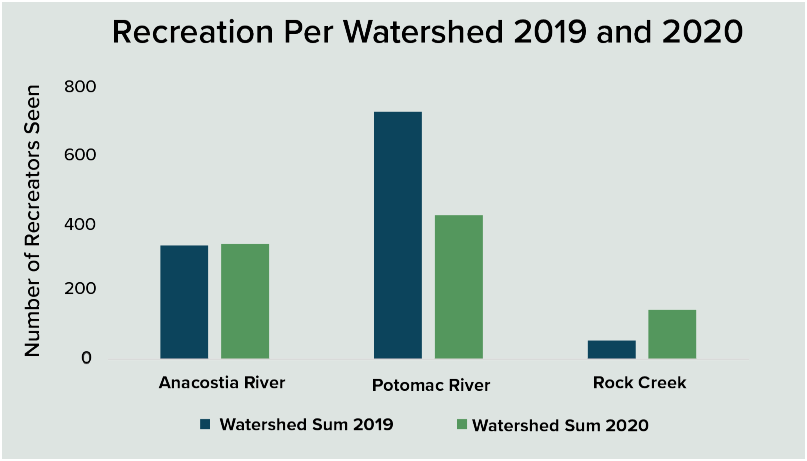
Recreational Use 2019 vs 2020

In addition to water quality data, recreational use data was collected across all watersheds for both 2019 and 2020. From 2019 to 2020, observed recreation on or near District waterbodies decreased by 13% city wide. While recreational activity increased on both the Anacostia (+36%) and Rock Creek (+160%), it dropped significantly on the Potomac (-39%), causing an overall decrease in total observed water recreation activities over the course of the summer. Increases in both the Anacostia and Rock Creek are attributed to the COVID-19 pandemic and spring lockdown that occurred before sampling, causing residents and visitors to spend more time in outdoor recreation spaces along the water. Much of Rock Creek and Anacostia recreation is focused on singular or small group activities like dog walking, kayaking, and power boating, meaning that participants could still take advantage of water-based recreation activities while still adhering to public safety standards. In our opinion, decreases from 2019 to 2020 on the Potomac are due to the COVID-19 pandemic limiting the type of recreation that citizens could enjoy on the water. On the Potomac in 2019 one of the primary recreational uses of the river was crew, requiring participants to be in close proximity on smaller sized watercraft, something that may have been limited in 2020 due to COVID-19 restrictions.

Recreation observations in 2020 exhibited both increases and decreases in select activities across the city. Along the Anacostia River volunteers recorded a decrease in power boat use while activities like fishing and rowing increased. Contact with dogs and on-water recreation like kayaking and direct contact with the water increased in Rock Creek and the Potomac, reflecting recreational changes due to COVID-19. Data supports the observation that the pandemic caused a shift in preferred recreation type across all waterbodies from 2019 to 2020, with larger group activities or those with close proximity to others being replaced by smaller, single or small group activities. An increase in wading in Rock Creek was particularly concerning due to frequent periods of poor water quality and may reflect the closing of many public facilities and fountains used officially and unofficially by DC residents to keep cool in the warmer summer months.

In 2021, if the pandemic continues to cause facility closures next summer, it is imperative that safe recreational opportunities be available to District residents – particularly those without yards (in which to put a slip and slide, baby pool, or sprinkler) or without access to private pools. While water quality regulations focus on human health, pets can also be harmed by contact with contaminated water. **The data collected in both years suggests significant use of the creek by dogs, which presumably are off leashes**. National Park Service regulations require that dogs be on leash in Rock Creek Park.

Pet waste may be a contributor to bacteria levels around the city, and in Rock Creek particularly. While the results represent a small portion of the annual visitation of Rock Creek, they align with Rock Creek Conservancy's and Audubon Naturalist Society's observations more generally in the area and with anecdotal reports from National Park Service staff indicating increased park visitation during the pandemic.



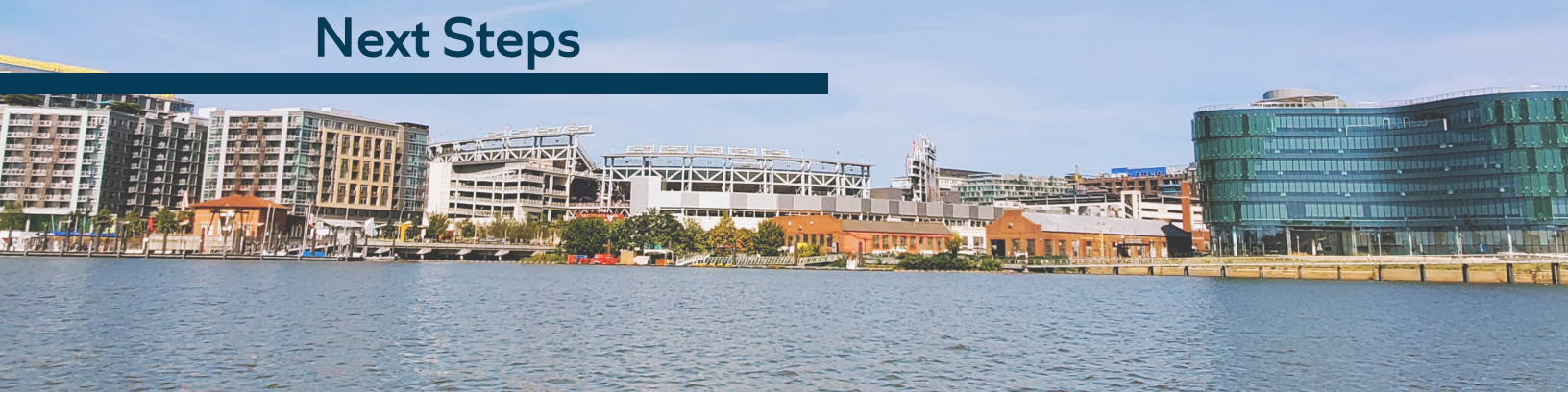
Recreation Changes Per Watershed 2019 vs 2020

Anacostia River	Potomac River	Rock Creek
Rowing/sculling, Sailing, and Flshing ▲	Kayaking, contact with wet dogs ▲	Water play by children contact with water while hiking ▲
Power Boating ▼	Rowing/sculling, Paddle boarding/swan boat ▼	Contact with wet dogs after playing in water ▼
Total Recreation ▬	Total Recreation ▼	Total Recreation ▲

*Recreation surveys taken on Wednesday only

Poster credit: RCC

Next Steps



Where can I find the data?

During the monitoring season data is available on Anacostia Riverkeeper's website at anacostiariverkeeper.org/dc-water-quality. 24 - 48 hours after sampling.

Data for the whole season can also be accessed on our Water Reporter Maps here and on Chesapeake Monitoring Cooperative here (CMC).

How can I get involved?

Training for the new wave of volunteers will begin in April 2021. Once you have completed a training session and in person demo, you can sign up across any of the three watersheds. You can sample as much or as little as you would like, with collection time on Wednesday morning ranging from 7 AM – 12 PM.

To get involved in other Anacostia Riverkeeper's endeavors such as:

- Trash Clean ups
- Friday Night Fishing
- Outreach

Email Anacostia Riverkeeper at info@anacostiariverkeeper.org.

What's next for water quality in DC?

DOEE is actively assessing and analyzing the most current water quality data around the District, including data from this water quality monitoring program. The goal is to have portions of District waters swimmable in the near future, however there is still no confirmed timeline or plan for swimming. More legs of the Clean Rivers Project will open in the next 10 years and continue to decrease sewage overflow volume into our rivers. Anacostia Riverkeeper is also working with an AI Forecast Modeling company, DataRobot, to perform bacteria modeling based on current water quality conditions of turbidity, precipitation, water temperature, and more.

Thanks to our funder:

DEPARTMENT OF ENERGY & ENVIRONMENT

WE ARE WASHINGTON DC GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

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Audubon Naturalist Society
Connecting people with nature in the DC Region

POTOMAC RIVERKEEPER® NETWORK

ROCK CREEK CONSERVANCY

Special thanks to Anacostia Riverkeeper staff Olivia Anderson, Robbie O'Donnell, and Maricruz Zarco for their dedicated work on this report.

Monitoring inquries: monitor@anacostiariverkeeper.org
General inquiries: info@anacostiariverkeeper.org

@AnacostiaRrkpr

Anacostia Riverkeeper

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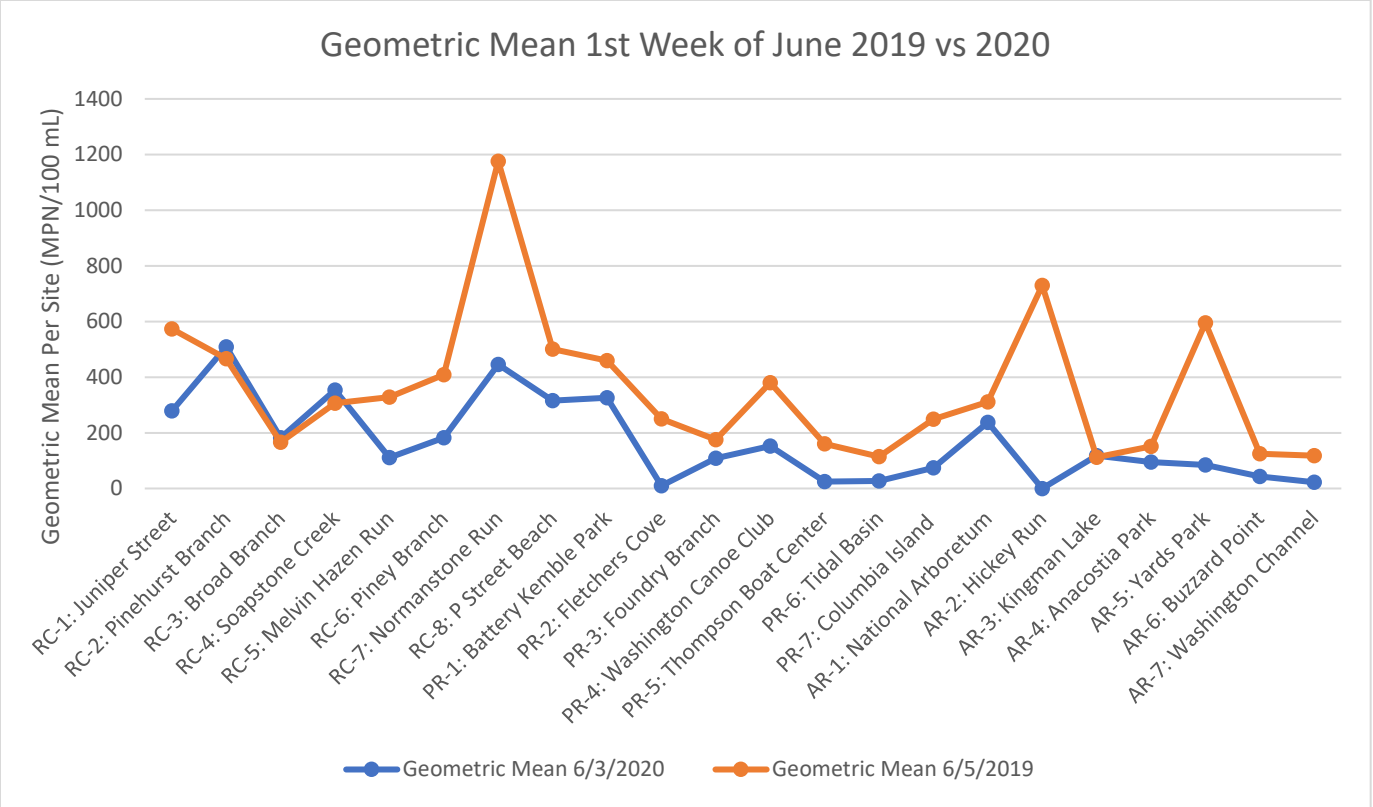
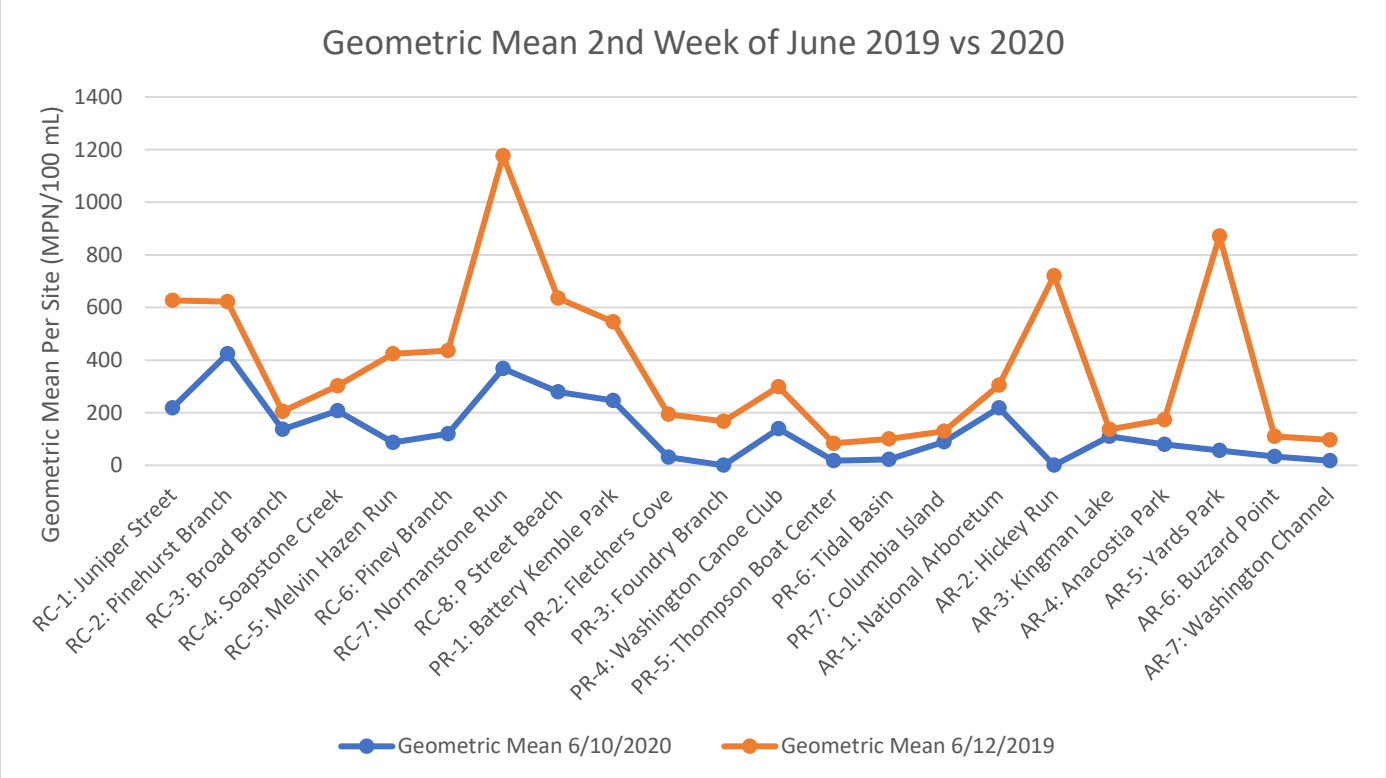
www.anacostiariverkeeper.org
(202) 863 - 0158

Anacostia RIVERKEEPER®

Appendix A


Geometric Mean 1st Week of June 2019 vs 2020
Geometric Mean Per Site (MPN/100 mL)
1400
1200
1000
800
600
400
200
0
RC-1: Juniper Street
RC-2: Pinehurst Branch
RC-3: Broad Branch
RC-4: Soapstone Creek
RC-5: Melvin Hazen Run
RC-6: Piney Branch
RC-7: Normanstone Run
RC-8: P Street Beach
PR-1: Battery Kemble Park
PR-2: Fletchers Cove
PR-3: Foundry Branch
PR-4: Washington Canoe Club
PR-5: Thompson Boat Center
PR-6: Tidal Basin
PR-7: Columbia Island
AR-1: National Arboretum
AR-2: Hickey Run
AR-3: Kingman Lake
AR-4: Anacostia Park
AR-5: Yards Park
AR-6: Buzzard Point
AR-7: Washington Channel
Geometric Mean 6/3/2020
Geometric Mean 6/5/2019


Geometric Mean 2nd Week of June 2019 vs 2020
Geometric Mean Per Site (MPN/100 mL)
1400
1200
1000
800
600
400
200
0
RC-1: Juniper Street
RC-2: Pinehurst Branch
RC-3: Broad Branch
RC-4: Soapstone Creek
RC-5: Melvin Hazen Run
RC-6: Piney Branch
RC-7: Normanstone Run
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PR-1: Battery Kemble Park
PR-2: Fletchers Cove
PR-3: Foundry Branch
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PR-5: Thompson Boat Center
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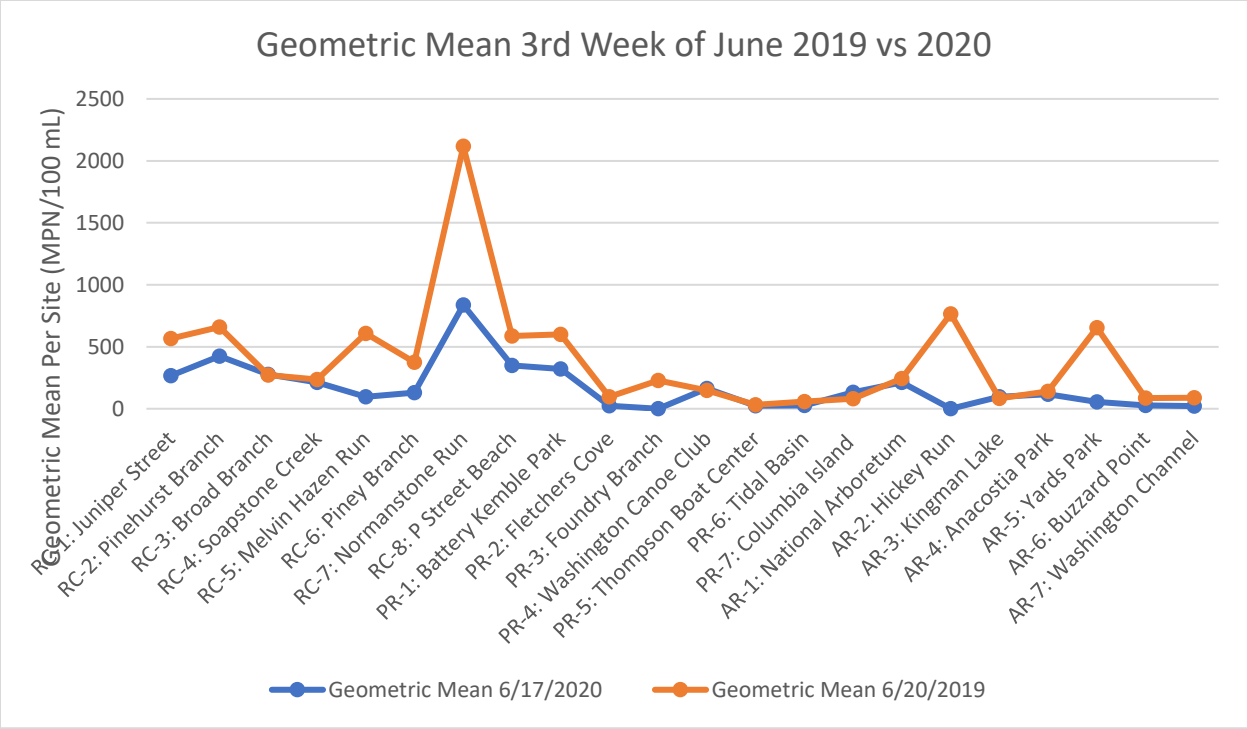
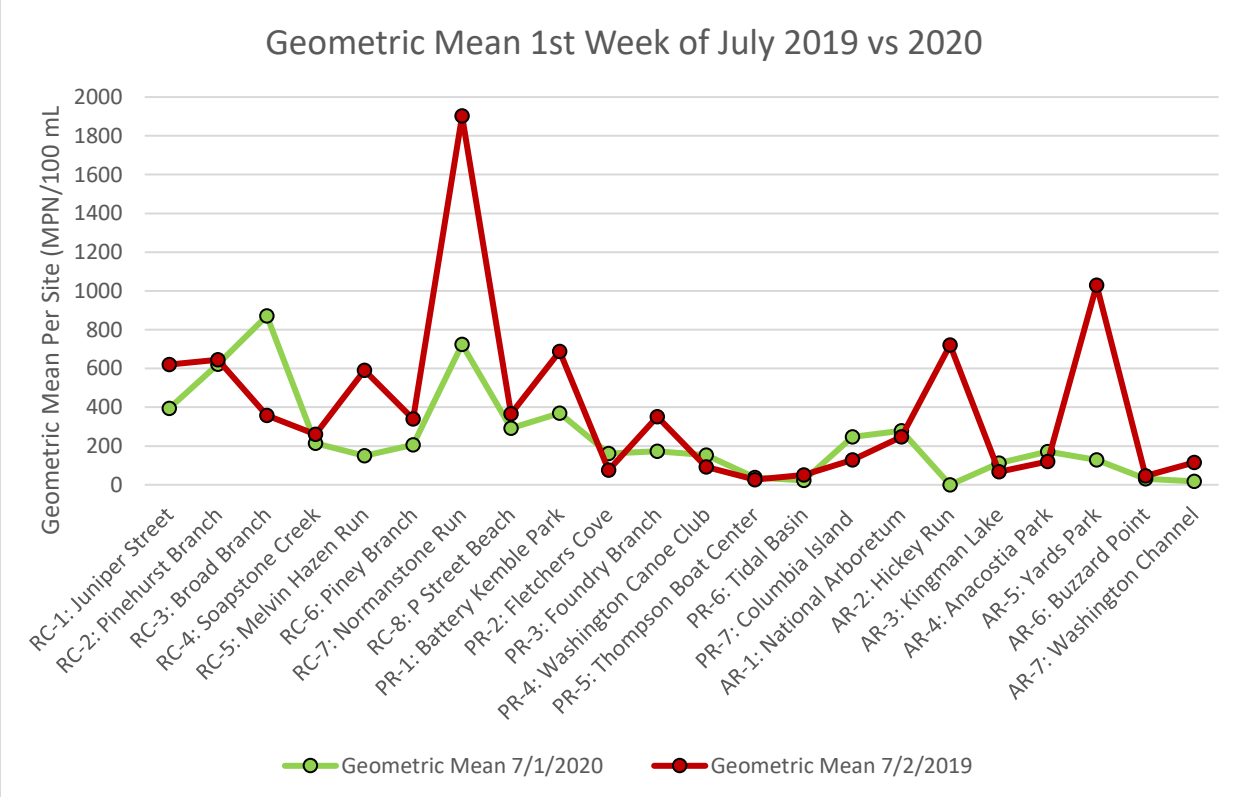
PR-7: Columbia Island
AR-1: National Arboretum
AR-2: Hickey Run
AR-3: Kingman Lake
AR-4: Anacostia Park
AR-5: Yards Park
AR-6: Buzzard Point
AR-7: Washington Channel
Geometric Mean 6/10/2020
Geometric Mean 6/12/2019


Geometric Mean 3rd Week of June 2019 vs 2020
Geometric Mean Per Site (MPN/100 mL)
2500
2000
1500
1000
500
0
RC-1: Juniper Street
RC-2: Pinehurst Branch
RC-3: Broad Branch
RC-4: Soapstone Creek
RC-5: Melvin Hazen Run
RC-6: Piney Branch
RC-7: Normanstone Run
RC-8: P Street Beach
PR-1: Battery Kemble Park
PR-2: Fletchers Cove
PR-3: Foundry Branch
PR-4: Washington Canoe Club
PR-5: Thompson Boat Center
PR-6: Tidal Basin
PR-7: Columbia Island
AR-1: National Arboretum
AR-2: Hickey Run
AR-3: Kingman Lake
AR-4: Anacostia Park
AR-5: Yards Park
AR-6: Buzzard Point
AR-7: Washington Channel
Geometric Mean 6/17/2020
Geometric Mean 6/20/2019


Geometric Mean 1st Week of July 2019 vs 2020
Geometric Mean Per Site (MPN/100 mL
2000
1800
1600
1400
1200
1000
800
600
400
200
0
RC-1: Juniper Street
RC-2: Pinehurst Branch
RC-3: Broad Branch
RC-4: Soapstone Creek
RC-5: Melvin Hazen Run
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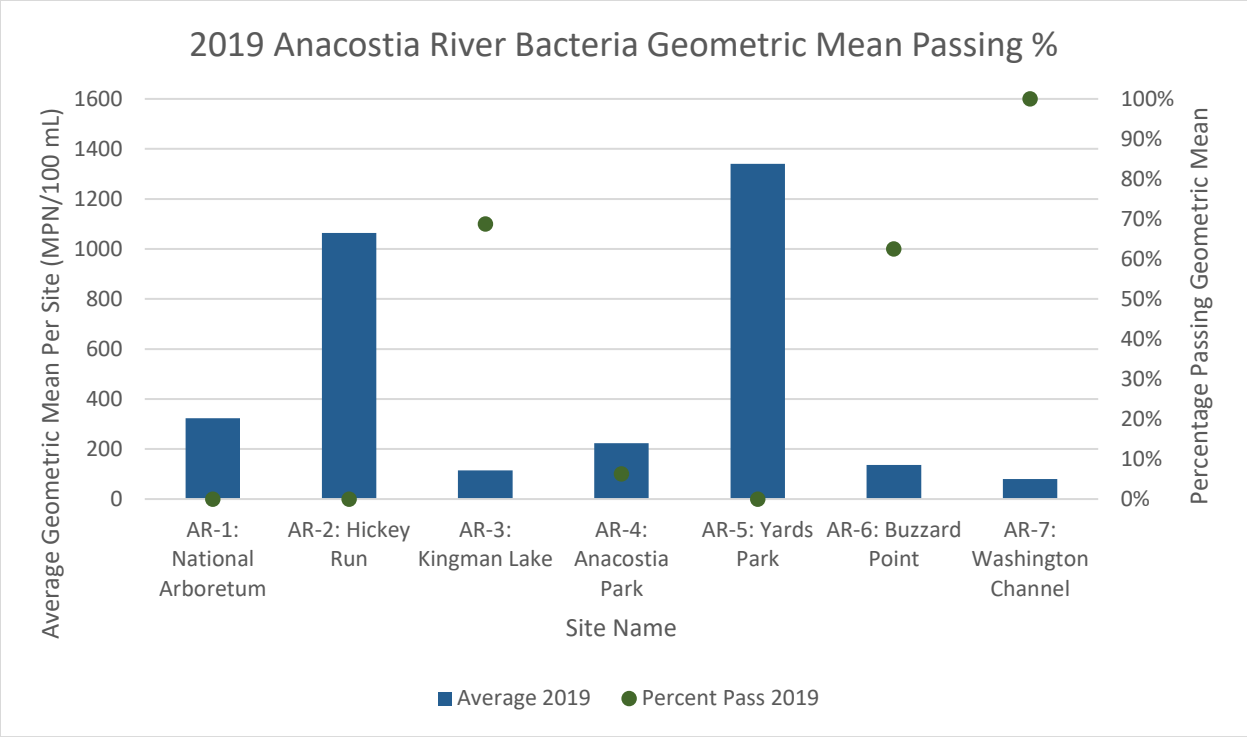
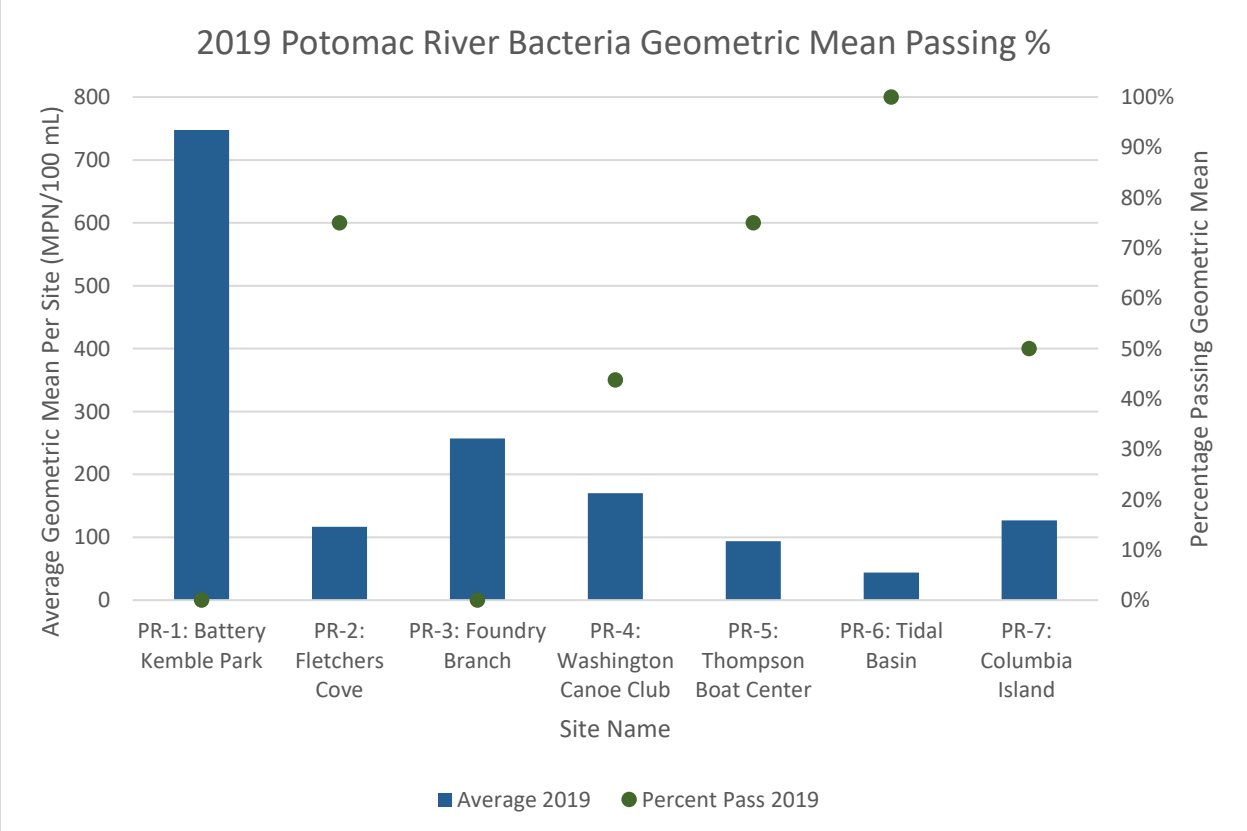
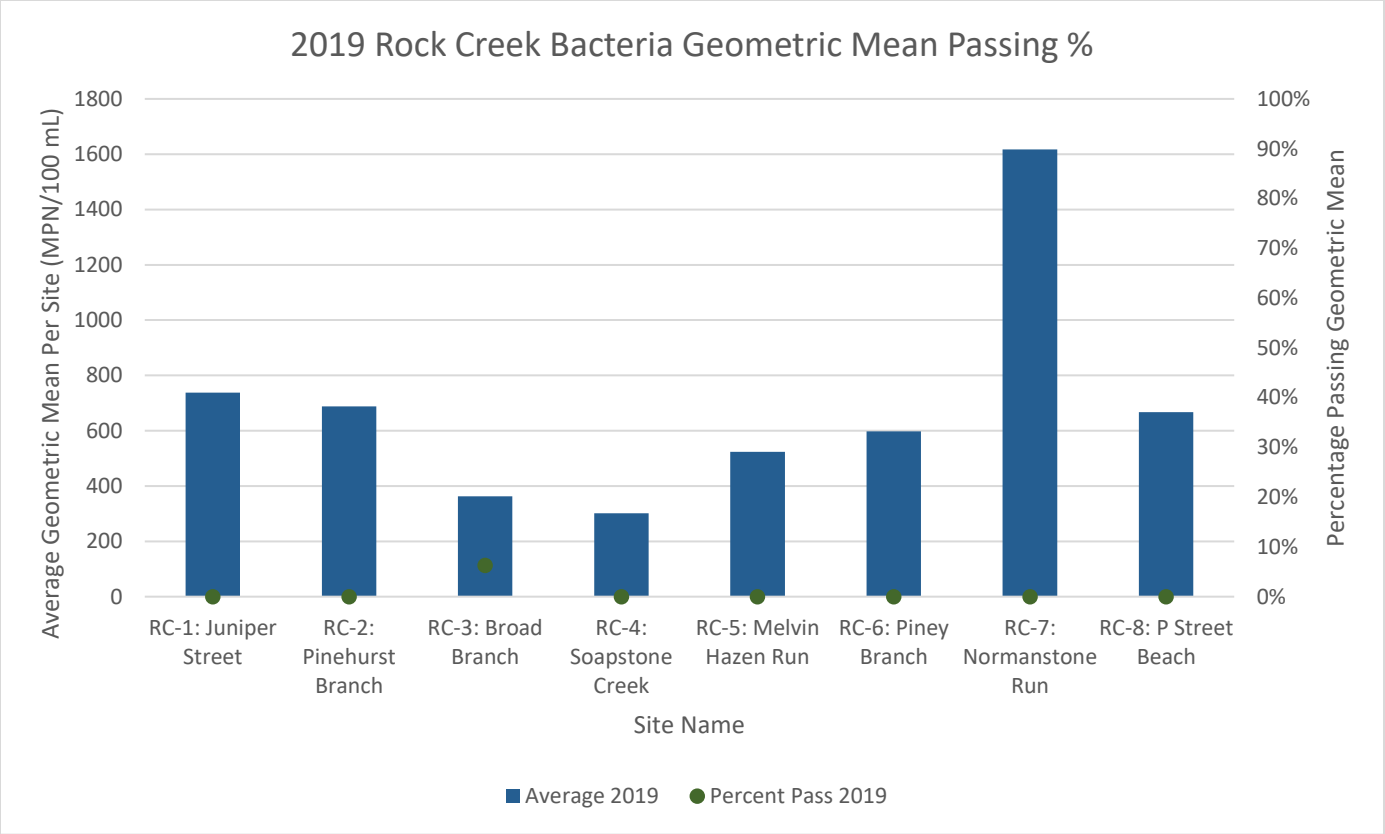
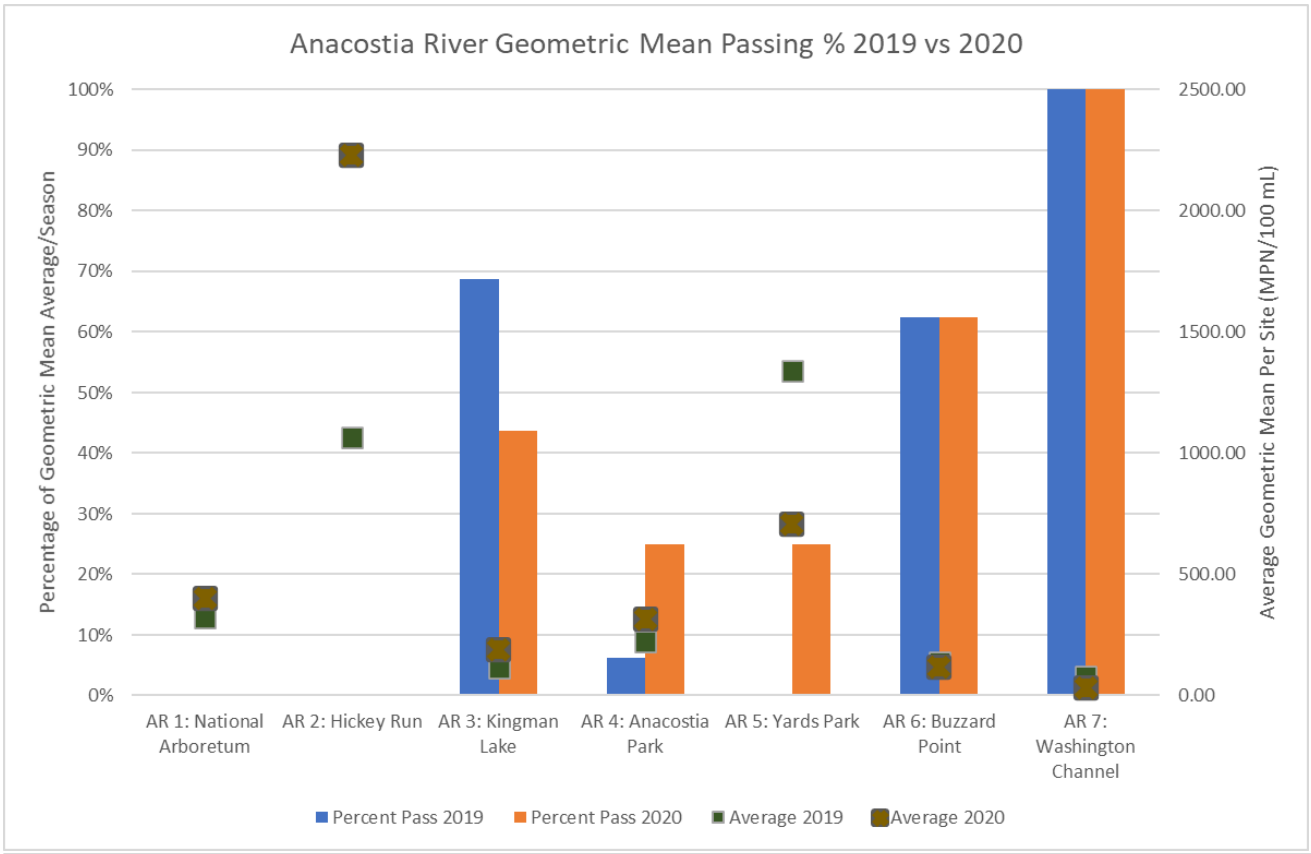
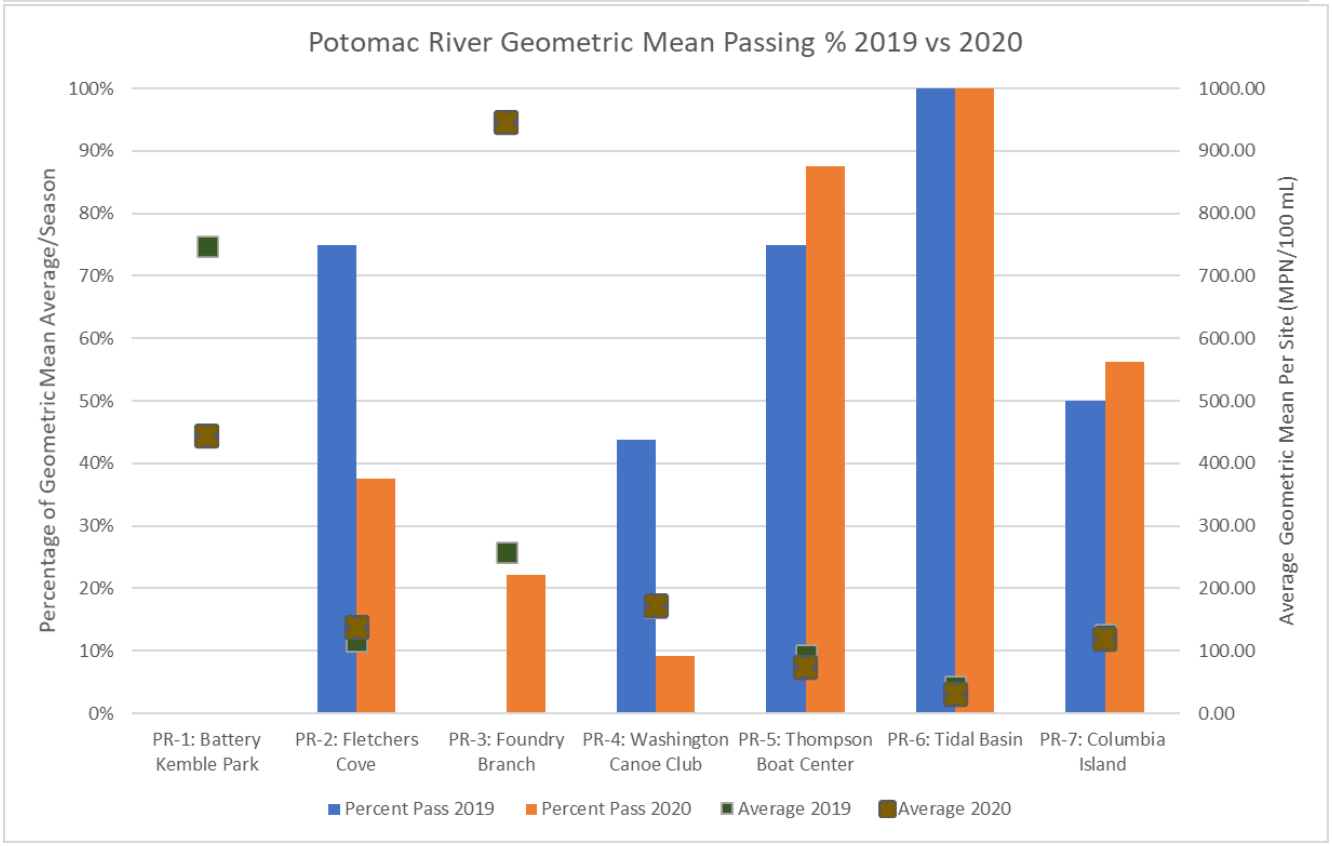
AR-2: Hickey Run
AR-3: Kingman Lake
AR-4: Anacostia Park
AR-5: Yards Park
AR-6: Buzzard Point
AR-7: Washington Channel
Geometric Mean 7/1/2020
Geometric Mean 7/2/2019

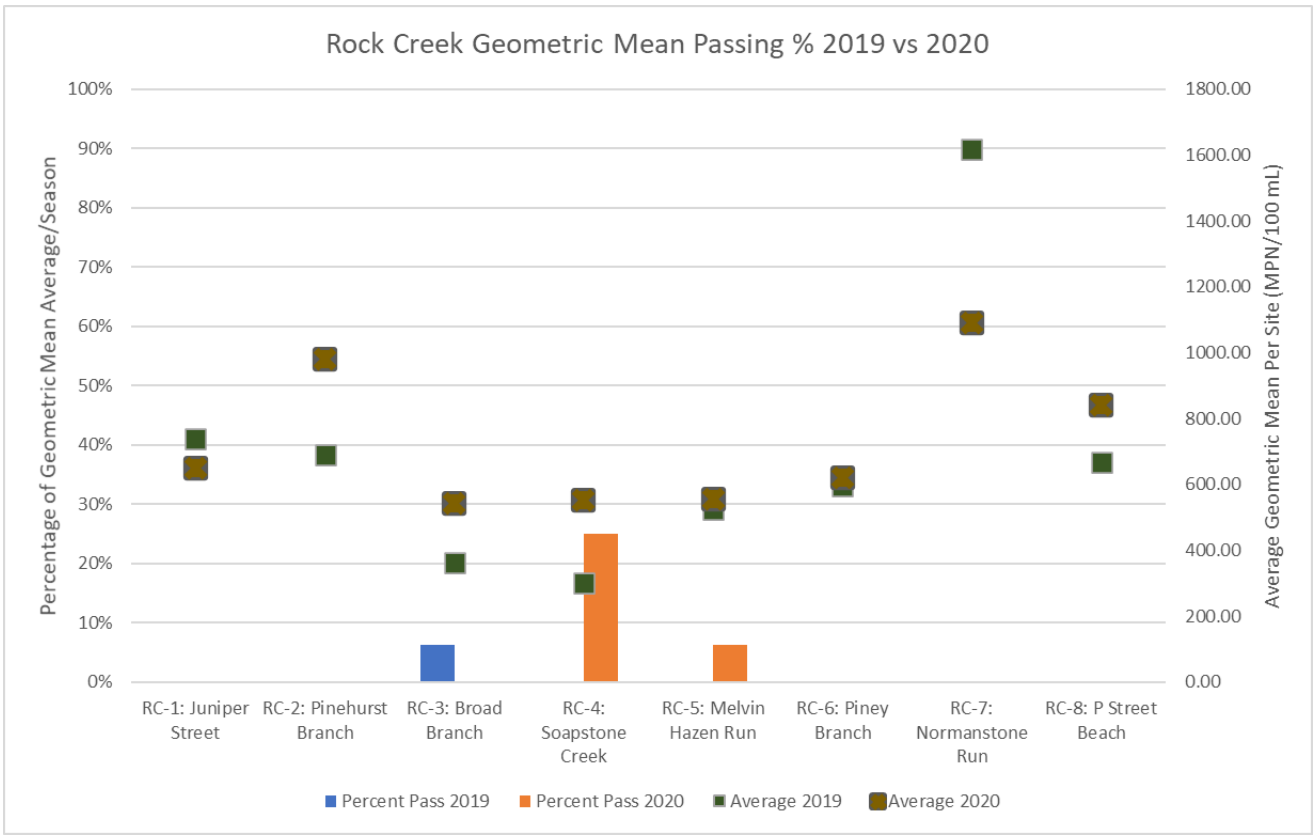

2019 Anacostia River Bacteria Geometric Mean Passing %
Average Geometric Mean Per Site (MPN/100 mL)
Percentage Passing Geometric Mean
1600
1400
1200
1000
800
600
400
200
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
AR-1: National Arboretum
AR-2: Hickey Run
AR-3: Kingman Lake
AR-4: Anacostia Park
AR-5: Yards Park
AR-6: Buzzard Point
AR-7: Washington Channel
Site Name
Average 2019
Percent Pass 2019

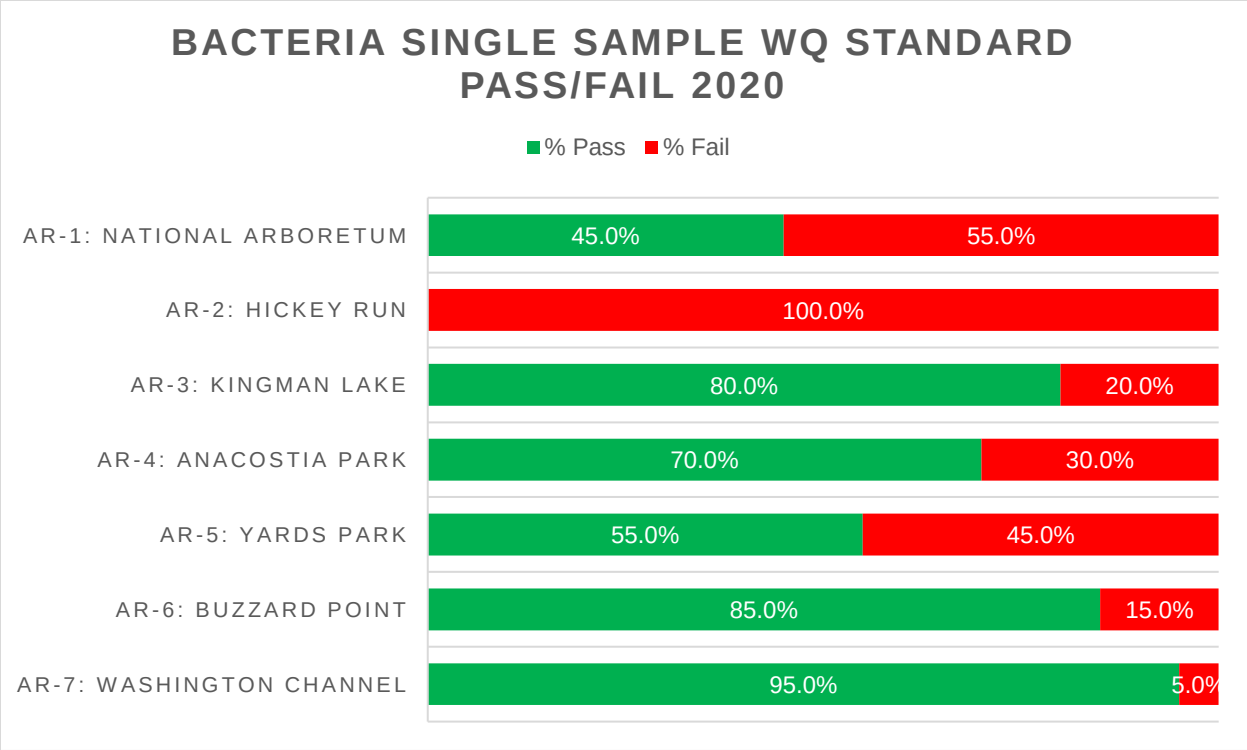

2019 Potomac River Bacteria Geometric Mean Passing %
Average Geometric Mean Per Site (MPN/100 mL)
Percentage Passing Geometric Mean
800
700
600
500
400
300
200
100
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
PR-1: Battery Kemble Park
PR-2: Fletchers Cove
PR-3: Foundry Branch
PR-4: Washington Canoe Club
PR-5: Thompson Boat Center
PR-6: Tidal Basin
PR-7: Columbia Island
Site Name
Average 2019
Percent Pass 2019

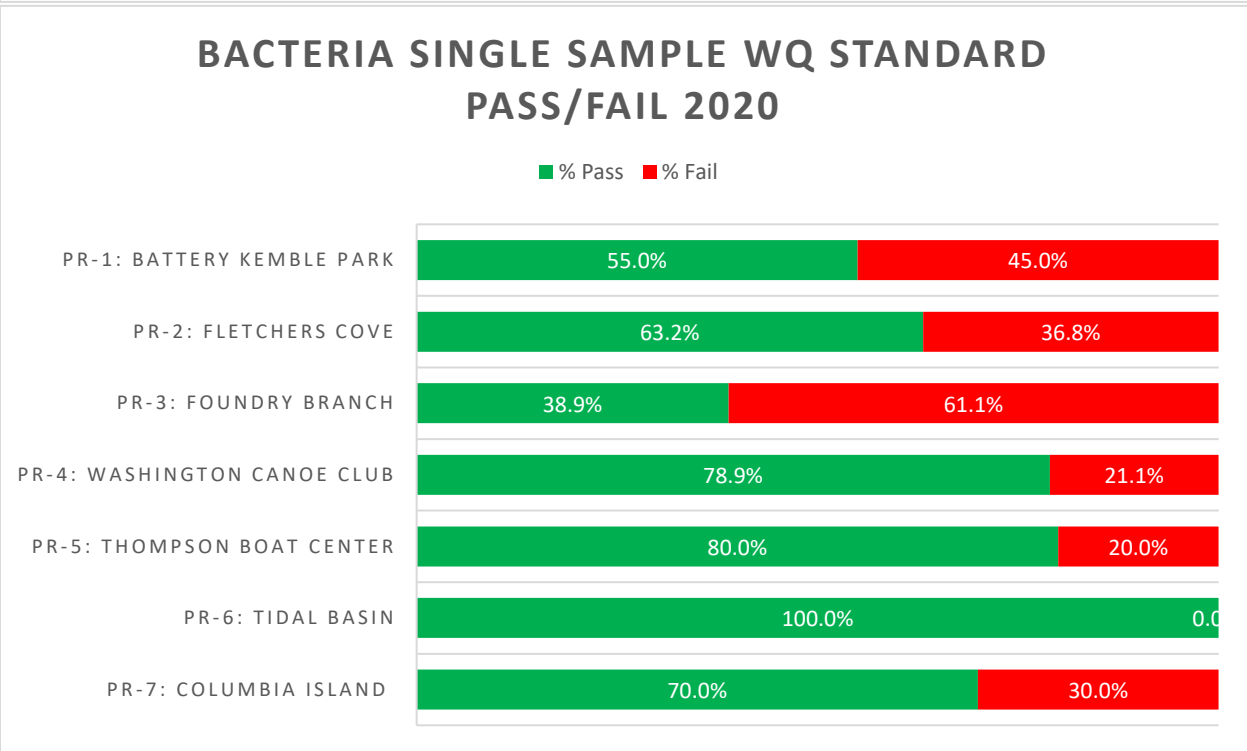

2019 Rock Creek Bacteria Geometric Mean Passing %
Average Geometric Mean Per Site (MPN/100 mL)
1800
1600
1400
1200
1000
800
600
400
200
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage Passing Geometric Mean
RC-1: Juniper Street
RC-2: Pinehurst Branch
RC-3: Broad Branch
RC-4: Soapstone Creek
RC-5: Melvin Hazen Run
RC-6: Piney Branch
RC-7: Normanstone Run
RC-8: P Street Beach
Site Name
Average 2019
Percent Pass 2019

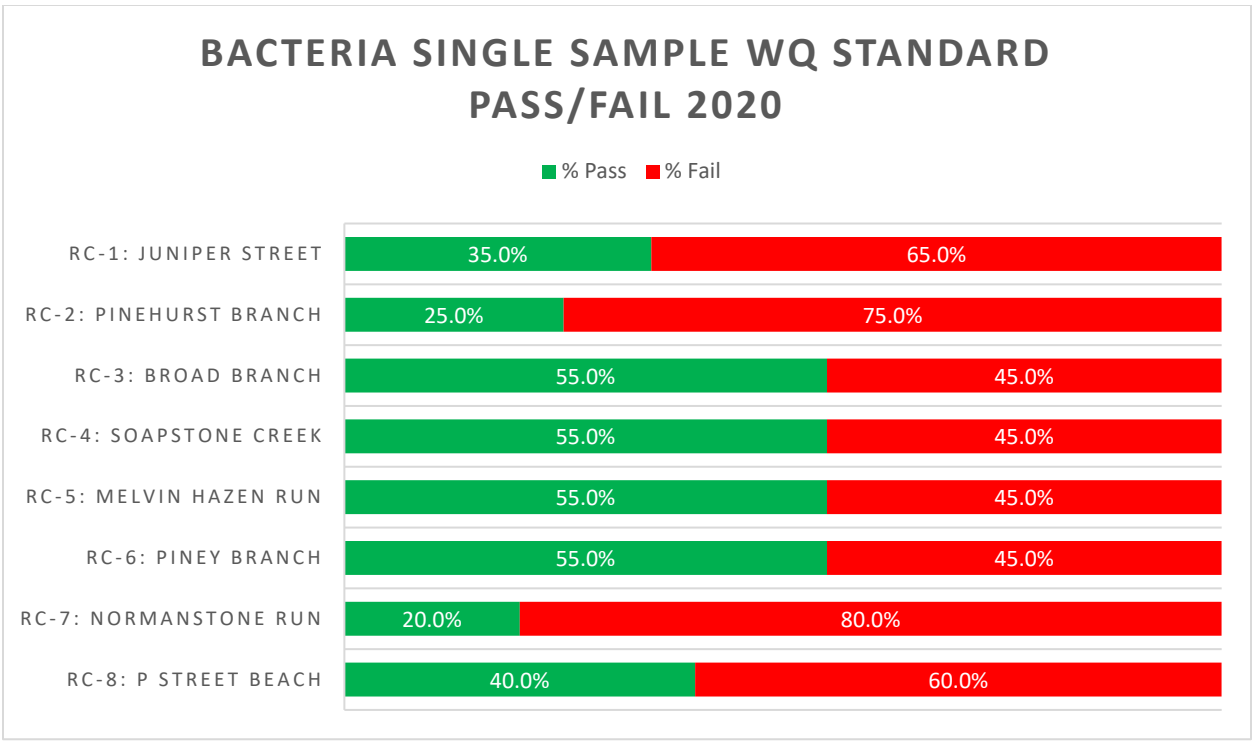

Anacostia River Geometric Mean Passing % 2019 vs 2020
Percentage of Geometric Mean Average/Season
Average Geometric Mean Per Site (MPN/100 mL)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2500.00
2000.00
1500.00
1000.00
500.00
0.00
AR 1: National Arboretum
AR 2: Hickey Run
AR 3: Kingman Lake
AR 4: Anacostia Park
AR 5: Yards Park
AR 6: Buzzard Point
AR 7: Washington Channel
Percent Pass 2019
Percent Pass 2020
Average 2019
Average 2020

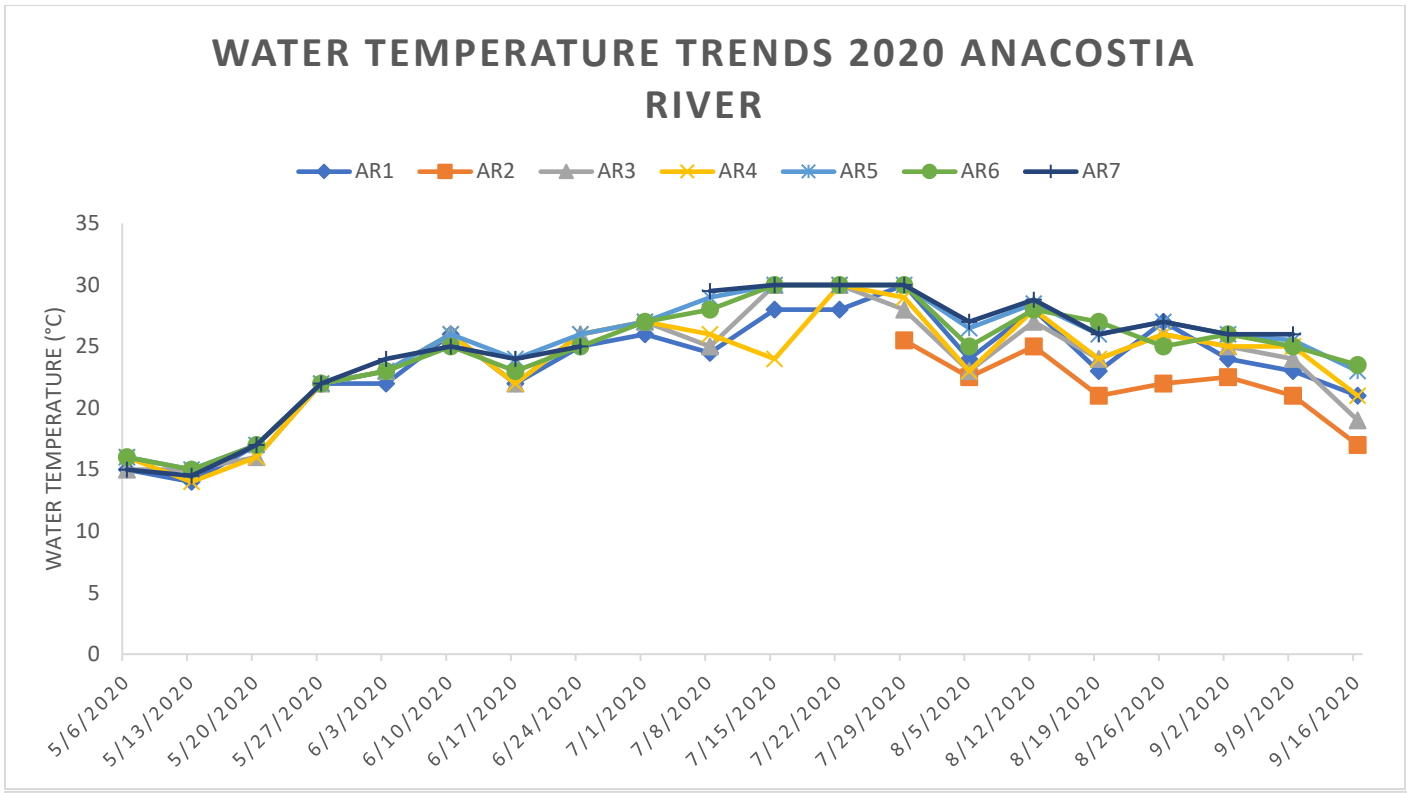

Potomac River Geometric Mean Passing % 2019 vs 2020
Percentage of Geometric Mean Average/Season
Average Geometric Mean Per Site (MPN/100 mL)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1000.00
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
PR-1: Battery Kemble Park
PR-2: Fletchers Cove
PR-3: Foundry Branch
PR-4: Washington Canoe Club
PR-5: Thompson Boat Center
PR-6: Tidal Basin
PR-7: Columbia Island
Percent Pass 2019
Percent Pass 2020
Average 2019
Average 2020

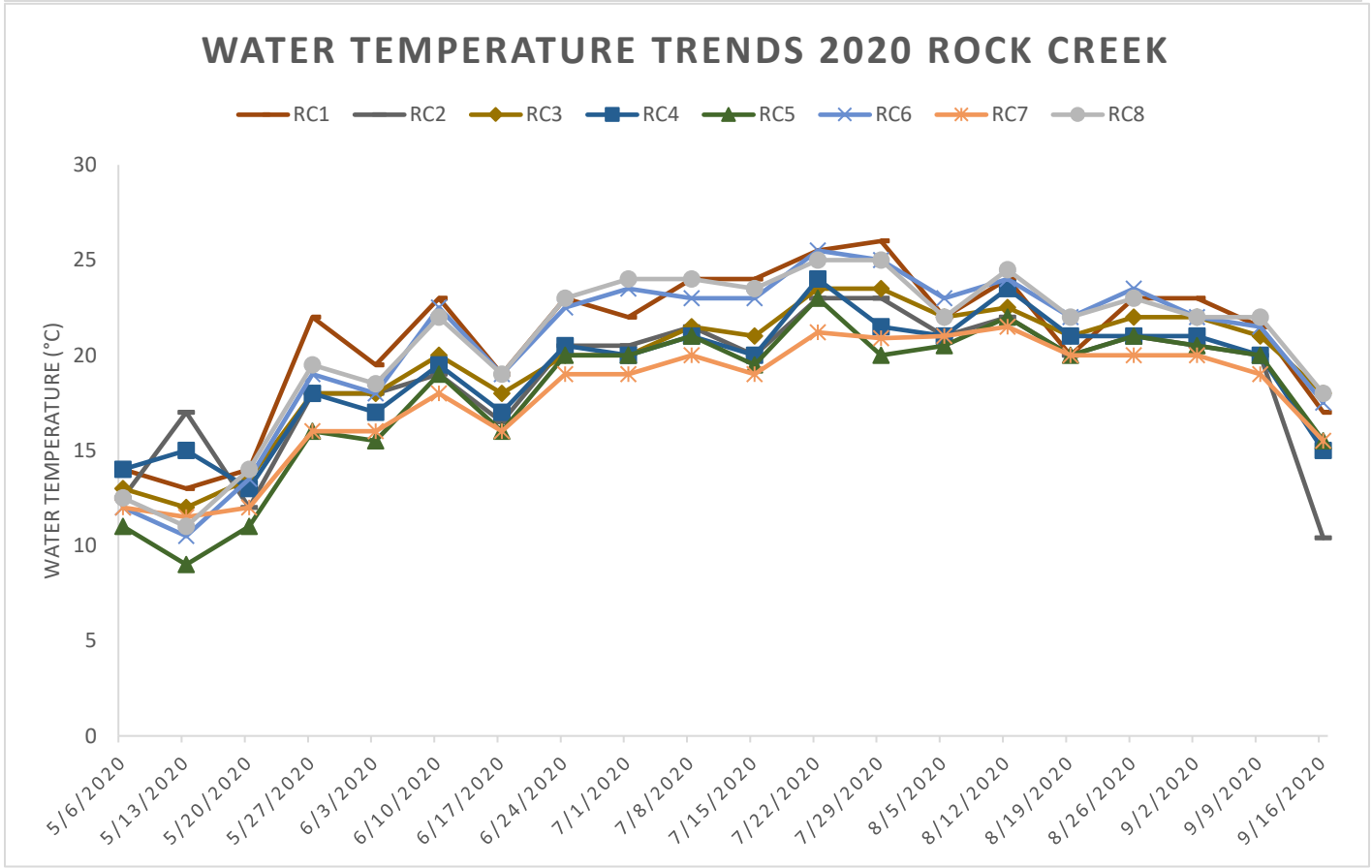

Rock Creek Geometric Mean Passing % 2019 vs 2020
Percentage of Geometric Mean Average/Season
Average Geometric Mean Per Site (MPN/100 mL)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
RC-1: Juniper Street
RC-2: Pinehurst Branch
RC-3: Broad Branch
RC-4: Soapstone Creek
RC-5: Melvin Hazen Run
RC-6: Piney Branch
RC-7: Normanstone Run
RC-8: P Street Beach
Percent Pass 2019
Percent Pass 2020
Average 2019
Average 2020

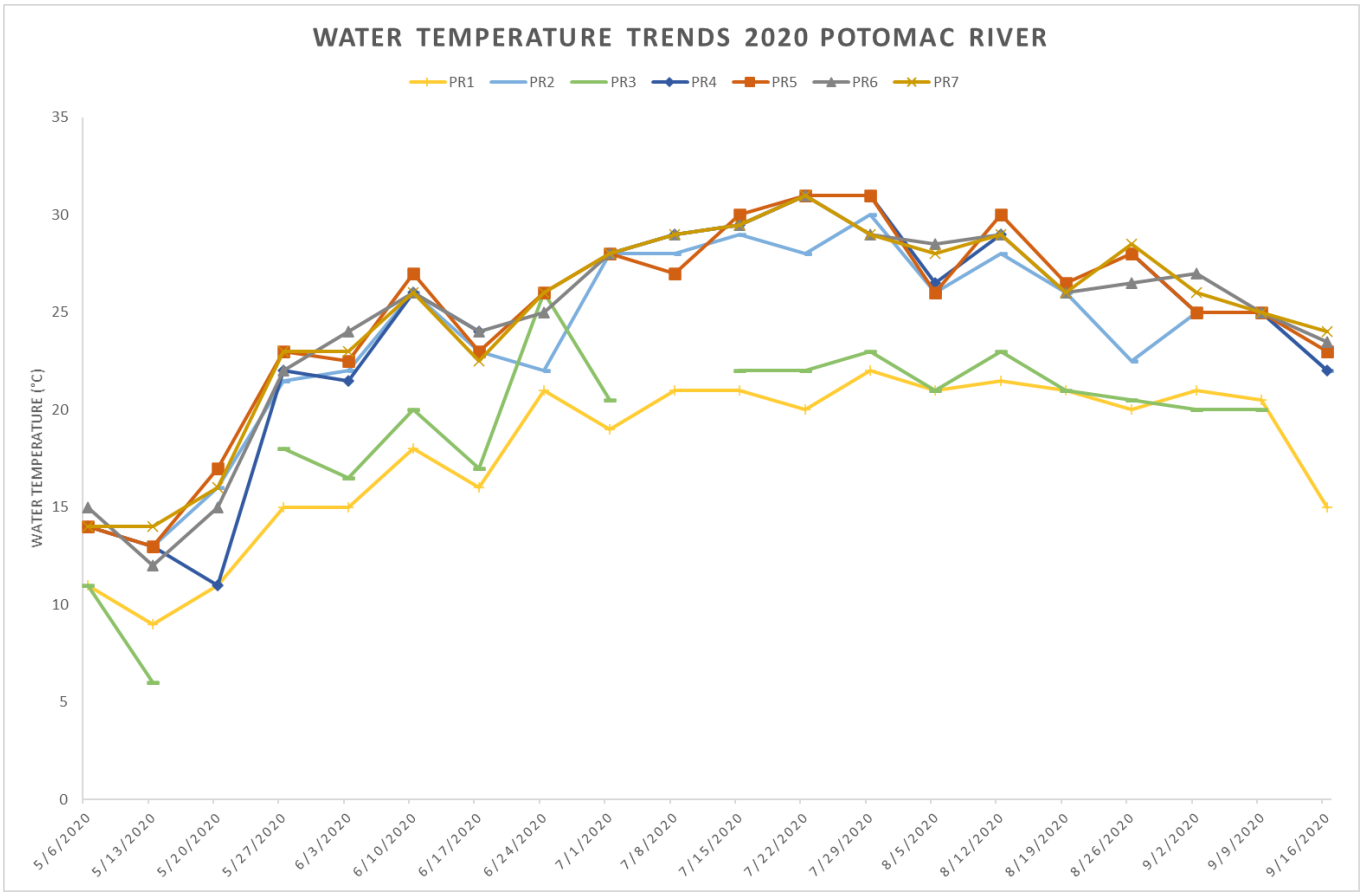

BACTERIA SINGLE SAMPLE WQ STANDARD PASS/FAIL 2020
% Pass
% Fail
AR-1: NATIONAL ARBORETUM
45.0%
55.0%
AR-2: HICKEY RUN
100.0%
AR-3: KINGMAN LAKE
80.0%
20.0%
AR-4: ANACOSTIA PARK
70.0%
30.0%
AR-5: YARDS PARK
55.0%
45.0%
AR-6: BUZZARD POINT
85.0%
15.0%
AR-7: WASHINGTON CHANNEL
95.0%
5.0%

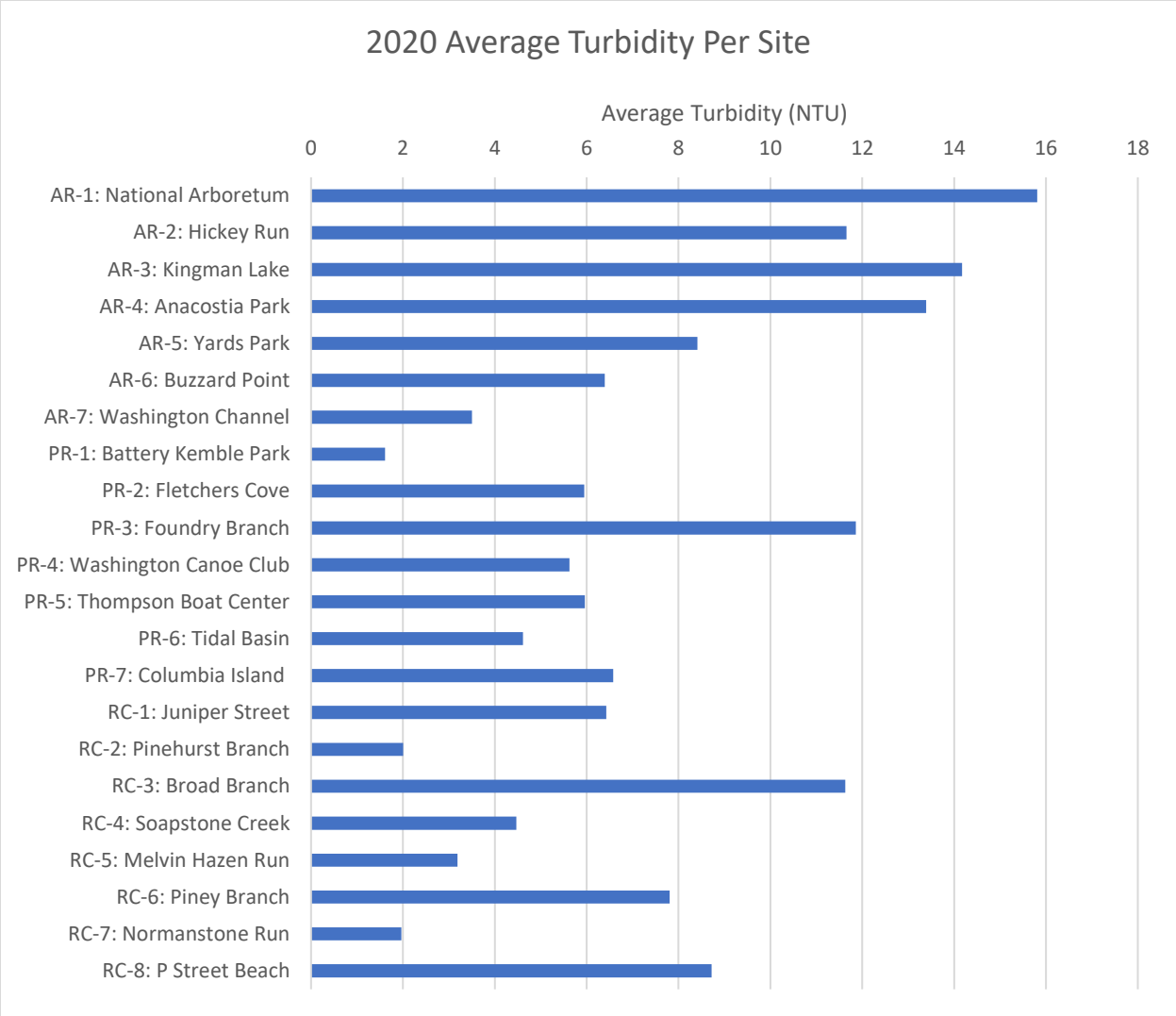

BACTERIA SINGLE SAMPLE WQ STANDARD PASS/FAIL 2020
% Pass
% Fail
PR-1: BATTERY KEMBLE PARK
55.0%
45.0%
PR-2: FLETCHERS COVE
63.2%
36.8%
PR-3: FOUNDRY BRANCH
38.9%
61.1%
PR-4: WASHINGTON CANOE CLUB
78.9%
21.1%
PR-5: THOMPSON BOAT CENTER
80.0%
20.0%
PR-6: TIDAL BASIN
100.0%
PR-7: COLUMBIA ISLAND
70.0%
30.0%


BACTERIA SINGLE SAMPLE WQ STANDARD
PASS/FAIL 2020
% Pass
% Fail
RC-1: JUNIPER STREET
35.0%
65.0%
RC-2: PINEHURST BRANCH
25.0%
75.0%
RC-3: BROAD BRANCH
55.0%
45.0%
RC-4: SOAPSTONE CREEK
55.0%
45.0%
RC-5: MELVIN HAZEN RUN
55.0%
45.0%
RC-6: PINEY BRANCH
55.0%
45.0%
RC-7: NORMANSTONE RUN
20.0%
80.0%
RC-8: P STREET BEACH
40.0%
60.0%


WATER TEMPERATURE TRENDS 2020 ANACOSTIA RIVER
AR1
AR2
AR3
AR4
AR5
AR6
AR7
WATER TEMPERATURE (°C)
35
30
25
20
15
10
5
0
5/6/2020
5/13/2020
5/20/2020
5/27/2020
6/3/2020
6/10/2020
6/17/2020
6/24/2020
7/1/2020
7/8/2020
7/15/2020
7/22/2020
7/29/2020
8/5/2020
8/12/2020
8/19/2020
8/26/2020
9/2/2020
9/9/2020
9/16/2020


WATER TEMPERATURE TRENDS 2020 ROCK CREEK
RC1
RC2
RC3
RC4
RC5
RC6
RC7
RC8
WATER TEMPERATURE (°C)
30
25
20
15
10
5
0
5/6/2020
5/13/2020
5/20/2020
5/27/2020
6/3/2020
6/10/2020
6/17/2020
6/24/2020
7/1/2020
7/8/2020
7/15/2020
7/22/2020
7/29/2020
8/5/2020
8/12/2020
8/19/2020
8/26/2020
9/2/2020
9/9/2020
9/16/2020


WATER TEMPERATURE TRENDS 2020 POTOMAC RIVER
PR1
PR2
PR3
PR4
PR5
PR6
PR7
WATER TEMPERATURE (°C)
35
30
25
20
15
10
5
0
5/6/2020
5/13/2020
5/20/2020
5/27/2020
6/3/2020
6/10/2020
6/17/2020
6/24/2020
7/1/2020
7/8/2020
7/15/2020
7/22/2020
7/29/2020
8/5/2020
8/12/2020
8/19/2020
8/26/2020
9/2/2020
9/9/2020
9/16/2020


2020 Average Turbidity Per Site
Average Turbidity (NTU)
0
2
4
6
8
10
12
14
16
18
AR-1: National Arboretum
AR-2: Hickey Run
AR-3: Kingman Lake
AR-4: Anacostia Park
AR-5: Yards Park
AR-6: Buzzard Point
AR-7: Washington Channel
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PR-2: Fletchers Cove
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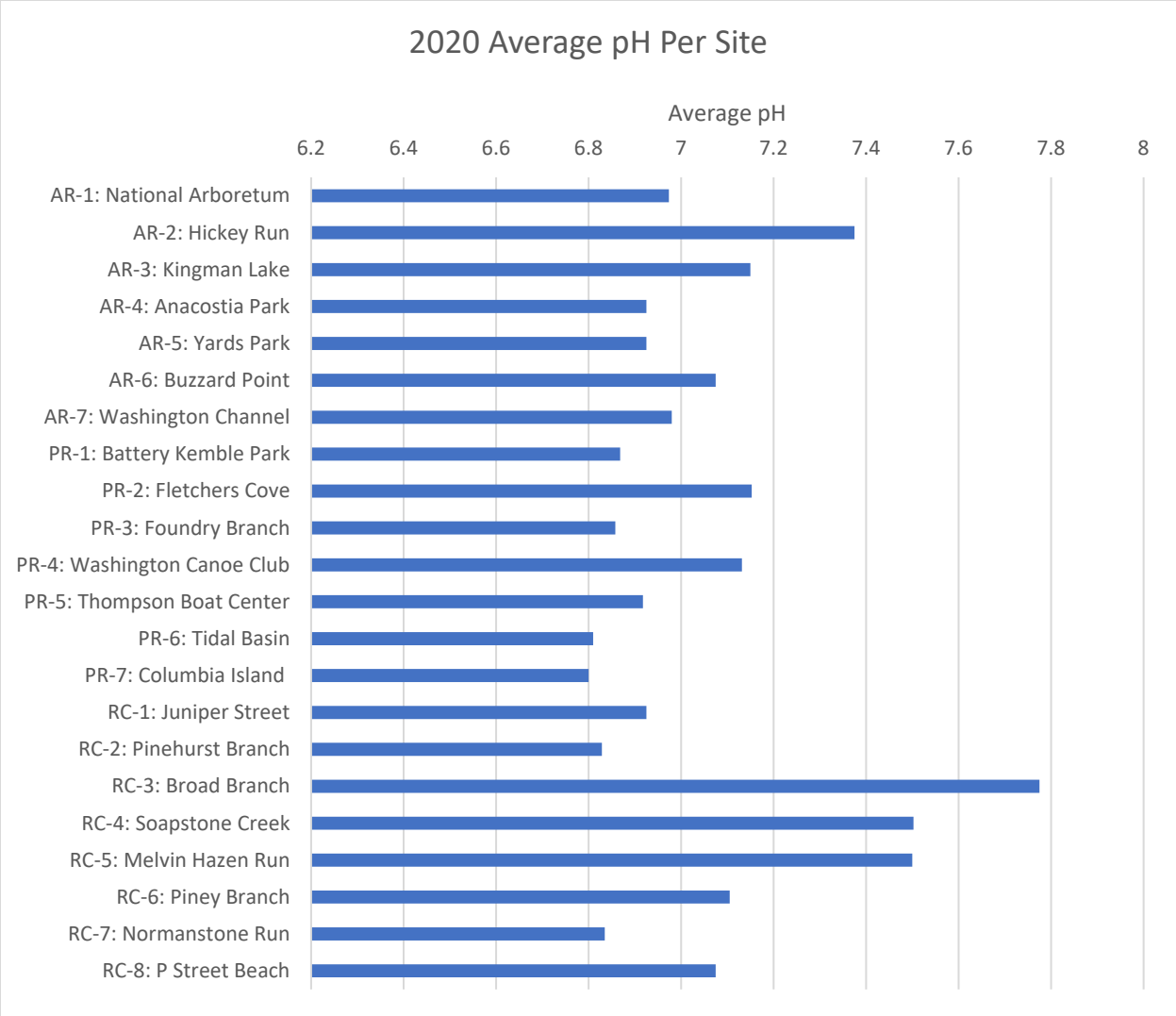
RC-3: Broad Branch
RC-4: Soapstone Creek
RC-5: Melvin Hazen Run
RC-6: Piney Branch
RC-7: Normanstone Run
RC-8: P Street Beach


2020 Average pH Per Site
Average pH
6.2
6.4
6.6
6.8
7
7.2
7.4
7.6
7.8
8
AR-1: National Arboretum
AR-2: Hickey Run
AR-3: Kingman Lake
AR-4: Anacostia Park
AR-5: Yards Park
AR-6: Buzzard Point
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PR-1: Battery Kemble Park
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RC-8: P Street Beach