2023 Prioritization Report:

How volunteer and nontraditional monitoring fill data gaps in the Chesapeake Bay Watershed

The Chesapeake Monitoring Cooperative (CMC) has assessed progress towards priorities in water quality and benthic macroinvertebrate data collection gaps identified in the 2017 report and investigated updated priorities throughout the Chesapeake Bay watershed. This report summarizes the progress to date and re-prioritizes data gaps based on the current monitoring efforts.

CMC
Chesapeake Monitoring Cooperative

Produced by the Chesapeake Monitoring Cooperative

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chesapeakemonitoringcoop.org

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Chesapeake Bay Program partnership: A regional partnership that leads and directs Chesapeake Bay restoration and protection. Bay Program partners include federal and state agencies, local governments, non-profit organizations and academic institutions.

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Introduction

The Chesapeake Monitoring Cooperative (CMC) was formed to integrate water quality and benthic macroinvertebrate volunteer and nontraditional monitoring data into decision support for the Chesapeake Bay Program (CBP) partnership. Since its inception in 2015, the CMC has connected monitoring initiatives across the Chesapeake Bay region to fill temporal and spatial data gaps in state and federal datasets and enhance our understanding of the Chesapeake Bay watershed. The CMC has provided technical, programmatic, and outreach support to start new monitoring programs and integrate existing monitoring programs. To date, the CMC has integrated data from over 100 monitoring groups and approximately 3,200 stations into our CMC Data Explorer (see Figure 1). There are currently over 800,000 water quality and benthic macroinvertebrate monitoring data points in the Data Explorer. Data were contributed from all seven Bay jurisdictions - New York, Pennsylvania, Maryland, West Virginia, Delaware, the District of Columbia, and Virginia.

At the outset of CMC, the team conducted a prioritization process in 2016 to engage diverse stakeholders and identify potential gaps volunteer-based data could fill. The CMC team assessed progress towards the goals and priorities identified in the Prioritization Report released in 2017. Significant progress has been made integrating data into the Chesapeake Bay Program's dissolved oxygen assessment and jurisdictions' Federal Clean Water Act reporting requirements with biennial Integrated Reports to the U.S. Environmental Protection Agency (EPA). However, gaps still remain within the existing water quality and macroinvertebrate data sets outlined in this report. Additionally, it has become apparent that opportunities exist to expand the reach and scope of monitoring within the CMC network to meet additional CBP and jurisdiction data needs through the development of a community-based restoration monitoring protocol with inclusion of crowd-sourced chloride data from the Izaak Walton League led program, Salt Watch.

Over the past 2 years, the CMC has partnered with the National Fish and Wildlife Foundation (NFWF) and Stroud Water Research Center to develop a Chesapeake Bay watershed-wide community-based restoration monitoring protocol. This multifaceted protocol measures biological, chemical, and visual indicators to assess the in-stream impacts of forest buffer and stream restoration projects implemented through the Chesapeake Bay Stewardship Fund. Data collected will be compiled annually into a report to be shared with NFWF, project partners, and landowners, and has the potential to fill in many data gaps identified by our state partners.

Salt Watch is a simple, free, and accessible community science program that was launched by the Izaak Walton League of America (a CMC partner) in 2018. Salt Watch is a natural fit for the CMC to explore crowd-sourced monitoring models that can engage a large audience, shine a spotlight on specific pollution issues, and drive policy and restoration decisions within the watershed. Integrating Salt Watch data into the CMC will widen the geographic and temporal dataset collected within the program and increase access by federal, state, and local agencies who are concerned about the impacts to their communities.

The following report summarizes the updated priorities across individual monitoring groups, the Chesapeake Bay Program, and the Chesapeake Bay jurisdictions.

Chesapeake Monitoring Cooperative Monitoring Priorities

Since its inception in 2015, the CMC has connected data from over 100 monitoring groups and approximately 3,200 stations in order to fill temporal and spatial data gaps in state and federal datasets and enhance our understanding of the Chesapeake Bay watershed. Community volunteers and partners are the backbone of the CMC. Whether it is an individual monitor participating in a regional program or a community partner, everyone has their individual reasons motivating them to collect water quality and benthic macroinvertebrate data. However, there is limited consistency among methods and approaches used to collect data for the same parameters on a watershed-wide basis. While contributions from the abundance of active, passionate groups creates a rich dataset that meets a variety of local needs, it also highlights areas where we can leverage resources to expand the reach and aim to create and encourage adoption of consistent data collection methods supporting unified watershed-wide analyses.

Through conversations with our community, state, and federal partners, the CMC has identified bacteria and conductivity as opportunities to leverage existing monitoring methods and expand monitoring efforts into priority areas in order to meet data needs across the region. Additionally, crowd-sourced chloride data has been identified as a new, emerging parameter that would have high impact for the CMC by collecting practical data and engaging new communities.

Bacteria Monitoring

Bacteria (*E.coli* and *Enterococcus)* contamination of tidal and nontidal waters is an important issue throughout the Chesapeake Bay watershed and a growing area of interest for many monitoring groups due to exposure risk for direct human health impacts. Many watershed groups are monitoring bacteria weekly throughout the summer to inform the public about the exposure risks that can lead to various health effects as a function of recreational activities on and around the water. Other groups are monitoring bacteria monthly, year-round in order to track trends over time after TMDL implementation plans are in place or to identify pollution issues. Community-based data are of significant importance to marginalized communities where data may not otherwise exist or is not presented in an accessible way.

E. coli concentrations are typically used to assess the recreational water quality protection standard in non-tidal, freshwater areas while *Enterococcus* concentrations are used to assess the bacteria-based standards in tidal, salt, or brackish areas. Over the past few years the IDEXX Colilert and Enterolert systems have become more cost-efficient, accessible, and produce higher quality data than other methods. Therefore, monitoring groups have created their own labs using the IDEXX system in non-laboratory settings (ie. their office space). The Virginia Department of Environmental Quality (VA DEQ) and the District of Columbia Department of Energy and Environment (DOEE) have the regulatory framework to use data collected by volunteer-based programs and provide quality assurance support for monitoring groups to set up in-office bacteria labs. However, this same level of support does not yet exist in other Bay watershed jurisdictions.

Each jurisdiction has different water quality standards applicable for protection of various designated uses (recreation and swimming) and ways that bacteria data can be used to inform regulatory decisions. Monitoring groups have a common interest in community health impacts. Therefore, regardless of the regulatory use of data, it has become increasingly important to have standardized quality assurance requirements and practices within the CMC network to provide the public with reliable, consistent, and accurate data to inform recreation decisions. Over the past few years, the CMC has worked with monitoring groups, the Maryland Department of the Environment (MDE), and the Chesapeake Bay Program (CBP) to establish equivalent quality assurance processes supported by the CMC. This includes having an EPA approved Quality Assurance Project Plan (QAPP) to be considered Tier 2 within the CMC framework. There are now 4 monitoring groups outside VA with approved QAPPs collecting Tier 2 data (See Figure 2 for all of the sites collecting bacteria data and method used).

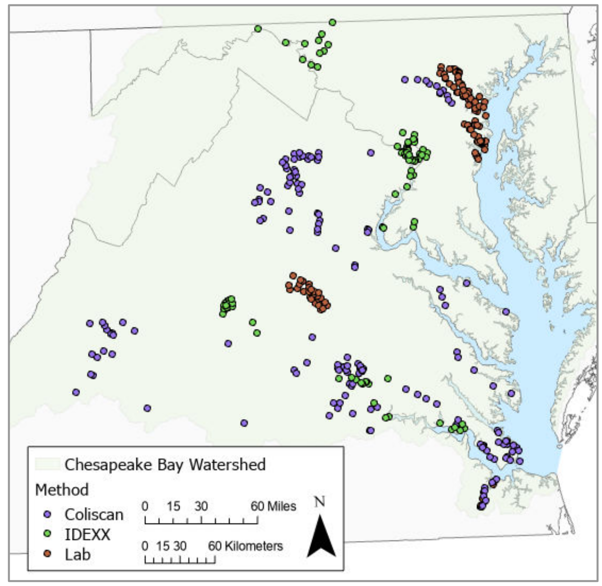

Figure 2: Monitoring sites collecting bacteria data using the coliscan, IDEXX or Lab Analysis in Virginia, Maryland and the District of Columbia.

The CMC will continue to explore opportunities to leverage the existing foundation for bacteria monitoring in order to provide support for new bacteria monitoring efforts in Maryland, Pennsylvania, New York and West Virginia. The CMC will work to identify additional Tier 3 regulatory uses and build pathways to accredit Tier 3 data collectors through local, state and federal partners.

Conductivity Monitoring

Conductivity is a robust ecosystem health indicator that has a myriad of uses. Conductivity is the measure of water's ability to conduct electricity, it is closely connected to total dissolved solids, and values increase with increased levels of inorganic materials. In tidal estuarine areas, conductivity is naturally higher due to the salt concentrations where freshwater from the watershed enters the bay mixes with water coming in from the ocean. Across the tidal and nontidal landscape, measures of conductivity can provide insight to relationships between water quality, land use, and geology. It is affected by natural geology (karst), runoff from road salts and agricultural activity, effluent from industrial activities and wastewater treatment plants, and stormwater runoff (Figure 3). Conductivity can be used to draw attention to a potential problem, to signal the need for follow-up testing (a canary in the coal mine effect), provide information about changes in water quality often due to human impacts, and can be an important first indication of a potential pollution problem.

In communities where shale gas extraction takes place (Pennsylvania, New York, and West Virginia), conductivity has been widely monitored for decades. Since there are hundreds of different chemicals found in well flowback water (which is 10-20 times saltier than ocean water), it is not possible to test for every possible constituent. However, conductivity values of flowback water are extremely high. A large increase in conductivity indicates that a stream has been impacted—potentially by spills, leaks, or other activities associated with shale gas extraction. Conductivity is used to evaluate industrial pollutants to ground-truth discharge monitoring reports and raise a red flag for follow up investigations. Additionally, conductivity is a strong parameter for tracking water quality conditions in and around communities experiencing environmental injustice related to industrial activities.

The CMC team will leverage accepted methods and verified approaches to guide effective monitoring of status and change over time in conductivity in area waterways. Monitoring designs will be suggested to yield data that meets community information needs while exploring opportunities to expand monitoring especially in at-risk or underrepresented communities.

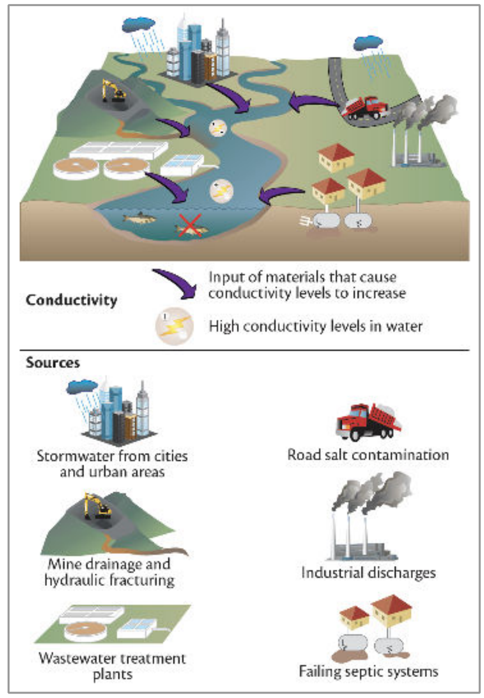

Figure 3: Sources contributing to non-tidal conductivity fluctuations.
Image Credit: UMCES

Crowd-sourced Monitoring

Up to 20 million tons of salt are spread on roads, parking lots, and sidewalks every year across America in the name of road safety. Dissolved salt runs off hard surfaces when snow and ice melt. Sewage chemistry across the watershed and irrigation runoff in rural areas can further affect salt levels in historically freshwater systems. Some of that runoff ends up directly in nearby streams and rivers and some soaks into the ground, leaching into groundwater supplies or flushing into streams, rivers, and lakes during spring and summer rains, causing chloride spikes. Other sources of salt and chloride in the environment include water softeners and fracking runoff, both of which occur in the Chesapeake Bay Watershed. This salt can be toxic to freshwater fish, the aquatic macroinvertebrates that fish and other stream dwellers eat, and in some cases can kill streamside plants, making erosion and runoff an even bigger problem. Excess salt can also infiltrate drinking water supplies. Between the health effects, impacts on fish and wildlife, and monetary costs, states and community groups are looking for alternatives to road salt.

Salt Watch is a community science program that was launched by the Izaak Walton League (a CMC partner) in 2018. Salt Watch is a simple, free, and accessible program. Participants are mailed Hach Chloride test strips and an informational postcard explaining how to perform the test and submit data. Results are compiled in a database, shared with monitors and stakeholders, and mapped to display chloride hotspots. Local, state, and federal agencies have

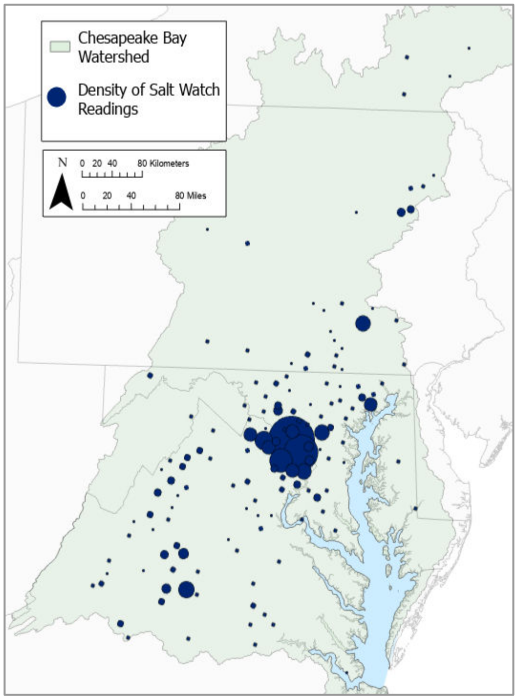

Figure 4: Density map of Salt Watch sampling events across the Chesapeake Bay watershed since 2018.

shown an increasing interest and concern in documenting and combating road salt pollution in their jurisdictions due to the impacts on environmental and human health as well as infrastructure. This interest has been proven with agencies such as Maryland Department of the Environment (MDE) and the Washington Suburban Sanitary Commision (WSSC) directly asking for Salt Watch data.

Salt Watch is a natural fit for the CMC to explore crowd-sourced monitoring models that can engage a large audience, shine a spotlight on specific pollution issues, and drive policy and restoration decisions within the watershed. As illustrated in Figure 4, Salt Watch has collected 4,274 total samples since 2018 and currently has data in all Bay jurisdictions except Delaware, with the largest dataset occurring in urban areas around DC, Richmond, and Gaithersburg. Integrating Salt Watch data into the CMC will widen the geographic and temporal dataset collected within the program and increase access by federal, state, and local agencies who are concerned about the impacts to their community.

Chesapeake Monitoring Cooperative Stewardship, Education and Advocacy Priorities

The CMC acknowledges that achieving optimal water quality in the Chesapeake Bay and its tributaries to support survival, growth and reproduction of living resources and protect human health and well-being extends beyond purely data driven or regulatory parameters—it necessitates the active involvement of all people who live, work, and play in the watershed. Stewardship, education, and advocacy are essential elements to volunteer-based water quality monitoring and are intrinsically linked with the strategic direction of the CMC. Promoting these aspects of our program not only amplifies environmental awareness at the grassroots level but also instills a collective accountability for the water quality of the Chesapeake Bay watershed.

The CMC works to provide educational materials in order to engage people in both data collection and data use. The CMC case studies are meant to highlight stories where volunteers and community members have successfully engaged in meaningful dialogue with their local community and contributed to the policies that meet local needs. The goal of highlighting these stories is to inspire other communities to do the same. Additionally, the CMC is committed to increasing engagement with diverse and underrepresented communities and outlines our two pronged approach to increasing such engagement over the next 3-4 years.

Education and Advocacy through Storytelling

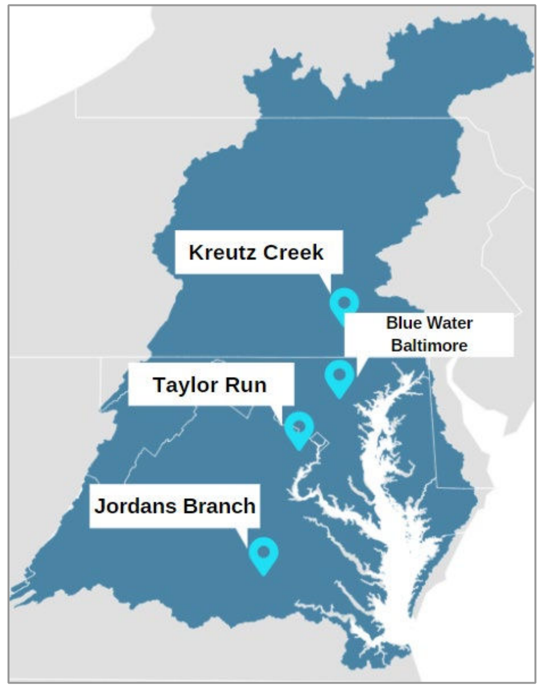

Figure 5: CMC case studies highlighting various data use scenarios.

While the CMC's main task is to connect data collected from community monitoring and non-traditional partners into the state and federal programs, it is important to amplify voices and impact on the local level as well. Each group within the CMC network is monitoring to achieve their own unique and individual goals for education, advocacy, outreach, and communication. The CMC developed case studies to better communicate key stories where monitoring data is being used to achieve improvement in water quality and environmental conditions on a local scale.

The CMC documented four data use successes with case studies this year, shown in Figure 5. The case studies are important for showing how water monitoring can detect problems and affect changes in wastewater management, stream restoration, business practices, and contaminant detection and identification. The four case studies are available on the CMC Website and print-ready PDFs. Over the next several years, the CMC will create additional case studies with specific focuses on highlighting engagement in diverse and underserved communities, mutually beneficial partnerships with local governments, and community outreach and education.

Building Stewardship with a DEIJ Lens

The CMC is committed to promoting Diversity, Equity, Inclusion, and Justice (DEIJ) principles within our water monitoring efforts. Without data from all communities, we cannot reach our goal of achieving a better understanding of the Chesapeake Bay watershed. As we embrace the values and practices of meaningful diversity, equity, inclusion and justice, we aim to reduce barriers to communities that do not currently participate in the CMC while making water quality information more accessible to all.

As a first step in creating a more inclusive environment, the CMC has updated our mission and vision statements in order to prioritize equitable access and commitment to supporting all partners, communities, and individuals who want to participate in chemical, physical, and biological monitoring. Moving forward, the CMC is working to create a **Community to Monitoring Connection** chart that serves as a starting point to open discussions about how community interests align with monitoring data collected by the CMC and other monitoring networks. This chart will be used to open the door to connecting communities to data they can use to understand local issues and advocate for their management needs. From there, we aim to collaboratively develop a two-pronged approach increasing access to monitoring data and support.

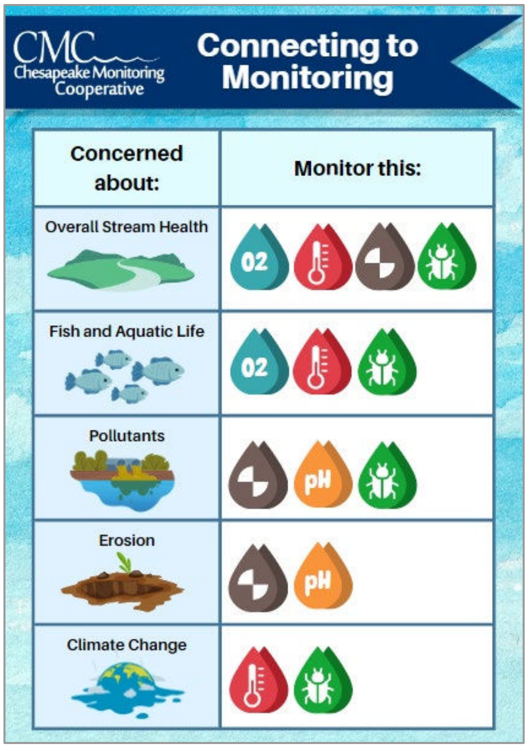

Figure 6: Connecting common community concerns to baseline monitoring indicators.

The first prong is aimed at connecting communities to existing data in order to help advocate for community needs. There are many barriers to active participation in data collection, mainly time, money, and expertise. This data connection approach is working to eliminate these barriers by allowing people who have the time and resources to collect data and connect the data to communities who could use it. Using the Community to Monitoring Connection chart and the Chesapeake Bay Program's Environmental Justice screen tool, the CMC will explore areas where community needs may overlap with CMC data collection.The second prong is aimed at reducing the barriers to active participation in data collection by co-producing additional tools and resources. Co-production of any new tools targets further support for communities in addressing their information needs while respecting available capacities in time and resources for effective, efficient information collection and product development.

The CMC recognizes the valuable insight that our vast volunteer network can provide as we work towards meeting and refining our DEIJ goals. The CMC plans work with our existing network to identify both barriers and success stories of engaging with underrepresented communities in monitoring efforts. This will provide guidance to the CMC team as we build tools and resources to overcome these barriers and engage with communities in a more inclusive way.

Chesapeake Bay Program Priorities

Since the CMC inception, the CBP has been interested in filling in data gaps to meet regulatory level (Tier 3) tidal water quality monitoring data needs. This includes data that are collected simultaneously in depth profiles at a monitoring location for salinity, temperature and dissolved oxygen. Salinity and temperature data are used to set boundaries on habitats represented in the water column based on density stratification layers. This data, coupled with the dissolved oxygen data are required for evaluating water quality against criteria attainment in assessing water quality standards. To date, the dissolved oxygen attainment analysis included CMC Tier 3 data from Arundel Rivers Federation, Blue Water Baltimore, Nanticoke Watershed Alliance, and Maryland Department of the Environment Shellfish monitoring. Anne Arundel Community College achieved Tier 3 status in 2023 and will be included in the next analysis. The CMC will continue to work with individual monitoring groups and the Scientific, Technical Assessment and Reporting (STAR) team and the Data Integrity Workgroup (DIWG) at the CBP in order to prioritize additional groups in achieving Tier 3 data collection methods.

More recently, the CBP has leveraged the CMC network to fill gaps in aquatic benthic macroinvertebrate data needs. Within the Stream Health Workgroup of the Chesapeake Bay Program, the Stream Health Indicator uses thousands of data collected by a variety of agencies and institutions across the watershed to score the health of local waters. Local scores are rolled up to create a single score for the Chesapeake Bay watershed using the "Chessie BIBI" (See "Chessie BIBI" Index for Streams - ICPRB (potomacriver.org) for more information). The scoring results from 3 successive 6-year assessments between 2000 and 2017 has suggested Chesapeake Bay watershed health is improving. However, gaps remain at the local watershed scale that, if filled, could better support the stream health assessment. The CMC coordinated with the USEPA, PA DEP, VA DEQ, and VASOS to develop a robust, volunteer-friendly protocol for benthic macroinvertebrate sample collection, consistent with methods used by agencies and institutions across the watershed. These samples are collected in-stream, preserved streamside, and sent to the EPA Wheeling Lab for analysis to the Family level classification of the macroinvertebrates in order to conform to the data quality needs for the Chessie BIBI analysis. The CMC will continue its work toward collecting 100 samples in unmonitored or poorly monitored watersheds to help fill these spatial data gaps by 2027. These data will be incorporated into the next round of the CBPs Stream Health Assessment (2018-2023).

Looking to the future, the CMC will continue to work with the CBP workgroups in order to identify additional pathways for data use, specifically with Tier 1 and 2 data, based on the STAR science needs database. Illustrated by Figure 7, the CMC monitoring locations help fill spatial data gaps in the CBP dataset. With the incorporation of the CMC monitoring network into the CBP Tidal and Nontidal monitoring network, the average distance from any point in the watershed to the nearest station decreases significantly from 25.9 km to 12.4 km. Additionally, the CBP's Scientific and Technical Advisory Committee (STAC) conducted a three year investigation on progress towards meeting the TMDL goals and recently released *A Comprehensive Evaluation of System Response* (CESR) report summarizing the findings. This report is an evaluation of progress towards the TMDL and water quality standards and highlights areas where progress can be accelerated. The recommendations include a focus on managing water quality to enhance living resources and increased attention to shallow water monitoring. Both of these areas are primed for leveraging CMC data collections.

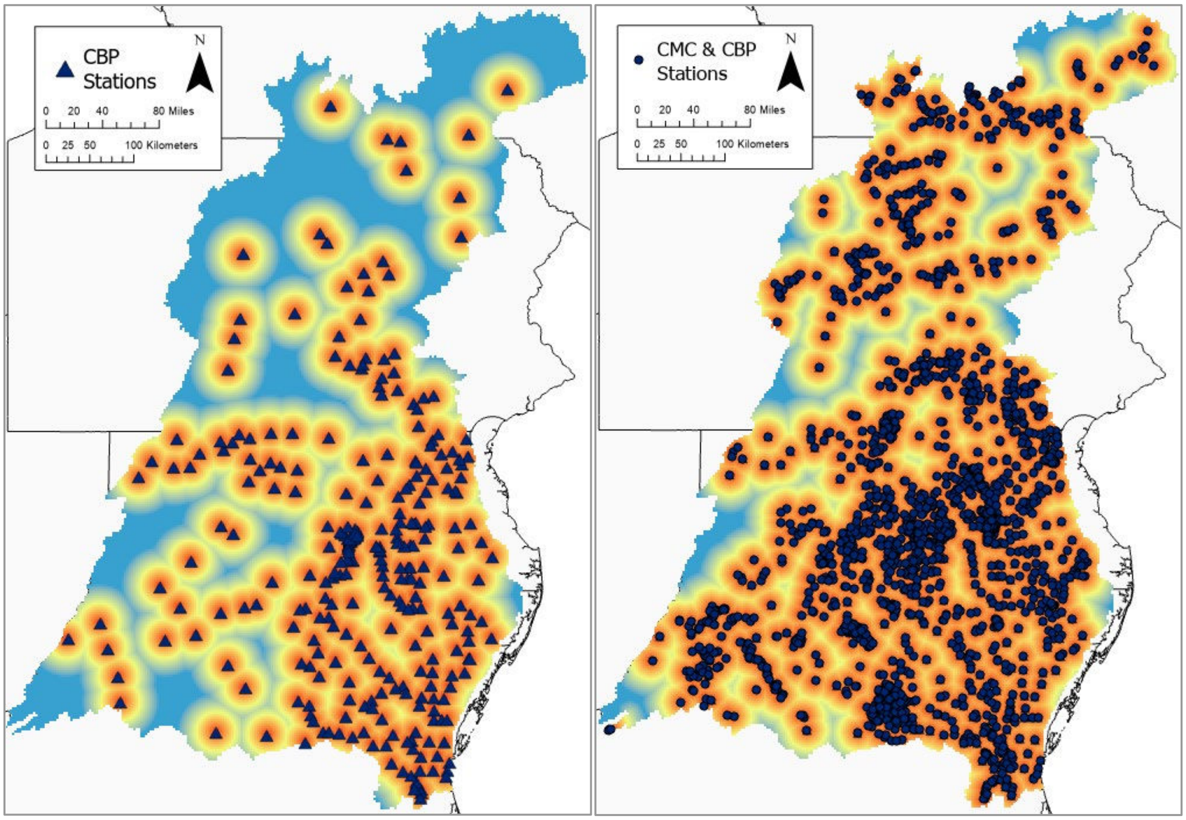

Figure 7: Distance to nearest station for Chesapeake Bay Program Tidal and NonTidal water quality monitoring networks (left panel) compared to the same network with the addition of Chesapeake Monitoring Cooperative monitoring stations where water quality samples have been collected since 2017.

State Agency Priorities

Delaware (DE)

Since Delaware has only a small portion of the state that drains to the Chesapeake Bay watershed, engagement in monitoring has been limited. Currently, the Nanticoke Watershed Alliance (Nanticoke) is the only CMC group with data in Delaware. In 2022, the CMC compared methodologies between DNREC and the CMC/Nanticoke, and found many of them to be consistent or compatible with each other. Therefore, for future Integrated Reporting cycles, the CMC will work with DNREC to incorporate Nanticoke's non-tidal water quality monitoring data into their reporting assessment.

The CMC will continue working with DNREC to incorporate citizen science and non-traditional monitoring data into their Integrated Report and identify priority watersheds to increase monitoring such as the upper Choptank. Additionally, it is a priority to connect CMC data to the WQX portal so that DNREC (and other agencies) can pull data directly from the national database for future Integrated Reports to streamline their process.

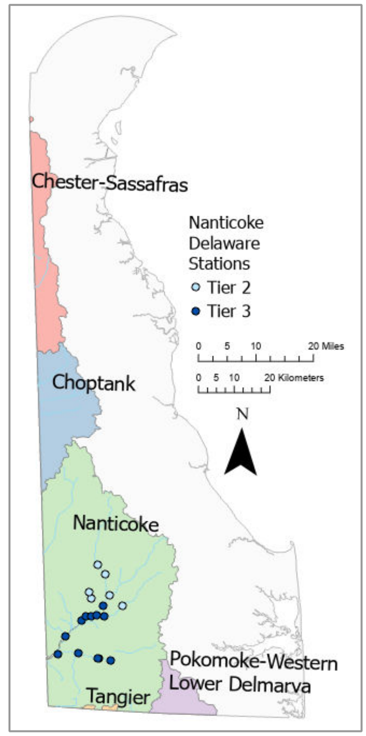

Figure 8: Nanticoke monitoring sites to integrate into the Integrated Report, and potential other sub-watersheds to target monitoring efforts.

District of Columbia

In 2018, the District of Columbia Department of Energy and Environment (DOEE) funded the Volunteer Water Monitoring in District of Columbia Waters project, which is a volunteer-based water quality monitoring program with the goal of providing up-to-date, weekly water quality data to residents and visitors by sampling for bacteria, turbidity, pH, air temperature, and water temperature weekly from May-September. This project was originally managed through the Anacostia Riverkeeper and is now managed through the Alliance for the Chesapeake Bay in partnership with the Anacostia Riverkeeper, Rock Creek Conservancy, and Nature Forward. This project fills gaps in the 305(b)/303(d) assessments, provides high frequency monitoring of impaired waters, and promotes stewardship by providing opportunity for community engagement and is one of the many monitoring projects occurring in the District.

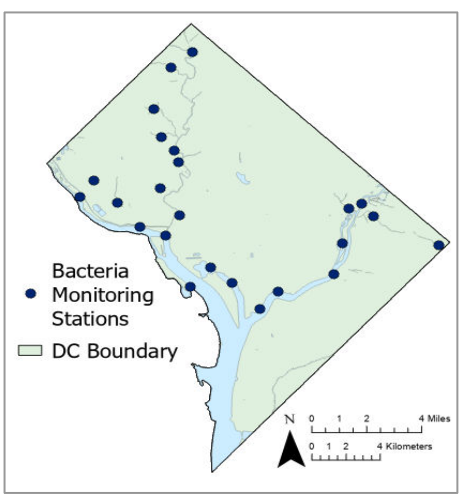

Figure 9: Monitoring sites within the District of Columbia funded by DOEE.

The future priorities in the District include maintaining the Volunteer Water Monitoring in District of Columbia Waters project at the current level which monitors 24 public access sites across the District. The CMC will also explore opportunities to leverage other datasets, such as Salt Watch, within the District.

Maryland (MD)

Over the past few years the CMC has worked towards creating a more cohesive and robust monitoring community in Maryland. The CMC has made significant progress towards meeting the monitoring needs identified in the 2016-17 prioritization process, including establishing and enhancing tidal and non-tidal baseline water quality data, collecting longitudinal data and monitoring water quality trends over time, and filling data gaps supporting impairment assessments documented for the Clean Water Act 305(b)/303(d) Integrated Report. In tidal areas of Maryland, the CMC supported the establishment of monitoring programs at the Severn River Association and integrated data from established Tier 2 monitoring groups into the CMC Data Explorer. The CMC Tidal Tier 3 groups in Maryland are the Nanticoke Watershed Alliance (since 2017), Blue Water Baltimore (2017-present), MDE Shellfish (2018-present), Arundel Rivers Federation (2019-2021, 2023), and Anne Arundel Community College (2023). In non-tidal areas of Maryland, the CMC supported the establishment of monitoring programs in high priority watersheds at the Antietam-Conococheague Watershed Association (Washington County) and Patapsco Heritage Greenway.

The CMC has worked with Maryland Department of the Environment (MDE) in order to provide quality assured data used in assessing water quality for Maryland's Clean Water Act 305(b)/303(d) Integrated Report. MDE adopted a Tiered Framework structure in order to assess data from community monitoring groups based on the CMC Tiered Framework for data uses. For the 2020/2022 combined Integrated Report, MDE pulled non-tidal data directly from the Chesapeake Data Explorer and used dissolved oxygen, pH and turbidity data in their assessment. Tidal data was pulled from the Chesapeake Bay Program and utilizes CMC Tidal Tier 3 data in the assessment.

Priorities for the next few years are to continue to support the existing Tier 1, 2, and 3 groups and assist new groups who want to start monitoring in Maryland, exploring a more standardized, shelf-ready non-tidal program, enhancing Tier 2 programs to Tier 3, exploring additional regulatory pathways for data use, and explore gaps in benthic monitoring. In non-tidal areas, the CMC will explore opportunities to create a more standardized umbrella program, equivalent to RiverTrends in Virginia and Stream Team in Pennsylvania. The goal of this program is to help groups begin new monitoring programs by reducing the barriers to entry: technical expertise, money for equipment, and quality assurance standards. This model for new programs should include water temperature, dissolved oxygen, turbidity, conductivity and/or pH as baseline parameters, with total nitrogen and total phosphorus as secondary options as funding allows.The CMC will look for funding sources and potential pilot areas.

In tidal areas, the CMC will prioritize enhancing Tier 2 programs to Tier 3 since this data is required by both the Chesapeake Bay Program and MDE for assessments (see Figure 10 for current tidal Tier 2 and Tier 3 groups). The CMC has identified various groups as Tier 3 candidates and has discussed with them the challenges they face for becoming a Tier 3 member. We have identified several ways in which we can assist these monitoring groups, such as by helping them draft their QAPP, providing flexibility in monitoring frequency, and offering assistance with data analysis. However, some groups have expressed that they lack the necessary funding or staff to implement a Tier 3 monitoring program at this time.

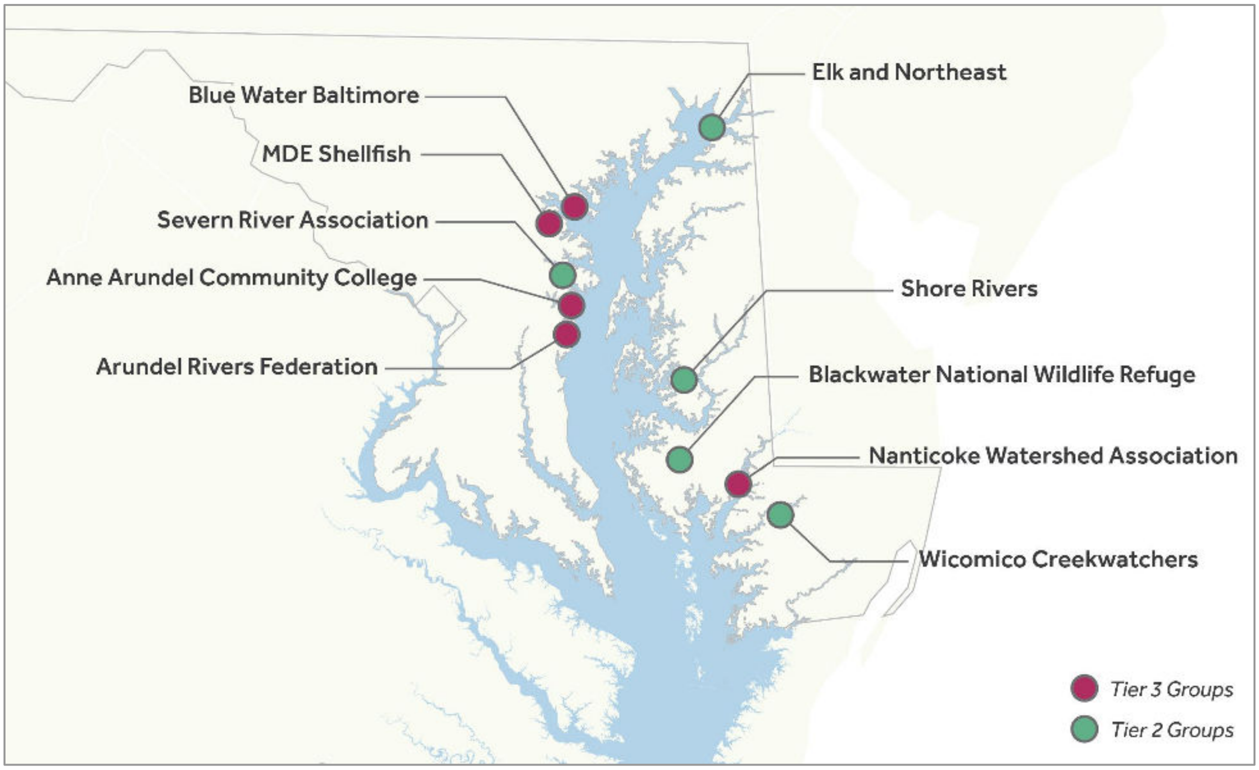

Figure 10: Current Tidal Tier 2 and Tier 3 monitoring groups in Maryland.

Additionally, the CMC will explore opportunities to enhance current data use pathways beyond the Integrated Report including TMDL processes and local Water Quality Implementation Plans (WIPs). This includes adding Salt Watch data, which CMC partners have heard as a desire from Maryland Department of the Environment as they work to limit road salt pollution and pilot a road salt applicator training program.

Finally, the CMC will explore the gap generated by the Maryland Stream Waders program. Maryland Department of Natural Resources (DNR) has not had the capacity to continue implementing Stream Waders, which is a Tier 2 nontidal benthic macroinvertebrate monitoring program (benthic macroinvertebrates are collected by volunteers, preserved streamside, and then identified and scored by DNR staff). The discontinuation of the program has resulted in a large volunteer engagement and data gap in the state. As a result, the CMC team is exploring opportunities for the state of Maryland, which may include expanding Tier I monitoring for the lower watershed or implement Tier 2 monitoring in Maryland to take the place of the Stream Waders program.

New York (NY)

Of the goals identified by key stakeholders (primarily, the Upper Susquehanna Coalition) in NY in the 2017 prioritization report, the CMC succeeded in expanding the collection of longitudinal water quality monitoring data and evaluating trends over time. Towards this goal, the CMC partnered with Otsego County Conservation Association in 2017 to develop a volunteer monthly data collection-based water quality monitoring program. Two of the 7 sites monitored capture the output of unassessed streams in the Schenevus Creek and Susquehanna Headwaters. Additional groups filling this data need include the New York Water Sentinels, the Community Science Institute, and the Susquehanna River Basin Commission.

To help assess the current (2023) status of monitoring and monitoring needs, the CMC developed a survey in partnership with the Upper Susquehanna Coalition (USC). The survey findings showed diverse partners engaged in monitoring but a decrease in monitoring activities since the first prioritization report. Therefore, the CMC and USC have identified four central priorities for NY: 1) Identify data gaps; 2) increase data collection to fill gaps; 3) collect data on restoration projects; and 4) climate change resiliency.

The CMC will continue to work with local monitoring groups and USC to increase data collection to fill data gaps throughout the state. Regarding the increased need for monitoring restoration project, during the pilot phase of the community-based restoration monitoring protocol created in partnership with NFWF and Stroud Water Research Center, a restoration site in NY will be prioritized, and further implementation of this protocol may address the data need for restoration project progress by USC and NY.

Climate change resiliency is an emerging concern for the USC, and the CMC will continue to work with local monitoring groups and the USC to increase data collection surrounding this concern. Other monitoring goals and concerns identified by agency and community-based monitoring groups in the survey include the monitoring of erosion and sediment loads, the monitoring of nutrients and farmland, fish survival conditions, the creation of long-term datasets, and community science tools, and Chesapeake Bay Goals. CMC will continue conversations with USC and other key partners to support community engagement in water quality monitoring in NY.

Additionally, as the headwaters of the Susquehanna River, NY plays an important role in relation to the entire watershed. A continued challenge is that only a fraction of the state falls within the Chesapeake Bay watershed and is geographically far from the Bay itself. As a result it is important to frame Bay clean up and data collection goals locally. The continued conversations and relationship-building between the CMC and NY partners will contribute to addressing these challenges.

Pennsylvania (PA)

Since the first prioritization report, the CMC has succeeded in meeting a majority of the data needs identified by key stakeholders in Pennsylvania. In 2016, Pennsylvania prioritized data collection in locations with high concentrations of agriculture, establishing baseline water quality data, promoting stewardship, and providing opportunities for community outreach and engagement. The CMC has increased and supported community data collection efforts in 7 out of the 8 priority counties identified by Pennsylvania Department of Environmental Protection (PA DEP). Within these counties, PA DEP prioritized watersheds with high concentrations of agriculture and noted the lack of agency resources to monitor water quality changes from implementation of current best management practices (BMPs) or planned BMP implementation.

Through ALLARM's Stream Team program, which aims to develop baseline water quality data examining the relationship between land use, geology, and watershed health, PA communities have collected data, and continue to do so, in these targeted counties: York, Lebanon, Dauphin, Cumberland, and Columbia. Additionally, the CMC has supported monitoring in Lancaster County by working with the Lancaster County Water Quality Volunteer Coalition to integrate and upload data into the CMC's Chesapeake Data Explorer (CDE). Lastly, through CMC, ALLARM reinitiated a collaboration with the Watershed Alliance of Adams County, providing technical assistance to improve techniques and quality assurance, and are in the process of integrating their data into the CMC.

Additionally, PA DEP has adopted a tiered data use framework based off of the CMC's three tiered data use classification framework to classify data they accept for the Integrated Water Quality Monitoring and Assessment Report. Although PA DEP did not report any specific uses of the CMC data to assess waterways in the Integrated Report to inform the 303(d) assessment process, the CMC will continue to submit data through the Data Submission Form when there are calls for existing and readily available data. We have seen, however, that community collected data in PA has been used locally and regionally in a variety of ways by volunteers, County Conservation Districts, city governments, and Riverkeepers, etc.

Consistent with the 2017 prioritization report, PA DEP recommends continuing to prioritize areas with high concentrations of agriculture and monitoring specific catchments in these areas that are receiving a high level of BMP implementation. There is a need for more data in these areas in order to track potential improvement of water quality that may lead to restoration or delistings. Specifically, PA DEP identified a need for additional data in high agricultural areas with Advance Restoration Plans (ARPs), which are often included in Countywide Action Plans (CAPs). This includes Spring Creek in Dauphin County, Fishing Creek in Lancaster County, Marsh Creek in Centre County, Fishing Creek in Clinton County, and Hammer Creek in Lebanon County (Figure 11).

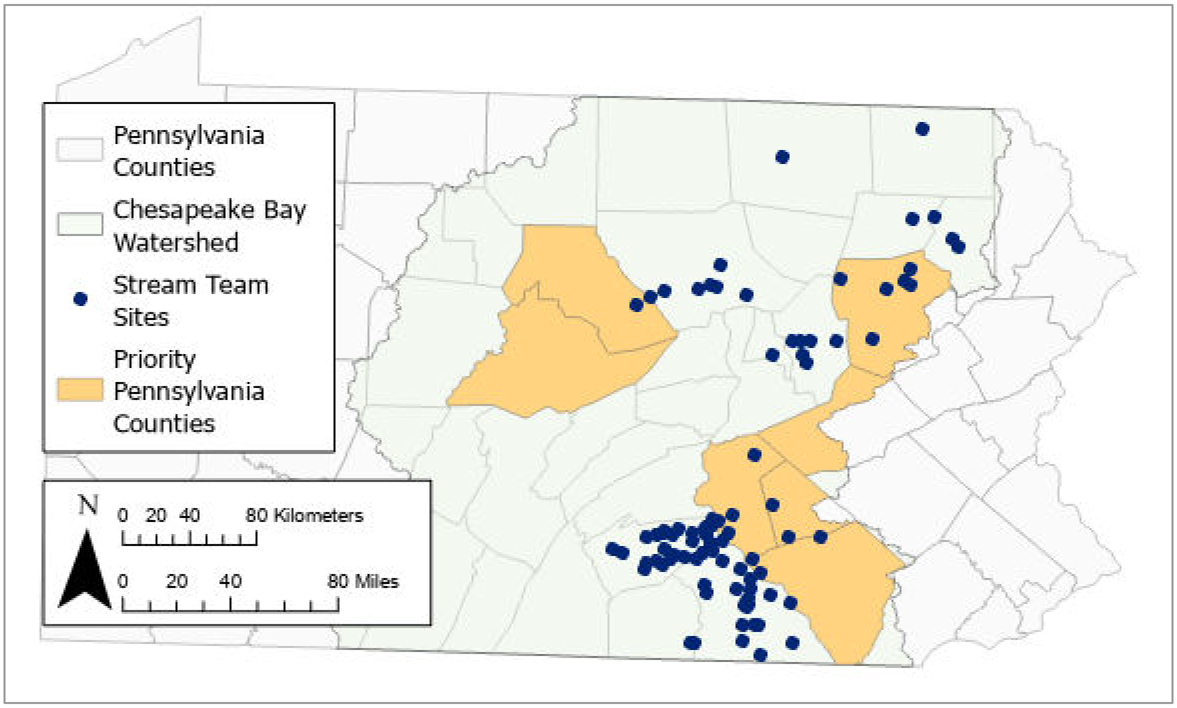

Figure 11: Pennsylvania priority watersheds for data collection identified by PA DEP and ALLARM Stream Team active monitoring sites.

With ALLARM's Stream Team program, volunteers have been monitoring Spring Creek and Hammer Creek monthly for approximately two years. Sites on Fishing Creek in Lancaster County have also historically been monitored and continue to be monitored by Lancaster County Water Quality Volunteer Coalition. Centre County Pennsylvania Senior Environmental Corps began to monitor Little Marsh Creek, a tributary to Marsh Creek in the past year. The overlap between the sites targeted by current community monitoring initiatives and PA

DEP's priority areas highlight that the community and state have similar concerns in those areas and that data is continuously needed. The CMC will continue to support active monitoring in these areas and will target monitoring for ALLARM's Stream Team in Clinton County based on these suggestions.

PA DEP also recommends considering areas impacted by abandoned mine drainage (AMD) that are expected to be targeted for rehabilitation and remediation through program investments from the Infrastructure Investment and Jobs Act (IIJA) funds. Monitoring in AMD affected areas was mentioned as an interest in the 2017 report to determine the effectiveness of remediation actions on water quality. Two general areas were identified as priorities, as projects are being targeted in these areas with IIJA funds: 1) Swatara Creek basin in Schuylkill County in cooperation with Schuylkill County staff, and 2) Luzerne County in cooperation with the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR). Although not in Schuylkill County, ALLARM's Stream Team program has a site on Swatara Creek further downstream in Lebanon County. Within Luzerne County, ALLARM's Stream Team has had 7 sites monitored historically, with 5 sites currently active for at least 2 years: Huntsville Creek, Abrahams Creek, Wapwallopen Creek, and Toby Creek (Figure 11). The CMC will continue to support active monitoring in these areas and explore targeting sites with these AMD restoration projects.

Lastly, PA DEP identified an overall need for monitoring restoration progress associated with water quality and BMP implementation as well as BMP status. The pilot implementation of the community-based restoration monitoring protocol created in partnership with NFWF and Stroud Water Research Center will provide an increase in data collected to track restoration project progress.This protocol collects visual, physical, and benthic macroinvertebrate data and is currently being piloted throughout the Chesapeake Bay Watershed, including PA priority counties such as Lancaster County. Further implementation of this protocol will help meet the needs of monitoring restoration progress in the state.

Virginia (VA)

Virginia continues to be a leader in volunteer monitoring support and data use in the Chesapeake region. Since the first prioritization report, the CMC has succeeded in meeting the data needs identified in Virginia, by continuing to collect high quality baseline water quality data in tidal and non-tidal areas and filling data gaps for Clean Water Act 305(b)/303(d) Integrated Report. The Alliance for the Chesapeake Bay has strategically expanded RiverTrends baseline monitoring in areas where specific gaps were identified in 2017. East of the fall line in Virginia, the Alliance has on boarded five community groups to the RiverTrends program on the middle peninsula (Middle Peninsula Master Naturalists, Friends of Dragon Run, Saint Margaret's School), the northern neck (Northern Neck Master Naturalists), and New Kent County (Chickahominy Tribe Eastern Division). West of the fall line, RiverTrends has partnered with two additional community groups in Rockbridge County (Rockbridge Water Monitors) and Rappahannock County (Rappahannock League of Environmental Protection). The addition of these seven monitoring groups over the last few years to the RiverTrends program have proven to be mutually beneficial partnerships, both filling existing data gaps in the integrated report and responding to community-identified need for baseline water quality data. The Izaak Walton League of America has also onboarded several new Virginia Save Our Streams monitoring groups in the piedmont region since 2017. These include Henrico Soil and Water Conservation District, the Fredericksburg Chapter of the Izaak Walton League of America, Lake Anna Civic Association, the Alexandria Chapter of the Izaak Walton League of America, and expanded engagement with chapters of the Virginia Master Naturalists. These groups are filling key data gaps in the piedmont region and also in muddy bottom streams

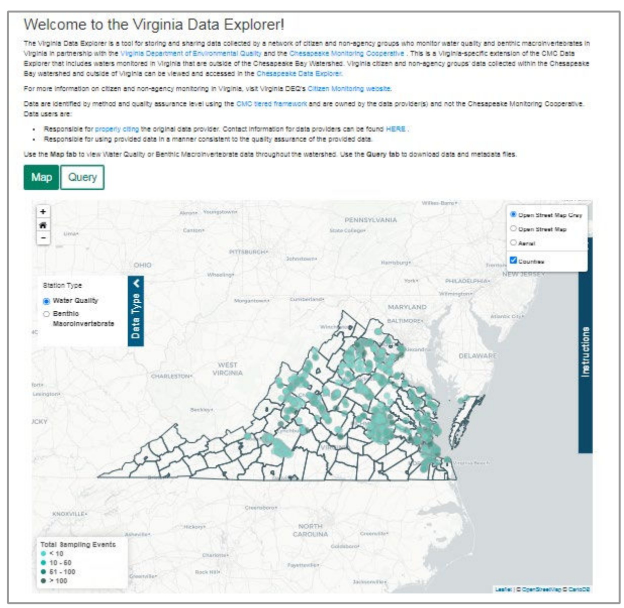

Figure 12: The Virginia Data Explorer homepage.

east of the I-95 corridor where consistent benthic monitoring is scarce.

Additionally, the CMC has worked with the Virginia Department of Environmental Quality (VA DEQ) in order to build a Virginia Data Explorer that has a Virginia specific homepage and can accept data in Virginia outside of the Chesapeake Bay watershed (Figure 12). The CMC has worked with VA DEQ to integrate the data from the majority of Citizen Monitoring groups submitting data for the Integrated Report, streamlining their data analysis process. For the 2022 assessment report data were submitted and evaluated from 80 citizen monitoring groups across 1,655 monitoring sites.

While Virginia continues to be a leader in the community science arena, there are still data gaps and priorities for data collection throughout the state. The CMC plans to continue supporting VA DEQ and community-based monitoring efforts across Virginia in order to fill data gaps in the Integrated Report. The Eastern Shore continues to lack water quality data collection. While VASOS volunteers have increased data collection in the piedmont region, there will be a continued effort to onboard new groups in this area (Figure 13). VA DEQ has also identified a new need for high frequency bacteria monitoring following the updated bacteria criteria methodology. Additionally, the CMC will explore opportunities to enhance current data use pathways beyond the Integrated Report to include planning and decision support for TMDL development and assessment processes, creation of local Water Quality Implementation Plans (WIPs), and applications suitable for Soil and Water Conservation Districts. Lastly, as Salt Watch continues to grow throughout the region the CMC will explore opportunities to leverage this data at the local and state level.

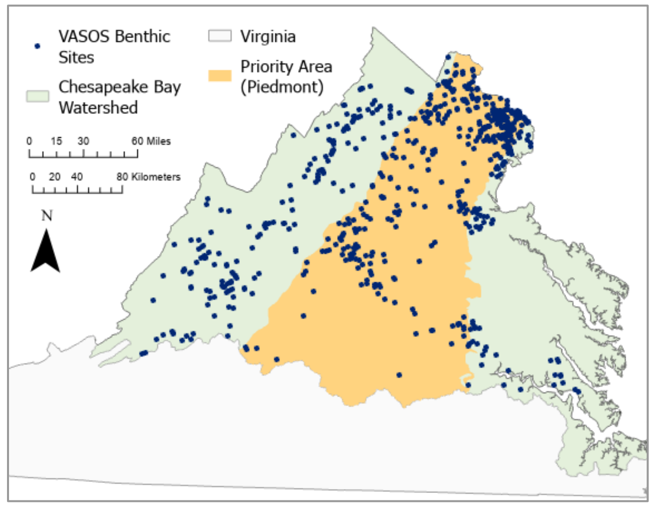

Figure 13: VA DEQ identified the piedmont region as a priority area to increase benthic macroinvertebrate monitoring.

West Virginia (WV)

The West Virginia Department of Environmental Protection (WV DEP) has a vested interest in and provides robust technical and quality assurance support for volunteer-based water quality monitoring programs. All groups are trained by WV DEP and data are directly uploaded to a database managed by WV DEP. Due to this support, WV DEP is able to incorporate conductivity, temperature, and turbidity data collected by community groups into the West Virginia Integrated Report (IR) and other uses within the State. The utilization of these parameters, which are key indicators of water quality, underscores the state's commitment to science-based decision making and resource management.

Additionally, West Virginia Rivers Coalition and Trout Unlimited coordinate the WV-VA Water Quality Monitoring Project aimed at monitoring streams that support trout populations and high quality warmwater fisheries, track water quality impacts of shale gas and pipeline projects, and are starting to monitor highway construction projects. They provide equipment and training to volunteers throughout West Virginia and work closely with WV DEP to report any issues found.

While West Virginia has a robust dataset, they still face unique challenges in connecting this data to other Chesapeake Bay initiatives. One significant obstacle is that the Chesapeake Bay watershed encompasses only a small part of the state and therefore pose logistical difficulties when integrating these data into the CMC in addition to WV DEP's existing database. The CMC is working with WV DEP to explore pathways to integrate data into the CMC Data Explorer directly from WV DEP's database instead of through the individual monitoring groups. This collaboration could streamline the data integration process, thereby overcoming the logistical challenges and provide the added benefit of connecting this robust dataset to the CBP network and EPA's Water Quality Exchange (WQX).

Additionally, there is a growing interest in enhancing bacteria monitoring due to its significance for identifying pollution risks impactful for human health and the environment. This focus aligns with the priorities of the state of West Virginia, where there's an increasing emphasis on understanding and managing bacterial threats to water quality and public health. To support these efforts, the CMC will collaborate with existing water monitoring groups within the state to build partnerships aimed at augmenting their bacteria monitoring capabilities.

While acknowledging the successes and learning from the challenges, these priorities for the West Virginia portion of the Chesapeake Bay watershed emphasize the importance of integration and innovation in the future of water quality monitoring.

Local Government Integration

Since the inception of the CMC it has become increasingly important and valuable to not only connect community science data to our federal and state partners, but also to local governments. Local officials can achieve mutually beneficial outcomes by prioritizing local economic development, infrastructure resiliency, public health, and education, while also protecting our environment. Community monitoring data can play a key role in informing our local officials about environmental issues.

The CMC worked with the CBP Local Leadership Workgroup in order to integrate educational materials about the CMC and community-based science into their Local Government Guide to the Chesapeake Bay series created to support decision-making by local officials. This is the first stepping stone to building a model for communities who collect data to engage with their local officials. The CMC will continue to collaborate with the Local Leadership Workgroup and the Local Government Advisory Committee to identify pathways and synergies between decision-making entities and community science. The CMC will focus on building case studies highlighting successful partnerships and outcomes of monitoring data use at the local level in order to inspire additional partnerships.

Conclusion

Over the last 8 years, significant progress has been made integrating data from volunteer and nontraditional monitoring programs into decision-making and regulatory frameworks of the Chesapeake Bay Program and individual Bay jurisdictions. Most notably, the CMC helped 5 volunteer-based monitoring groups attain Tier 3 data use status and integrated their data into the Chesapeake Bay Program database to be used in regulatory water quality standards attainment assessments. Virginia continues to invest in volunteer monitoring and partnered with the CMC to build out a Virginia Data Explorer in order to integrate all groups within the state into one centralized place. Pennsylvania and Maryland made significant strides towards data inclusion by adopting a Tiered Framework based off of the CMC Tiered structure. Maryland further used the CMC Data Explorer to organize and obtain data for their combined 2020/2022 Integrated Report. Also, the District of Columbia funded a volunteer bacteria monitoring program specifically designed to fill critical data gaps.

While the CMC team is excited about the progress made, there are still major gaps that exist and renewed priorities as we move closer to 2025. Inclusion of underrepresented or marginalized communities continues to be at the forefront of the CMC mission. As the CMC continues to break down barriers to entry, we will assess the integration of Salt Watch as an easily accessible method that can reach new audiences.

Also, we will continue to look for ways to leverage systems and methods in place to meet community needs, specifically noted are bacteria and conductivity data. The CMC will continue working with the CBP to identify avenues for Tier 1 and 2 data use throughout the partnership and potential new data uses as CBP shifts its monitoring priorities based on findings of the CESR report, recommendations generated for science and monitoring needs in the 2022 CBP STAR's Monitoring Program Review for the Principal Staff Committee (Enhancing_the_Chesapeake_Bay_Program_Monitoring_Networks_A-Report_to_the_Principals_Staff_Committee.pdf (d18lev1ok5leia.cloudfront.net)) in addition to recommendations in new STAC Workshop reports being published (e.g., 2022 STAC Rising Temperatures Workshop). Finally, the CMC team will continue working with state agencies in order to integrate volunteer data in their biennial Integrated Reports and other regulatory processes.

Glossary

Acid mine drainage – the result of water flowing over or through rocks containing sulfur-bearing minerals. The resulting chemical reaction creates highly acidic waters. Typically occurs in connection with mining activity.

Bacteria - microscopic organisms that come from the intestines of humans and other warm blooded animals. If present in the water can be an indicator of other harmful bacteria present that pose a risk to human health.

Baseline – initial collection of data that serves as a basis for comparisons of future data.

Benthic Macroinvertebrate – organisms that live underwater in streams and rivers that do not have a backbone and can be seen by the naked eye. The diversity of organisms found are indicators of stream/river health.

Best Management Practice (BMP) – practice(s) that have been determined to be an effective and practical means of preventing or reducing pollution

Chlorophyll a – the predominant green pigment found in microscopic algae in fresh and saltwater ecosystems, and used as a measure of microalgae abundance.

Coastal Plain – the level land downstream of the Piedmont and fall line, where soils are generally finer and fertile and rivers are influenced by the tide.

Conductivity – ability of water to conduct an electrical current due to the presence of charged particles.

Dissolved Oxygen – the amount of oxygen gas that is present in the water.

EPA's Water Quality Exchange - is the mechanism for data partners to submit water monitoring data to EPA.

Impaired waters – waterways that do not meet water quality standards set by jurisdictions and/or the Clean Water Act.

Nitrogen – an essential nutrient for all life, can be a limiting factor.

Non-point source – sources of pollution that come from many diffused sources and cannot be traced to a single source. For example: runoff from lawns, farmland or streets.

Nontraditional monitoring – for the sake of this project, nontraditional monitoring refers to efforts by monitoring groups who do not traditionally submit their data to the Chesapeake Bay Program.

Nutrient – any substance that provides for essential growth and life.

pH – a measure of how acidic or basic water is. The pH scale ranges from 0-14, with 7 being neutral. pH less than 7 indicates acidity, and a pH greater than 7 indicates a base.

Phosphorus – an essential nutrient for all growth and reproduction.

Piedmont – uplands or hill country located above the fall line. Rivers and streams in the Piedmont region are not influenced by the tide.

Priority area – any area with an identified need for more information that could conceivably be filled by volunteer or nontraditional data of known quality.

QAPP – Quality Assurance Project Plan – documentation that provides the framework and procedures used to meet quality assurance standards.

Salinity – a measure of the salt content of water, the weight of salt per volume of water measured in parts per thousand (ppt).

Shale gas – natural gas that either resides or has been extracted from a shale formation such as the Marcellus Shale.

Spatial – relating to space or geographic spread of sampling.

Stormwater MS4 – Stormwater Municipal Separate Storm Sewer System which separates stormwater from wastewater and only wastewater goes to the treatment plant.

Temporal – relating to time or frequency of sampling.

Total Maximum Daily Load (TMDL) – the total maximum amount of pollutant allowed in a water body in order to meet water quality standards.

Total suspended solids (TSS) – solids within a water column that can be trapped by filtration.

Turbidity – a measure of the clarity of a water body; the cloudiness of the water.