2024 STATE OF THE ANACOSTIA RIVER REPORT CARD

Celebrating 35 Years

ANACOSTIA WATERSHED SOCIETY

Executive Summary

Overall Water Quality Grade: PASS

The Anacostia Watershed Society (AWS) in its 2024 State of the River Report has determined that the water quality of the Anacostia River receives a passing grade for sample year 2023. In fact, it is the highest grade to date since the Report began grading the river in 2014. Several parameters are showing consistent improvement. Others are more sluggish from year-to-year, but overall the river continues steady progress toward a clean and healthy future.

Every year since 2002, AWS has been monitoring the water quality of the river in a rigorous and consistent manner. This has produced a wealth of dependable data to track changes in water quality, providing not only a snapshot of water quality today, but a record of progress and setbacks over time. The State of the Anacostia River Report is our annual analysis of this data, providing a detailed report to the decision-makers, stakeholders, and the public on the river's progress toward recovery.

Highlights

- The river's water quality grade received a boost this year due to healthy growth of submerged aquatic vegetation (SAV).
- Parameters showing steady improvement in Trash, Toxics, Chlorophyll *a*, and Water Clarity.
- Parameters that remain sluggish include Fecal Bacteria, Dissolved Oxygen, SAV.
- Significant progress by the District Department of Energy and Environment in addressing toxic pollutants at the river's bottom are steadily improving the score for Toxics Remediation.
- In the most southern section of the tidal Anacostia, water clarity received its highest grade ever and its first passing grade.
- Over the past decade, SAV acreage has been inconsistent, fluctuating between scores of 5% and 100%. It is likely that SAV acreage in some years is influenced by poor/decreased water clarity in early spring. This instability indicates that improved land management and strategies like green infrastructure supporting increased water clarity will likely result in more stable SAV acreage.

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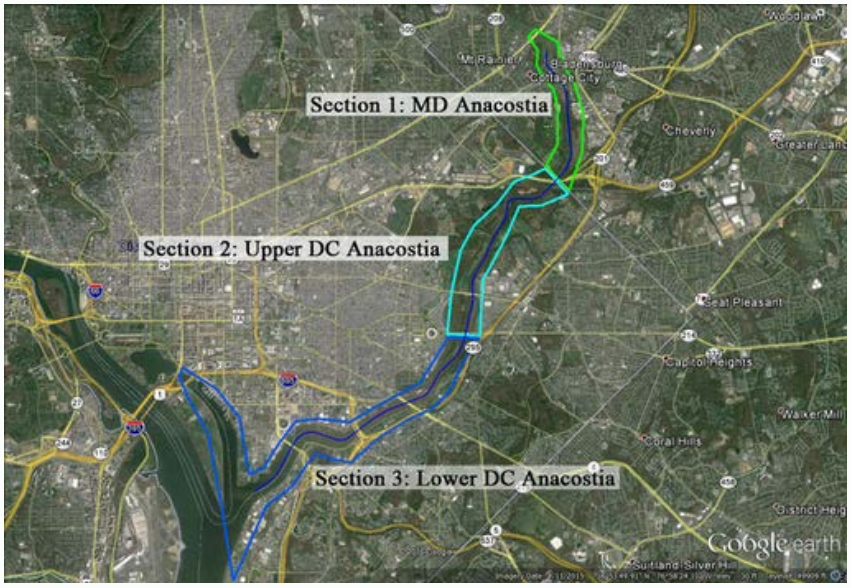
While there is great progress in controlling threats to water quality such as sewage and industrial toxics, the Anacostia watershed continues to suffer from the historical loss of wetlands and forests that once protected our rivers and streams from excessive run-off, sediment, and pollution. Climate change will heighten these challenges, and indeed threatens to roll back the gains we've made over the last 30 years. The Anacostia Watershed Society urges further, comprehensive efforts to conserve and restore wetlands and forests, reconnect floodplains with the river and streams of DC, Montgomery County and Prince George's County, and ensure climate resilience.

How we assess water quality

To arrive at the overall grade for water quality in the Anacostia River, the Anacostia Watershed Society (AWS) evaluates and grades each of three sections of the 9-mile tidal river from Bladensburg, MD to its confluence with the Potomac. We monitor key indicators including Dissolved Oxygen, Fecal Bacteria, Water Clarity, and Chlorophyll *a*. AWS uses the average score of each of these indicators to determine the river's overall grade.



Map 1: Three evaluated sections of the Anacostia River

The three sections, shown on Map 1, are the Maryland portion of the Anacostia (Section 1: MD Anacostia), the upper half of the Anacostia in the District of Columbia above the East Capitol Street Bridge (Section 2: Upper DC Anacostia), and the lower portion in the District (Section 3: Lower DC Anacostia).

Assessment for Submerged Aquatic Vegetation (SAV), Stormwater Volume Runoff, Toxics, and Trash is conducted for the entire tidal Anacostia River. These parameters will also be considered to give a percentage score (%Score) and grade for each section and the entire river.

Grade through the years

Over the past decade, the Anacostia River has made steady progress and finally received a passing grade in the 2018 State of the River Report Card. In the 2019 report card (data year: 2018), the grade slipped just below passing, but the overall momentum towards a swimmable and fishable river remained evident. We suspect this dip is due to the impacts of increased stormwater runoff in 2018, the wettest year in recorded history. The record-setting rains brought an increase in pollutants to the river from impervious surfaces (roads, roofs, parking lots, etc.) and created torrential streamflows that aggravated streambank erosion and sent increased sediment loads into the river. All of this led to murkier water unable to support the nearly 100 acres of submerged aquatic vegetation that the Anacostia River is clearly capable of supporting under optimal conditions.

In 2019 (data year) the precipitation was average and the %Score for the entire river quickly recovered to 63%.

It is promising that the %Score remained at 63 in 2020 (data year) even though it was the 3rd wettest year on record.

In 2021 (data year) the precipitation was average and most parameters had improved or remained the same. However, the %Score for SAV dropped from 100% to 32%. The river had only 6.41 acres of SAV. While the reasons are unclear, current theories hold that cloudy water in the early growing season may critically harm the growth of the grasses.

In 2022, the precipitation was again average. However, the acreage was reduced to 3.1 acres. More investigation is needed to understand the changes to this parameter.

In 2023, SAV came back to the Anacostia River and it exceeded the target (20 acres) set by scientists at the Metropolitan Washington Council of Governments. Also, there was significant progress in Water Clarity (Secchi Disk Depth) and Trash Reduction. Together, these improvements brought the aggregate %Score to 67 for the entire river, the highest since our annual assessment began.

Figure 1 shows the %Score trend for the entire Anacostia. The graph clearly illustrates that the river is gradually improving.

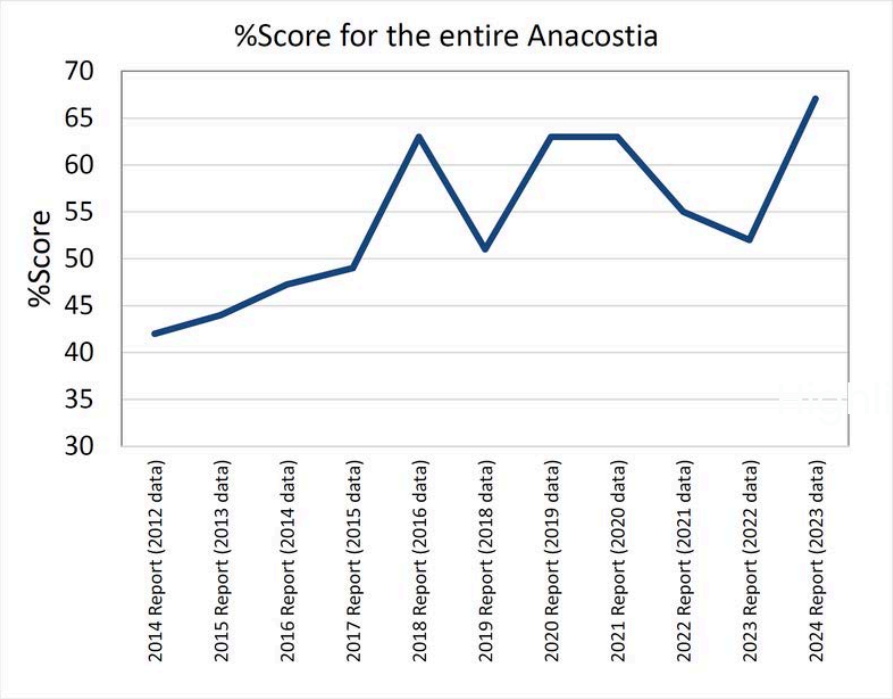


Figure 1: Percent score for the entire Anacostia river

2024 at a glance

Figure 2 shows %Scores for each parameter and for each section (when available). The %Score for the entire Anacostia is 67 and is the highest since our annual assessments began. The letter grade for the entire river is D+.

2024 State of the Anacostia River (2023 Data Analysis)

	Parameter*1	Dissolved Oxygen	Fecal Bacteria	Secchi Disk Depth (Water Clarity)	Chlorophyll (a)	SAV *3	Stormwater Runoff Volume	Toxics	Trash	Average of % Score	Grade for section*2	%Score and Grade for the entire Anacostia
Section 1 (MD Anacostia)	% Score	75	56	51	79	% Score 100	% Score 53	% Score 64	% Score 73	69	D+	% Score 67
	Grade for each parameter*2	C	F	F	C+							
	Long Term Trend	Improving	Sign of degradation	Improving	Improving							
Section 2 (Upper DC Anacostia)	% Score	21	69	53	83	Grade A	Grade F	Grade D	Grade C	64	D	
	Grade for each parameter*2	F	D+	F	B							
	Long Term Trend	Sign of improvement	Improving	Improving	Improving							
Section 3 (Lower DC Anacostia)	% Score	55	54	64	82	Trend Needs attention	Trend static	Trend Improving	Trend Improving	68	D+	Grade D+
	Grade for each parameter*2	F	F	D	B-							
	Long Term Trend	Needs attention	Needs attention	Improving	Improving							

*1 AWS scoring method used for Stormwater, Toxics and Trash. EcoCheck scoring method for all other parameters. (100% is best.)
*2 Standard school grading system (Below 60 = F)
*3 From 2017, AWS decided to use DOEE data since DOEE does survey on the ground and it is more accurate than VIMS data for SAV in the water of DC
Note: 2023 Data sets were used for all parameters. For the trend analysis, data sets from 1984 to 2023 were used.

Figure 2: 2024 State of the River data analysis chart

- Dissolved Oxygen (DO) had been declining despite the implementation of the new storm tunnels in the District. These tunnels aimed to reduce Combined Sewer Overflow (CSO), with reduction efforts beginning in 2009. DO was expected to improve as soon as these reductions began, but instead it continued to decline. However, in the Maryland section of the Anacostia River, there has been a modest overall improvement in DO since 2012. Additionally, DO in the Upper DC Anacostia began to improve gradually in 2017, and the Lower DC Anacostia has shown similar improvement since 2019. For more information, refer to the Dissolved Oxygen section in Data Analysis.
- The Fecal Bacteria %Score improved from 53 (in the 2022 data year) to 60. Fecal Bacteria %Score is heavily weather dependent and can fluctuate significantly depending on frequency and amount of rainfall. Stormwater runoff from impervious surfaces brings fecal matter from all sources including pet waste, wildlife, and birds. Severe rainfall can cause sewage overflows even from the separate sanitary sewer pipes (pipes dedicated to sewage delivery).
- Water Clarity improved significantly from 50 (2022 data year) to 56. In Section 3, the %Score for Water Clarity was 64 in the 2023 data year and it received a passing grade for the first time since our assessment began.
- Chlorophyll *a* slightly declined to 81 from 82. SAV improved significantly from 16 (in the 2022 data year) to 100.
- Stormwater Runoff Volume improved from 34 to 53.
- The Toxics Remediation, which is a measure of progress toward clean-up of toxic pollutants in the bed of the river, continued steady improvement, rising from 62 to 64.
- The Trash Reduction score improved to 73. Montgomery County reported progress in its trash removal implementation plan, which helped raise the %Score for trash. Also, Prince George's County, which reports trash reduction activities very well, achieved the Trash TMDL allocation again this year. The County implements numerous programs to reduce trash.

Variations by river section

In the past, intense rain events resulted in regular sewage and runoff discharges to the DC portion of the river from the District's Combined Sewer Overflow (CSO) system. Though 98% of discharge was reduced thanks to the Anacostia Tunnel, this overflow still happens in the Anacostia occasionally.

The largest amount of CSO discharge happens in Section 2. CSOs discharge a lot of organic matter that will later decompose, consuming oxygen in the water. As a result, dissolved oxygen values are often very low in the District portion of the river, especially in Section 2. The faster flowing, more turbulent, Maryland streams carry more dissolved oxygen, and give the Maryland portion of the Anacostia a better grade for dissolved oxygen compared to the DC portions of the Anacostia.

In contrast, the tidal river in Maryland normally has higher readings of fecal bacteria (thus a lower score) than the lower portions in the District due in part to the presence of more wildlife feces upriver. Cleaner Potomac River water that enters the lower Anacostia as part of the daily tide cycle also has a stronger dilution effect in the lower river which could be a factor in giving higher %Scores (low fecal bacteria numbers) in the DC Sections (2 & 3). However, we've seen that the %Score in Section 3 (the most southern portion of the river) has been declining in recent years.

See Data Analysis section for further discussion.

Signs of Improvement

In addition to the data-driven, quantifiable measures of water quality improvement analyzed and reported here, there are also visible signs of an ecosystem on the mend due to natural recovery and active restoration projects that are only possible because of improving water quality.

Signs of Improvement - Mussels

In 2015 we began a study to inventory the river's freshwater mussel species. In 2018, we started propagating mussels in the Anacostia River through our #MusselPower program. The juvenile mussels we use are produced from broodstock collected in the river and raised by our partners U.S. Fish and Wildlife Service at a mussel hatchery at the Virginia Fisheries and Aquatic Wildlife Center. Once we get juvenile mussels from the hatchery, they are deployed in different types of cages in the Anacostia River for one year, and during that time their growth and survival are monitored frequently. Then the mussels are released into the river, with a sample group of the mussels tagged for post-release monitoring purposes.

Since we started the propagation effort, we have released more than 36,000 native freshwater mussels into the river ecosystem. Just one adult mussel can filter 10-20 gallons of water each day. It is estimated that these mussels filter more than 88 million gallons of river water a year, the equivalent of over 200 Olympic-size swimming pools annually. Our mussels play the same biofiltration role as the oysters in the Chesapeake Bay, however the latter can only grow in brackish waters. Get an in-depth look at our #MusselPower program and read the story map by clicking here.

Left: Mussel Volunteers at Joint Base Anacostia Bolling discovering thriving mussel bed;
Right: Volunteers survey mussels at Buzzard Point in SW DC.

We are encouraged by our recent mussel surveys in the river. At Buzzard Point in April 2022 we found a record number of mussels - 220 mussels in one hour, making it the biggest mussel bed observed so far, with all eight species of native mussels represented. In June 2022 we were granted permission to survey the shoreline at Joint Base Anacostia-Bolling (JBAB) and since then we have found two large mussel beds with large, healthy mussels, one in the lower Anacostia River across the river from Buzzard Point and the other one in the Potomac River, across the river from the Ronald Reagan Washington National Airport on the JBAB side. The Potomac River mussel bed is the second largest observed to date with 200 mussels observed in one hour. Another important mussel bed was found in April of 2023 at the Blue Plains Advanced Water Treatment Plant just north of the plant's effluent with about 50 mussels found in one hour.

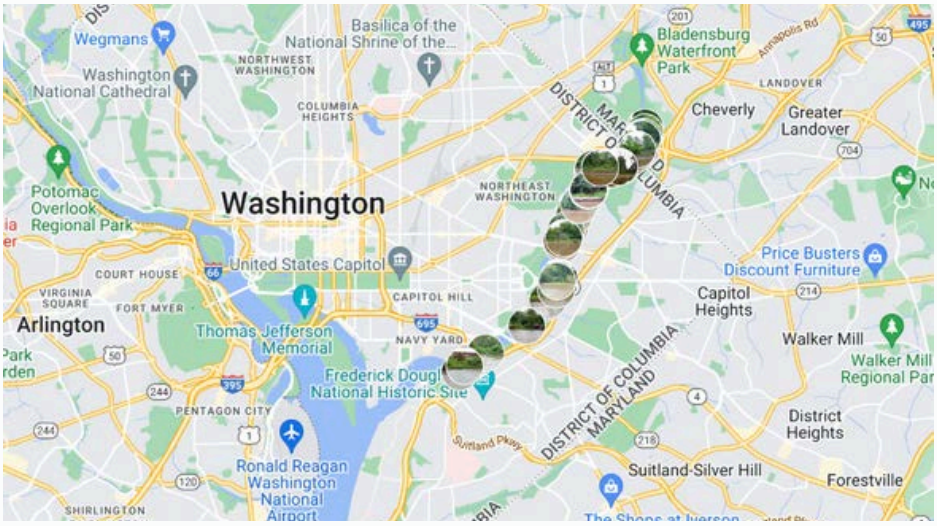
Freshwater mussels are the most imperiled of all animals in the United States, a country known to have the world's greatest diversity of this taxonomic group with over 300 species. We have identified eight species of freshwater mussels in the tidal Anacostia River: Eastern floater, Eastern elliptio, Paper pondshell, Eastern pondmussel, Tidewater mucket, Northern lance, and Eastern Lampmussel and Alewife floater. Five of those species are listed as "Species of Greatest Conservation Need" in Maryland and/or DC.

Signs of Improvement - River Otters

Closeup of River Otter from our trail camera in January 2023

In 2016 AWS captured a photo of what we suspect to be a river otter with our trail camera, in 2017 DOEE took clear photos of the Northern River Otter at the National Arboretum, and then they were spotted by the National Park Service at the Tidal Basin. In January 2023, we captured a photo on our critter cam and then later otters were spotted frolicking in College Park. The Northern River Otter is a species listed as a "Species of Greatest Conservation Need" in the DC 2015 Wildlife Action Plan. The return of species like the river otter is another sign of the Anacostia River's improving health.

Signs of Improvement - Emergent Wetland Plants



Map 2: Emergent Wetland Plants 2023
*Click on map for interactive view of emergent wetland plants since 2015

Thanks to water clarity improvement and the resident Canada goose management by the National Park Service, which started in 2016, AWS staff noticed during our routine water quality monitoring that emergent wetland plants are appearing along the river voluntarily. Emergent wetland plants are rooted in the soil where the basal portions exist beneath the water surface but the leaves and stems are above water. Normally "natural" Canada geese stay in the Anacostia area only during the late fall and winter. However, a non-migrating population was introduced by humans who clipped the wings of the geese to be live decoys. These clipped geese and their young adapted to not migrating, which meant they ate wetland plants all year round, including at their most vulnerable spring emergence stage. Wetland plants had to be protected by fences in the past since those plants had been over-eaten by resident Canada geese. Thanks to the successful efforts to cull the non-migratory population, wetland plants are coming up voluntarily without the fences.

Signs of Improvement - Wild Rice

AWS has been propagating native Wild Rice (*Zizania aquatica*) in the Anacostia River since the early 2000's. For many years, we partnered with the Maryland-National Capital Parks and Planning Commission (M-NCPPC) at the Jug Bay Natural Area in the Patuxent River to learn about wild rice propagation and to collect seed from the Jug Bay wetlands. We consider the Jug Bay wetlands a reference ecosystem for restoration purposes because it is closest to what the Anacostia used to look like centuries ago. At Jug Bay, wild rice seeds were bagged with tyvek bags, then harvested and the seed was then stored wet in refrigerators over the winter. Seeds were normally sowed in the early spring, first in nursery wetbeds and later by mudballing (embedding seeds in a mudball and throwing them into a promising spot in the wetland). Due to the resident Canada goose overpopulation, the planted sites initially had to be fenced to avoid grazing by the geese. Populations were patchy until 2019 when populations started growing exponentially. During the summer of 2022 AWS started mapping the wild rice acreage in its last stronghold in the tidal Anacostia River at Kingman Lake north of Benning Road, NE.

Map 3: Wild rice acreage (10 acres) at Kingman Marsh in 2022.

Wild Rice (Zizania aquatica) Populations at Kingman Lake (2023)

Map 4: Wild rice acreage (23 acres) at Kingman Marsh in 2023.

Data Analysis

There are limitations when comparing water quality scores over a short period because of numerous variables that impact water quality parameters. For example, more intense and frequent precipitation patterns generally make the water quality worse. More rain results in more sewer overflows and an increase in polluted runoff from streets and parking lots. So the comparison of indicators for wet and dry years can mask the underlying conditions. Long-term trends are generally more helpful for understanding the river and changes in water quality than year-to-year, short-term comparisons.

Dissolved Oxygen

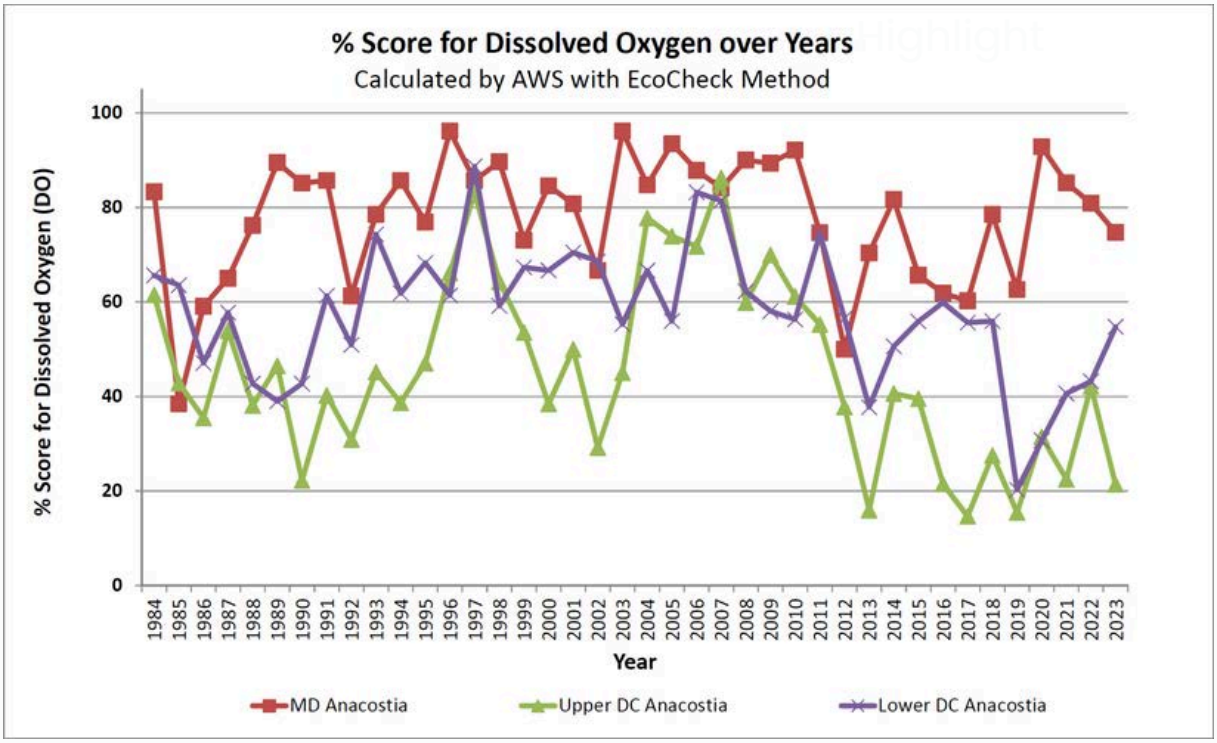


Figure 3: % score for Dissolved Oxygen over years

The amount of dissolved oxygen (DO) has been steadily improving in all three sections of the river, though there has been a decline in recent years. DO values have been low recently and the %Score, as a result, has been low.

Oxygen enters water by direct absorption from the atmosphere, which is enhanced by turbulence. Thus, DO is introduced to the river when water enters the river from turbulent tributaries. Rainfalls with moderate intensity will bring oxygen-rich water into the tidal river, as do the river's faster-moving tributaries. Water also absorbs oxygen released by aquatic plants during photosynthesis.

Intense rainfall events result in Combined Sewer Overflow (CSO) events. CSO events dump raw sewage mixed with rainwater into the river when it rains heavily. Because the CSO discharge is churned up, the discharge itself has high DO values; however, the discharge includes organic matter which will later be decomposed by bacteria. The decomposition consumes oxygen in the water, resulting in prolonged low DO values. Therefore, CSO events are ultimate drivers of reduced DO values.

Lack of consistent rainfall also reduces the amount of oxygen, especially in a tidal river. Without these oxygen supplies during very dry weather, the amount of oxygen tends to become low.

See Figure 4 below that shows how DO changes with intense rainfall.

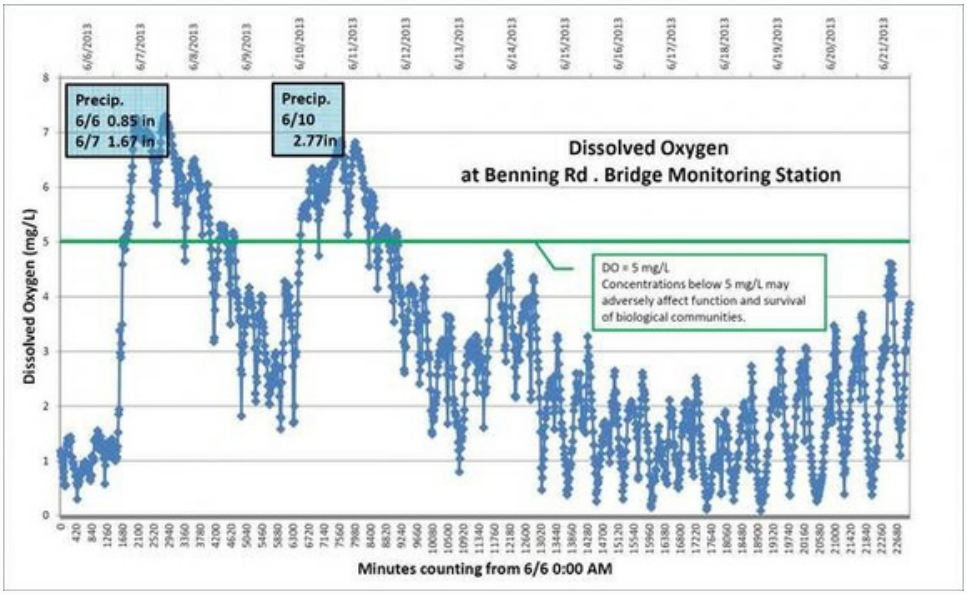


Figure 4: Dissolved Oxygen changes with intense rainfall

The sharp %Score drop in 2013 seems to be because of weather patterns that were not favorable to DO. Many intense rainfall events regularly caused Combined Sewer Overflow (CSO) events in downstream DC in 2013.

It seemed that this was not the case in 2018. According to DC Water, 90% of CSO discharge was captured and sent to Blue Plains thanks to the 1st phase of the Anacostia Tunnel completion. The tunnel started to store a large volume of sewage. While sewage dumping was reduced, a lot of rain in 2018 brought DO-rich water into the tidal Anacostia from the tributaries, resulting in a higher %Score in 2018.

Because the MD Anacostia (Section 1) receives oxygen-rich water from two large tributaries -- the Northwest and the Northeast Branches -- DO tends to be higher than in the DC portion (green and purple line/dots in the graph). AWS reported on the DO decline of unknown origin appearing since 2009 when CSO overflow reduction started and presented three hypotheses of the reduction.

The edited hypotheses from the blog article are shown below.

1. Legacy organic matter is accumulated at the bottom of the river.

   CSOs carry a lot of organic matter, not only feces but also food scraps from disposers, into the river. There is a significant amount of heavier organic matter deposited at the bottom of the river. That organic matter is now being decomposed. It may be consuming oxygen significantly. We know that the DO values are zero as we measure DO deeper in the river.

2. CSO events actually added some oxygen temporarily.

   CSOs are a mixture of sewage and rainwater. Rainwater is oxygen-rich, and the mixture is agitated vigorously in the pipes before being discharged, which allows oxygen to get into the mixture, so discharge itself is oxygen-rich. This could mean that the discharge into the river has raised the oxygen level at least for a few days, though eventually it will cause the Anacostia River water to have low oxygen due to the organic matter decomposition.

3. Increased organic matter from other sources.

   In addition to CSOs, there are other organic matter inputs, such as grass clippings and leaves on impervious surfaces, flowing into the river.

In 2020, signs of improvement were evident in the MD Anacostia. This is consistent with our river observation, but we are cautious about the improvement until we see longer term results. The muddy river shore is becoming sandier, which indicates that the river shore may be getting oxidized. We see a similar trend of improvement in 2023.

The Upper DC Anacostia also seems to be gradually improving, though the %Score is still low. We hope to see this trend continue.

DC Water (formerly DC WASA) broke ground in October 2011 on the $2.6 billion Clean Rivers Project (CSO Long Term Control Plan) to control sewer overflows. The Blue Plains and Anacostia River Tunnels came online in March 2018. DC Water reported in March 2019 that the tunnels reduced 90% of the combined sewer overflows to the Anacostia River. The tunnel project was completed in 2023. The tunnels now reduce combined sewer overflows by 98 percent.

Fecal Bacteria

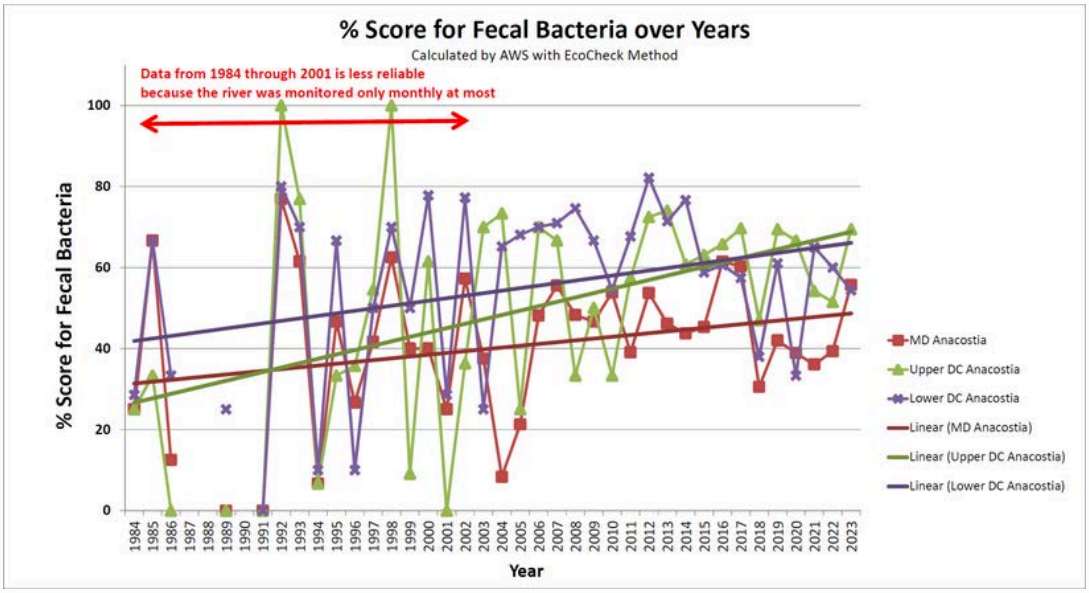


Figure 5: %Score for fecal bacteria over the years

Many Anacostia watershed residents know of the Combined Sewer Overflow problem in DC. The sewer system in DC was designed to overflow into the river when a rain event exceeds approximately a half inch. However, contrary to public perception, in terms of fecal bacteria downstream DC water is cleaner than the upstream MD water in the Anacostia River.

Two possible reasons account for this: (1) the tidal action washes the mouth of the Anacostia with much cleaner Potomac River water twice a day, and (2) there is a large amount of fecal matter input from Maryland.

Washington Suburban Sanitary Commission (WSSC) in Maryland and DC Water are working to repair sewer leaks and implement remediation projects to reduce sewer overflows. However, there is quite a large uncontrolled portion of fecal matter from wildlife.

According to a study conducted by AWS and Charles Hagedorn of Virginia Tech University, funded in part by Chesapeake Bay Trust (CBT), approximately 70 percent of fecal bacteria from Maryland is attributed to wildlife. Approximately 7-8 % of fecal bacteria is from canine species. Feces excreted on impervious surfaces by birds, squirrels, raccoons, deer, mice, rats, etc. is washed away by rainfall and carried into streams. Though the largest source of fecal bacteria may be wildlife, its transport to the river is caused by the impervious surfaces we have created. In natural settings, wildlife feces tend to decompose on site and most rainwater infiltrates into the ground and will not cause fecal bacteria pollution in streams.

All river sections show steady improvement over the years with the District portions improving faster. In 2018, all sections significantly degraded from the previous year. The score for the entire Anacostia (average of %Scores in 3 sections) declined from 62 in 2017 to 39 in 2018). This significant decline is due to heavy rainfall in 2018 (the wettest year in recorded history). Stormwater runoff carried a lot of fecal matter to the river. The year 2019 had an average amount of precipitation. Stormwater runoff inputs to the river were smaller than those in 2018. Thus, the %Score increased to 60 in 2019 from 39 in 2018. For the 2021 report card (2020 data), it was the 3rd wettest year since 1984; thus the %Scores for all jurisdictions in 2020 worsened. In 2021, the precipitation was average. Thus, the %Score for the entire river in 2021 improved to 55 from 46 (2020 data year).

Water Clarity (Secchi Disk Depth)

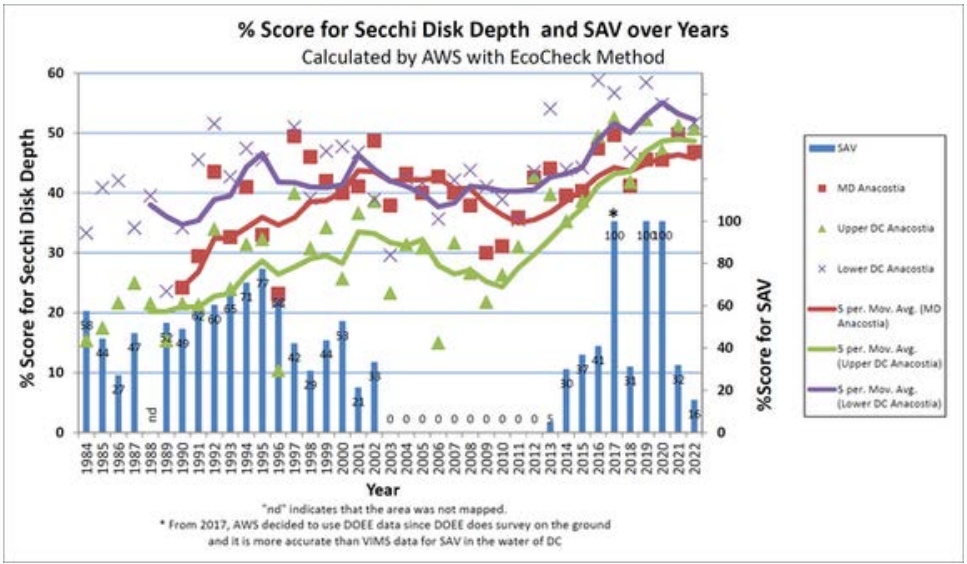


Figure 6: %Score for Secchi Disk Depth and SAV over years

In Figure 6 above, the trend line (not the scatter plots) is the average value of scores for the past five years. This method clearly illustrates the trend.

The water clarity indicator (Secchi Disk Depth) has been low for all sections in all years for which data is available.

However, since CSO discharge reduction started in 2009, the %Scores in all sections have been steadily increasing until 2017 though it became slightly worse in 2018 due to it being the wettest year on record. Since then, the steady improvement has continued through 2023. The Lower DC section of the Anacostia had the highest %Score of 64% in 2023 and this is the first passing score for a section.

From 2001 until 2009 water clarity in Maryland and Upper DC (Sections 1 and 2) had been declining. The best average score for these sections before 2009 was in 2001. Since then, the average had been declining until relatively recently. In the Lower DC Anacostia (Section 3) the best average score before 2009 was in 1995. Since then the average was declining until about 2006. However, thanks to the CSO overflow reduction started in 2009, water clarity in all sections has been improving steadily. Responding to the recent water clarity improvement, submerged aquatic vegetation (SAV) reappeared in 2013 after being absent from the Anacostia River for ten years. (See the trend analysis for SAV in Figure 8 for details.)

In order to accelerate and stabilize water clarity improvement, stringent regulations on stormwater runoff should be implemented because the increased peak stream flows resulting from flashy stormwater runoff from increased impervious surfaces have been eroding the streambanks and scouring streambeds, making the water cloudy.

According to a study conducted for the Total Maximum Daily Loads (TMDL) for sediment, about 73% of sediment is coming from streambank erosion. The study was conducted for suspended sediment particles in the water. When heavier particles of sediment are taken into consideration, it is safe to say that more than 73% of sediment is coming from streambank erosion.

Water Clarity has been responding to the CSO reduction very well. In 2009, CSOs were reduced by 40%. Upper DC Anacostia, which receives the largest amount of sewage from CSO, responded to it immediately in 2010. In 2011, CSO was reduced by 60%. Responding to the reduction, Water Clarity, especially in Upper DC Anacostia, has been rapidly improving.

The year of 2020 was the 3rd wettest year and the %Score declined a little from the previous year. However, the overall trend shows a clear improvement. In 2021, when the precipitation was average, the %Score remained similar to that of 2020. It was dry in 2023 and the %Score in 2023 increased.

Chlorophyll/Nutrients

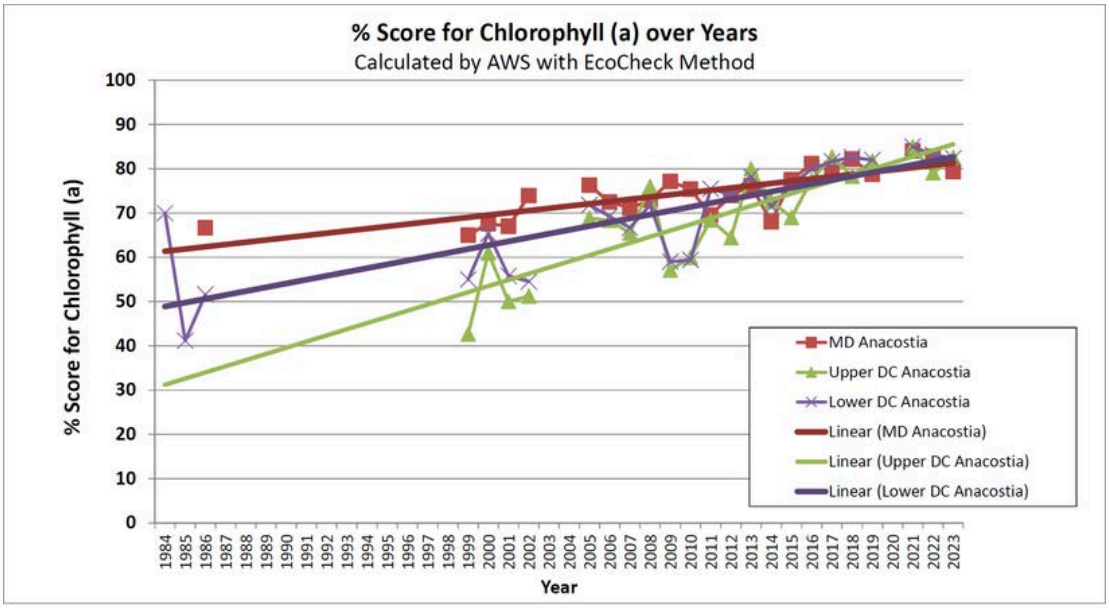


Figure 7: %Score for Chlorophyll *a* over years

Chlorophyll is the green pigment of plants that converts sunlight into organic compounds during photosynthesis. There are seven known types of chlorophyll; Chlorophyll *a* and Chlorophyll *b* are the two most common forms. Chlorophyll *a* is used as a measure of microalgae biomass, which is controlled by factors such as water temperature, light, and nutrient availability. Too much algae leads to large algal blooms that can reduce water clarity. In addition, when an algae bloom dies it depletes water of oxygen as it is decomposed.

%Score for Chlorophyll *a* has been improving. It improved even in the wettest year of 2018. The %Score in 2019 was the same as that in 2018. The overall better score in Maryland (Section 1) does not mean that there are no excessive nutrients coming from Maryland. Because Chlorophyll *a* is a green pigment in plants, algae, and cyanobacteria, it does not accurately reflect the nutrient amounts in water. There is a lag time between discharge of nutrients and their uptake by plants, etc.

In the free-flowing tributaries of the Anacostia River, discharged nutrients travel to the tidal Anacostia. Because the tidal river moves slowly, there is plenty of time for microalgae to take up nutrients. Thanks also to the ample sunlight for photosynthesis in the tidal Anacostia, the DC portions of the river (Section 2 and Section 3) tend to have higher Chlorophyll *a* values, resulting in lower scores. Both upstream and downstream communities need to reduce stormwater runoff that conveys nutrients (fertilizer, for example) from properties.

The river achieved the highest %Score of 85 for the entire river (average of 3 sections) in the 2022 report card. The value was high even in 2018 when the river experienced the wettest year in recorded history. This is probably thanks to the Anacostia Tunnel being operated from March 2018. The tunnel reduced 90% of CSO discharge. Also, the water was cloudier in 2018, which likely suppressed algal photosynthesis.

It is very interesting to see the DC sections (Sections 2 and 3) had been better than the MD section (Section 1) in 2013, 2014, 2019, and other years. As explained above, the tidal DC Anacostia is supposed to have worse %Scores in terms of Chlorophyll *a* than the MD Anacostia. Thanks to the CSO reduction and because the mouth of the Anacostia River is "washed" by the cleaner Potomac River water 2 times a day due to the tidal action, the DC Anacostia is recovering faster than the MD Anacostia. The faster improvement in the DC Anacostia can be seen from the inclination of the regression lines.

Submerged Aquatic Vegetation (SAV)

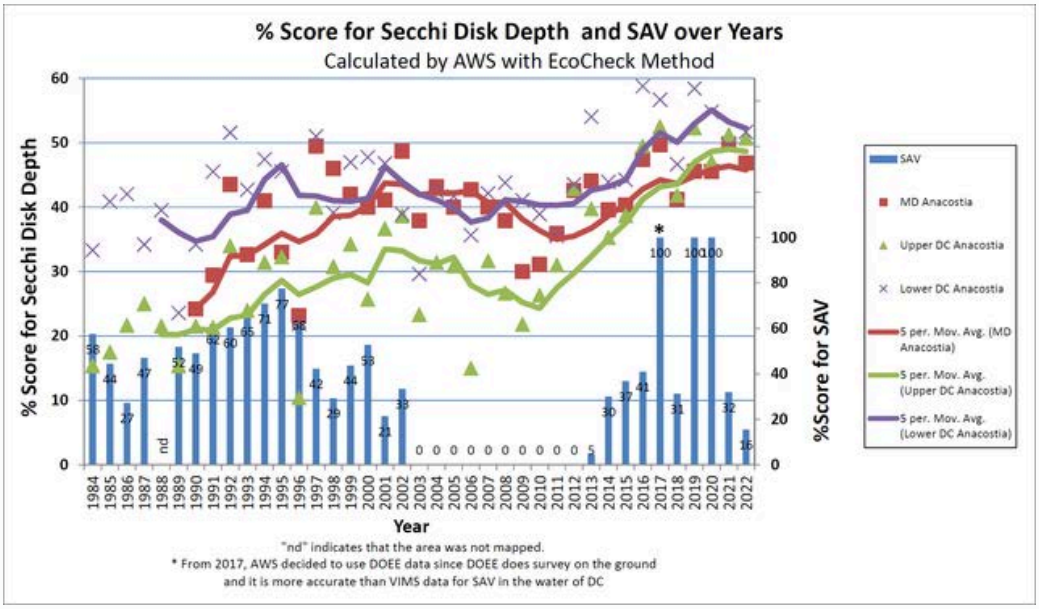


Figure 8: (SAV data source until 2016: http://web.vims.edu/bio/sav/index.html)

Since 2017, AWS has used DOEE data because DOEE does an accurate on-the-ground survey.

Submerged Aquatic Vegetation (SAV) are plants that cannot withstand excessive drying and therefore live with their leaves at or below the water surface. Such underwater grasses constitute an important habitat for young fish and other aquatic organisms.

AWS's goal for restoring SAV in the Anacostia is 20 acres, a goal identified in the Anacostia Watershed Restoration Indicators and Targets for Period 2001 - 2010 by scientists at Metropolitan Washington Council of Governments (COG).

As soon as the degradation of water clarity in the Lower DC Anacostia (Section 3) was observed in 1995, the acreage of SAV started to decline. No SAV was observed in the Anacostia from 2003 until 2012. While there was no SAV in the tidal Anacostia, it is known that there has been SAV in nontidal tributaries to the Anacostia River.

However, in 2013, 0.9 acres of SAV (thus, the %Score is approximately 5% 0.9/20x100) was identified in the Washington Channel and we learned that SAV is coming back to the Anacostia River.

AWS is not certain why SAV was present in the past --particularly in the 1980s and 1990s when the water clarity seemed worse than or equal to the current clarity. However, we have several hypotheses:

- The nature of the cloudiness of the water was different. There are many factors that make the water cloudy. Recent cloudiness may be a complex combination of sediment particles due to erosion, decaying organic matter from sewage, algae bloom, etc. while past cloudiness may have mainly come from sediment particles.

- The river was monitored less often in the 1980s and 1990s. The water quality data may then be less reliable during the time period.

- The SAV may have suffered in the 1980s and 1990s, but may still have been resilient to the pollution.

- The overall nature of pollution may have changed. In more recent years, numerous types of pollutants including chemicals such as pharmaceuticals, pesticides, herbicides, and heavy metals on top of water cloudiness may have helped eliminate the plants.

In 2017 the SAV coverage in the Anacostia River was 24.71 acres. This exceeded the goal of 20 acres and the %Score for SAV was 100%. In 2018, the wettest year in recorded history, the acreage of SAV receded. However, in 2019 when the precipitation was average, SAV grew significantly and the acreage was 92.6 acres (over 20 = 100%). In 2020, SAV showed resilience even though 2020 was the 3rd wettest year, and the Anacostia had 67.2 acres of SAV bed. In 2021, the river had only 6.41 acres. It is likely that the water was cloudy in the early growing season, an important time for SAV growth. In 2022, the acreage was 3.1 and remained low. In 2023, there was 52.76 acres of SAV and %Score is 100%

Stormwater Runoff Volume

Northwest Branch

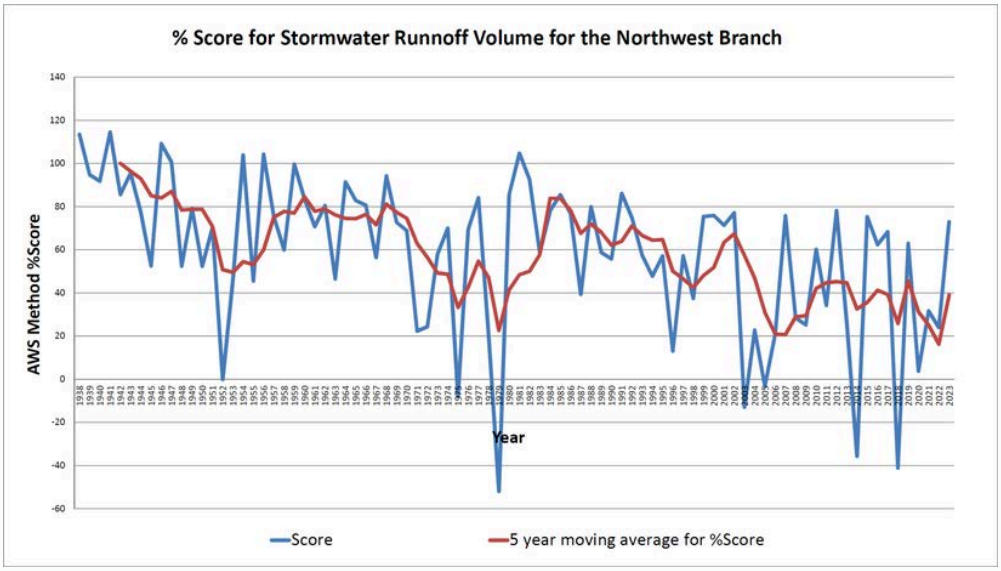


Figure 9: %Score for Stormwater Runoff Volume for the Northwest Branch

Northeast Branch

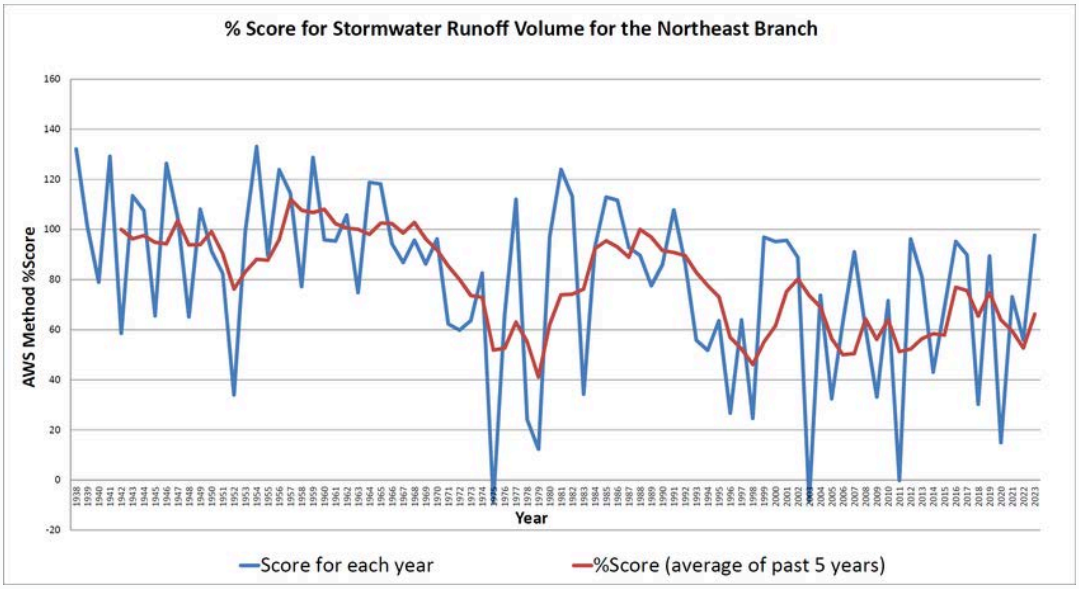


Figure 10: %Score for Stormwater Runoff Volume for the Northeast Branch

The data tells us that the %Scores of Stormwater Runoff Volume for the NW and NE Branches became static, even slightly improving in recent years, starting in 2007. We might be seeing a positive response from the Maryland Stormwater Management Act of 2007, which AWS helped pass. Under the act, all new developments have to treat precipitation of a 1-year rainfall event (2.7 inches). The Act also requires that re-development has to be designed to treat a certain amount of precipitation, the amount of which is different by jurisdiction. However, when we see the graphs, there is an improvement-degradation cycle approximately every 30 years. Thus, we need to see the trend for a longer time to see if it is improving in recent years or if it is only a cycle.

Toxics and Trash

The %Score calculation table for Toxics and Trash is shown below.

Toxics and Trash Scoring (This is like a Business Confidence Index)

Toxic Remediation	Year											
Evaluation Points	1989	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Technical research is adequate?	0.00	0.50	0.54	0.60	0.69	0.80	0.81	0.85	0.89	0.91	0.92	0.92
Appropriate plan to remove toxics	0.00	0.00	0.19	0.29	0.31	0.68	0.76	0.80	0.83	0.83	0.83	0.83
Political will	0.00	0.25	0.50	0.60	0.70	0.75						
Funding	0.00	0.25	0.25	0.25	0.35	0.40	0.45	0.50	0.65	0.65	0.65	0.70
Implementation/remediation	0.00	0.00	0.04	0.45	0.22	0.25	0.27	0.31	0.38	0.40	0.45	0.45
Fish tissue testing result show safe to eat?	0.00	0.00	0.00	0.00	0.00	0.15						
Fish advisory no advisory = 1							0.28	0.28	0.28	0.28	0.28	0.28
Declaration of fishable Anacostia by governments	0.00	0.00	0.00	0.00	0.00	0.00						
%Score	0.00	14.3	21.7	28.7	32.4	43.3	51.5	54.7	60.7	61.6	62.4	63.7

*There are detailed sub-matrices to fill in this matrix.

Trash Reduction	Year											
Evaluation Points	1989	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Technical research is adequate?	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Solid plan to remove trash in MS4	0.00	0.50	0.50	0.50	0.50	0.63	0.80	0.80	0.80	0.80	0.80	0.80
Political will	0.00	0.50	0.60	0.70	0.75	0.75						
Funding	0.00	0.50	0.50	0.50	0.55	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Implementation	0.00	0.50	0.50	0.50	0.50	0.63	0.70	0.60	0.70	0.57	0.74	0.79
Regulation for behavior change (bag bill, bottle/can deposit, Styro ban, etc.)	0.00	0.25	0.34	0.59	0.52	0.48	0.45	0.47	0.46	0.48	0.53	0.59
Trash reduction can be seen at Nash Run trap/Earth Day cleanup event	0.00	0.00	0.00	0.00	0.13	0.30	0.24	0.29	0.30	0.30	0.30	0.43
Strong education and public awareness							0.60	0.63	0.73	0.73	0.78	0.93
Visual assessment of the river (on water and on the shore/wetland)							0.50	0.55	0.50	0.50	0.50	0.60
Delcaration of Trash Free Anacostia?	0.00	0.00	0.00	0.00	0.00	0.00						
%Score	0.00	40.6	43.0	45.6	49.3	55.6	61.8	62.4	64.2	62.9	66.2	72.5

*There are detailed sub-matrices to fill in this matrix.

Figure 11: %Score calculation table for Toxics and Trash

AWS streamlined the scoring system in 2018 after getting feedback from stakeholders. We removed Political Will as an evaluation point because it could be evident among the other evaluation points. We also removed the Declaration of Fishable Anacostia by Governments and the Declaration of Trash Fee Anacostia. Instead, we added analysis for Fish Advisory to Toxic Remediation and Visual Assessment of the River to Trash Reduction. Since Education and Public Awareness is very important to change people's lifestyle to not litter, we added it to the evaluation points for Trash Reduction.

While there has been substantial progress in the study and assessment of legacy toxics in and along the river, notably the ongoing investigation of toxic river sediments throughout the entire tidal portion of the river, and continued collaboration and discussions among stakeholders and potentially responsible parties, little actual cleanup regarding the toxic sediment in the river has yet to occur.

The only sites along the river that have completed cleanups are Washington Gas, the Washington Navy Yard, and CSX Benning Yard, but these were on land only. However, the river portion (sediment) study is coming close to completion and the interim Record of Decision on the toxic sediment was released in September 2020.

The score for Funding improved significantly reflecting that the DC government reached a settlement in July 2020 that held Monsanto accountable for polluting the District's environment with PCB and Monsanto will pay $52 million to the district. Further in October 2023, the Attorney General of the District of Columbia announced the largest environmental enforcement settlement in the AG's history with Pepco. Pepco agrees to pay more than $57 million to support clean-up of toxic pollutants in the Anacostia River and $47 million will go to toxic sediment remediation.

Until there is a reduction in the presence of toxic substances in and along the river that results in an improvement in water quality and the health of aquatic organisms, the score/grade for Toxic Remediation will remain low. However, the Toxic Remediation evaluation received the first passing grade in the 2021 State of the River Report and is expected to keep the passing grade status.

Though the %Score for Toxics Remediation is still low, credit must go to the Department of Energy and Environment (DOEE). The %Score increased from 0 (in 1989) to 64 (in the 2023 data year) thanks to the strong leadership and investment by DOEE. Without their work, this improvement would not have happened. If in-the-water implementation of the remediation begins in 2025 as expected, this %Score will continue to rise.

Progress on trash reduction has been slow, but growing. Past efforts to install trash traps in the District and charge fees on plastic bags in DC and Montgomery County are notable. Elected officials in Prince George's County had been making a great effort to pass a bag fee law but failed because the state did not give the authority to create a new tax on bags. However, the county went beyond the bag fee and successfully banned the use of single use plastic bags in 2023.

Increased efforts by local jurisdictions to reach goals set in trash reduction plans required by federal law (due to the extreme nature of the problem here) have produced substantial results.

This includes laws passed to prohibit the use of plastic foam (a.k.a. Styrofoam) as food and beverage containers (effective January 1, 2016 in the District and Montgomery County, and July 1, 2016 in Prince George's County). The proliferation of single-use beverage containers in river trash is a major problem yet to be addressed. Environmental advocates have started to take action to reduce beverage containers through legislation. These efforts have been unsuccessful thus far, but 2025 will likely see legislation introduced in DC and MD to incentivize recycling of plastic and glass bottles and aluminum cans.

Non-floatable trash such as chip bags and candy wraps are also a significant problem; AWS trash monitoring at Nash Run shows about 70% of trash by count is non-floatable. More work needs to be done to address this larger problem, likely through enforcement of illegal dumping and littering or lifestyle and landscape change. Our food packing lifestyle could be changed so that food wrappers (chip bags, etc.) are reusable or recyclable. In addition, it is stormwater runoff that carries trash to streams. Continuing improvements in stormwater management to reduce run-off will help reduce trash in streams significantly.

Also, a law that requires Extended Producer Responsibility would reduce trash significantly at the very source: producers. For example, the proposed federal Break Free From Plastic Pollution Act requires producers to improve packaging to reduce waste. It also requires them to pay for the cost of trash disposal, recycling, and cleanups. In order to avoid these costs, they will be encouraged to improve packaging still further. This will promote a productive cycle of innovation to reduce the proliferation of single-use plastics.

Assessment Methods

To evaluate the data for the State of the River report card, the Anacostia Watershed Society employs a variety of scientific methods. Currently there is not a standard grading system to assess Stormwater Runoff Volume, Toxics, and Trash. These factors are very important to the health of the Anacostia River, so we created our own method, and we explain our scientific process here.

Water Quality Indicators

The EcoCheck method developed by the Mid-Atlantic Tributary Assessment Coalition is used to assess the river for water quality parameters as described under the Data Analysis section above: Dissolved Oxygen, Fecal Bacteria, Chlorophyll a, Secchi Disk Depth (Water Clarity), and Submerged Aquatic Vegetation (SAV).

For more information about the EcoCheck protocol, read the manual. (pdf file, 8.3 MB).

Though AWS uses the EcoCheck protocol to calculate the %Scores for the water quality parameters, in 2014 and after AWS did not use the manual's grading system (A through D and F) because it employs equal interval breaks for grading. Feedback from the public indicated that the EcoCheck grading system is confusing because of its similarity to a school grading system while the interval breaks are different. The EcoCheck grading of C (>=40 and <60 by the EchoCheck %Score) indicates the river is given a passing grade for a swimmable and fishable, but in actuality it is not). In order to make our grading more understandable and relatable to the general public, in 2014 and beyond, AWS is using a school grading system for the State of the Anacostia River Report.

Stormwater Runoff Volume

Initially, AWS wanted to measure the areas of impervious surfaces throughout the watershed. However, measuring impervious surfaces had various difficulties:

- AWS relies on government data which is not released on a regular schedule.
- There are several methods to calculate imperviousness that produce different results.
- There are 3 jurisdictions in the Anacostia watershed and they do not all use the same methods for calculations.
- Green infrastructure is continuously being installed and each technique/practice has a different capacity to manage stormwater. It is not clear how those differences will be taken into account as pervious surfaces.

Because of those factors, AWS decided to use peak streamflow data for the Stormwater Runoff Volume analysis because the excessive runoff is generated by impervious surfaces, which will generate sharper peak streamflows when it rains. It is not practical to measure the volume of stormwater runoff. However, the runoff will be concentrated in streams and it is known that peak stream discharges (flows) have been increasing. The United States Geological Survey (USGS) has been measuring stream discharge since 1938 in the Northwest and the Northeast Branches of the Anacostia River. The historic data was used to calculate the Stormwater Runoff Volume %score.

First, the 99th percentile of daily stream discharge was calculated for each year. Then, the values were plotted on a graph as shown below. The reason we use the 99th percentile is to eliminate values from most extreme events such as hurricanes. Using a 99th percentile value for a given year, the highest values for about 4 days will be dropped out.

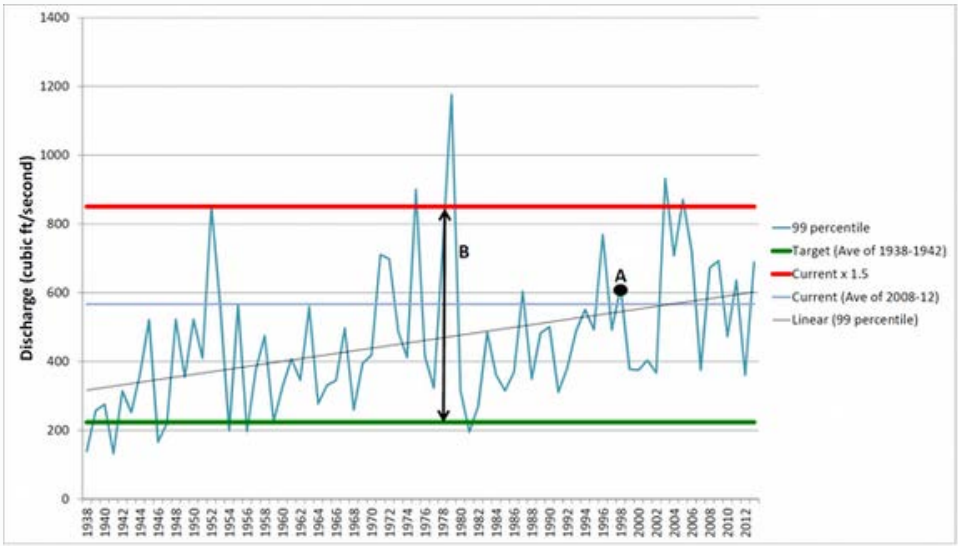


Figure 12: Stream Discharge

An average of 99th percentile daily stream discharges for the years 1938 to 1941 and that for 2008 to 2012 were calculated respectively. The former is a tentative target for a 99th percentile peak stream discharge. Because we did not want to have negative values, the average for 2008-2012 was multiplied by 1.5 for use as a baseline. From this baseline of peak stream discharge, we can determine the amount of stream discharge to be reduced (B in Figure 12).

The tentative goal is still reasonable because in the period of 1938 - 1941, there is documentation of people who swam in the Anacostia River. However, we know that the Anacostia River had been degrading long before then due mainly to agricultural activities, sewage influx, and dumping. As we learn more, we may revise the goal in the future.

The score was then calculated using the target and the baseline.

For example, the 99th percentile peak stream discharge in a given year is indicated as “A” in the graph. Then the score was calculated using this formula:

%Score = (Baseline (current x 1.5 in the graph) - A) / B x 100

With highly fluctuating annual values, to keep an accurate assessment, AWS used 5-year moving averages. The %Score for 2012 is actually an average of scores from 2008 through 2012. The scores were calculated for the Northwest and the Northeast Branches and the average value was used for the Anacostia River's %Score for Stormwater Runoff Volume.

Toxics Remediation and Trash Reduction

Calculating the score for Toxics and Trash is very difficult due to the complexity of assessing a wide range of factors. There are many toxic chemicals in the river such as pharmaceuticals, PCB, PAH, pesticide, herbicide, and heavy metals, to name a few. There are about 200 congeners of PCB and numerous chemicals in the group of Polycyclic Aromatic Hydrocarbons (PAHs). The standard toxicity level is different for each chemical. In addition, there are chemicals that do not have a safe standard for humans and wildlife. Quantifying the amount of trash in the Anacostia River watershed accurately each year is also very difficult, even though unlike chemicals, you can see it plainly with the naked eye.

All of these challenges make interpreting the data and comparing it to a scientifically rigorous standard in a reasonable manner nearly impossible.

Therefore, the Anacostia Watershed Society decided to take a different approach from strictly scientific scoring. AWS decided to apply the Business Confidence Index method to these important parameters. We listed actions to be taken for Toxics and Trash. Then, AWS professionals discussed how much work had been done for each action. It is like an Environmental Confidence Index for Toxics and Trash.

This method produces reasonably understandable and intuitive scores. Also, this method gives a good sense to the public about what actions should be taken and where we are to remedy the problems. We will continue to monitor the accuracy of this method, and make improvements as necessary.

The table calculating our scores for Toxics and Trash is shown below (Figure 13).

Toxics and Trash Scoring (This is like a Business Confidence Index)

Toxic Remediation	Year											
Evaluation Points	1989	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Technical research is adequate?	0.00	0.50	0.54	0.60	0.69	0.80	0.81	0.85	0.89	0.91	0.92	0.92
Appropriate plan to remove toxics	0.00	0.00	0.19	0.29	0.31	0.68	0.76	0.80	0.83	0.83	0.83	0.83
Political will	0.00	0.25	0.50	0.60	0.70	0.75						
Funding	0.00	0.25	0.25	0.25	0.35	0.40	0.45	0.50	0.65	0.65	0.65	0.70
Implementation/remediation	0.00	0.00	0.04	0.45	0.22	0.25	0.27	0.31	0.38	0.40	0.45	0.45
Fish tissue testing result show safe to eat?	0.00	0.00	0.00	0.00	0.00	0.15						
Fish advisory no advisory = 1							0.28	0.28	0.28	0.28	0.28	0.28
Declaration of fishable Anacostia by governments	0.00	0.00	0.00	0.00	0.00	0.00						
%Score	0.00	14.3	21.7	28.7	32.4	43.3	51.5	54.7	60.7	61.6	62.4	63.7

*There are detailed sub-matrices to fill in this matrix.

Trash Reduction	Year											
Evaluation Points	1989	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Technical research is adequate?	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Solid plan to remove trash in MS4	0.00	0.50	0.50	0.50	0.50	0.63	0.80	0.80	0.80	0.80	0.80	0.80
Political will	0.00	0.50	0.60	0.70	0.75	0.75						
Funding	0.00	0.50	0.50	0.50	0.55	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Implementation	0.00	0.50	0.50	0.50	0.50	0.63	0.70	0.60	0.70	0.57	0.74	0.79
Regulation for behavior change (bag bill, bottle/can deposit, Styro ban, etc.)	0.00	0.25	0.34	0.59	0.52	0.48	0.45	0.47	0.46	0.48	0.53	0.59
Trash reduction can be seen at Nash Run trap/Earth Day cleanup event	0.00	0.00	0.00	0.00	0.13	0.30	0.24	0.29	0.30	0.30	0.30	0.43
Strong education and public awareness							0.60	0.63	0.73	0.73	0.78	0.93
Visual assessment of the river (on water and on the shore/wetland)							0.50	0.55	0.50	0.50	0.50	0.60
Delcaration of Trash Free Anacostia?	0.00	0.00	0.00	0.00	0.00	0.00						
%Score	0.00	40.6	43.0	45.6	49.3	55.6	61.8	62.4	64.2	62.9	66.2	72.5

*There are detailed sub-matrices to fill in this matrix.

Figure 13: Toxics and Trash score table

Acknowledgments

The Anacostia Watershed Society would like to thank the following organizations for technical assistance and/or funding for this report card:

- The Keith Campbell Foundation for the Environment
- Mid Atlantic Tributary Assessment Coalition
- District Department of Energy and Environment (DOEE)
- American Chemical Society
- Prince Charitable Trusts

Thanks also to the AWS staff and consultants who contributed to the report:

- Masaya Maeda, Water Quality Specialist (lead researcher and author)
- Christopher E. Williams, Anacostia Watershed Society President
- Bekah Holloway, Director of Development and Communications
- Keisha Pendleton, Communications and Media Manager
- Jorge Bogantes Montero, Natural Resources Specialist

Definitions

Chlorophyll *a*: the measure of microalgae biomass; this can impact water clarity and dissolved oxygen levels, and indicates the amount of nutrients like phosphorus and nitrogen. A score of 100% means that the body of water has only the appropriate amount of microalgae biomass.

Dissolved Oxygen: critical for the survival of aquatic life and ecosystem sustainability. A score of 100% means that the water is equal to or more than 5mg/L of oxygen all the time. According to 2023 data, the long-term trend indicates that immediate attention is needed.

Stormwater Runoff: the fastest growing source of pollution in the watershed. Runoff flushes trash and toxics from paved areas and erodes stream banks, filling the river with sediment. A score of 100% means that the peak stream flow is the same as averaged values from recorded historical levels (1938-1942).

Submerged Aquatic Vegetation: vegetation requires light to thrive and is essential habitat for aquatic life. A score of 100% means that the Anacostia River has at least 20 acres of SAV bed. Over the past decade, SAV acreage has fluctuated between 5% and 100% Likely due to poor water clarity in early spring. This indicates that improved land management and green infrastructure is necessary to support increased water clarity, which will then likely result in more stable SAV acreage.

Water Clarity: a measure of light penetrating the water column; this affects the health of aquatic grasses. A score of 100% means that the water is clear enough to see through at at least 4.25 feet (1.3 meters).