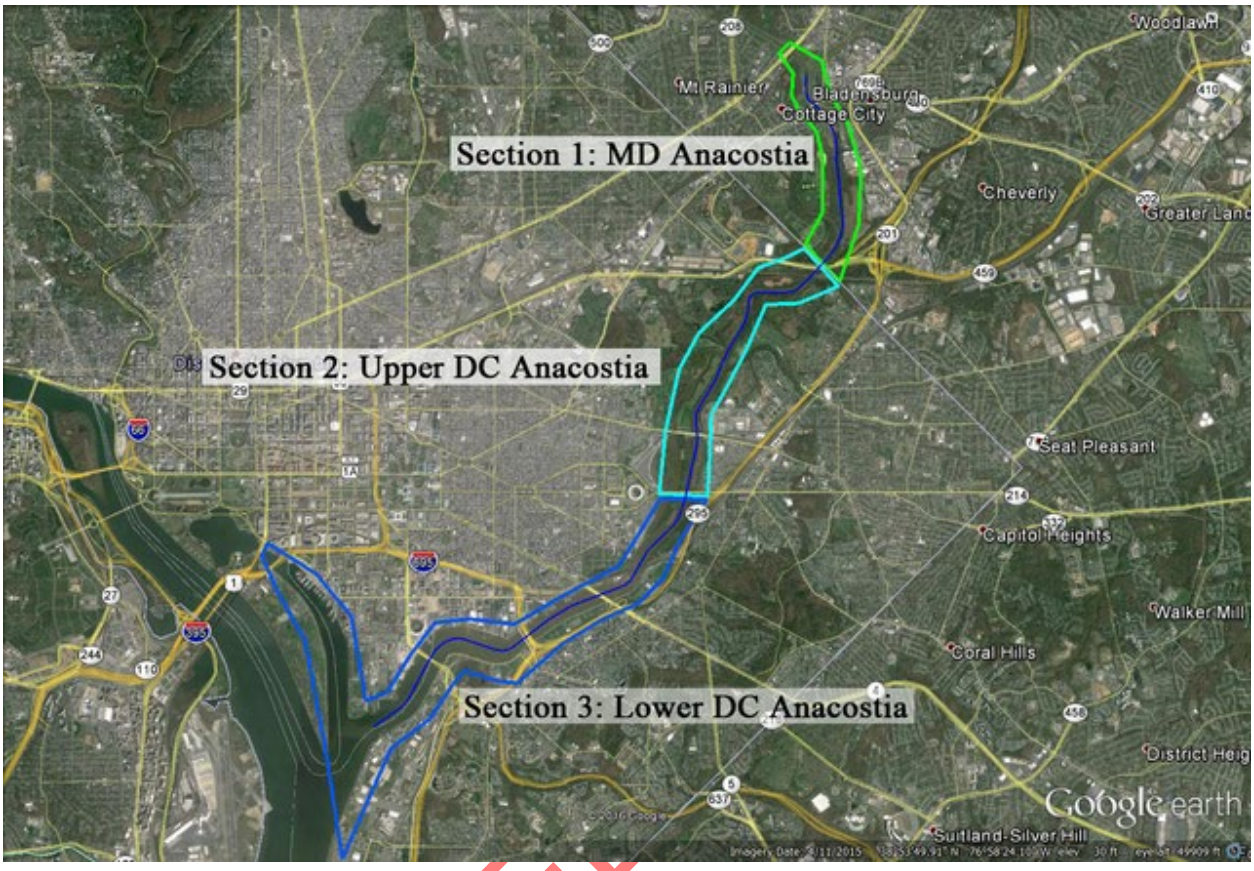
Anacostia Watershed Society State of the River Report

Overall Water Quality Assessment

Overall Water Quality Grade: FAIL

While long-term trends are positive, the Anacostia River receives a failing grade for the 2023 State of the River Report Card again due in large part to the continuation of low acreage of the river's underwater grasses (Submerged Aquatic Vegetation or SAV). Other indicators show sluggish but steady improvement towards a clean and healthy river. Thanks to significant efforts by the federal and District governments to address toxics at the river's bottom, the score for Toxics Remediation has been steadily improving. 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 advocates for further comprehensive efforts to mitigate climate change, and strengthening wetland, forest, and other restoration efforts to ensure resilience to its effects.

To arrive at the overall grade for water quality in the Anacostia River, the Anacostia Watershed Society (AWS) first evaluates and grades each of three sections of the 9-mile tidal river for the key indicators of Dissolved Oxygen, Fecal Bacteria, Water Clarity and Chlorophyll a. The three sections, shown on the map below, 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 taken into consideration to give % Score and Grade for each section and the entire river.



For the past decade, the Anacostia River made steady progress and finally received a passing grade in the 2018 State of the River Report Card. In the 2019 report card, the grade slipped just below passing, but the overall momentum towards swimmable and fishable is evident. The river recovered very quickly from the damage caused by the large amount of stormwater runoff in 2018, the wettest year in recorded history, a big reason we suspect that the 2019 grade went down. The record-setting rains brought an increase in pollutants to the river from impervious surfaces (roads, roofs, parking lots, etc.) and created torrential flows that caused streambank erosion which sent sediment to the river. All of this led to making the water cloudy and unable to support the nearly 100 acres of submerged aquatic vegetation that the Anacostia River is clearly capable of supporting now in the right conditions.

In data year 2019 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 third wettest year on record. In 2021 (data year) the

precipitation was average and most parameters had improved or maintained their % Scores. However, the % Score for SAV dropped from 100% in 2020 to 32% in 2021, as the river had only 6.41 acres of SAV. While the reasons are unclear, current theories hold that that cloudy water in the early growing season may critically harm the growth of the grasses. In 2022, the precipitation was again average, however, SAV acreage was reduced to 3.1 acres. More investigation is needed to understand the changes to this parameter.

Dissolved Oxygen (DO) has been declining in recent years despite the implementation of the new storm tunnels in the District. However in the MD Anacostia, the overall trend since 2012 shows signs of cautious improvement. In addition, Upper DC Anacostia started gradually improving in 2017 and Lower DC Anacostia shows similar improvement since 2019. Fecal Bacteria % Score remains similar; from 55% to 53% in data year 2021. Water Clarity slightly remained the same 50% from last year. Chlorophyll a slightly declined to 82% from 85%. SAV dropped again to 16%. Stormwater Runoff Volume degraded to 34% from 42%. The Toxics Remediation remained the same at 62% but steadily improving overall. The Trash Reduction score improved to 66. Prince George's County achieved the Trash TMDL allocation after the un-achievement due to pandemic and the county implements numerous programs to reduce trash and they report their activities well. Overall the grade for the entire Anacostia River declined to 52% (F grade).

2023 State of the Anacostia River (2022 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	81	43	47	83	% Score 16	% Score 34	% Score 62	% Score 66	54	F	% Score 52
	Grade for each parameter*2	B-	F	F	B							
	Long Term Trend	Improving	Sign of degradation	Improving	Improving							
Section 2 (Upper DC Anacostia)	% Score	42	53	51	79	Grade F	Grade F	Grade D-	Grade D	51	F	Grade F
	Grade for each parameter*2	F	F	F	C+							
	Long Term Trend	Sign of improvement	Improving	Improving	Improving							
Section 3 (Lower DC Anacostia)	% Score	43	62	52	83	Trend Needs attention	Trend static	Trend Improving	Trend Improving	52	F	
	Grade for each parameter*2	F	D-	F	B							
	Long Term Trend	Degrading	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: 2022 Data sets were used for all parameters.
For trend analysis, data sets from 1984 to 2022 were used.

The above table shows % Scores for each parameter and for each section (when available). Section 1 (MD Anacostia) had the highest % Score this year. The % Score for the entire Anacostia was 52%. The letter grade for the entire river was F; however, the long term trends indicate other improvements along the way to a swimmable and fishable Anacostia River.

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 90% of discharge was reduced thanks to the Anacostia Tunnel, this overflow still happens into the Anacostia. 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 could be very low in the District portion of the river, especially in Section 2. The faster flowing, more turbulent, Maryland streams carry more DO, and give the Maryland portion of the Anacostia a better grade for DO 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. 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 here. See Data Analysis for further discussion.

Signs of Improvement – Mussels

In 2015 we began a study to inventory the river's mussel species. By 2018, we started propagating mussels through our #MusselPower program in the Anacostia River. The juvenile mussels we use are produced from broodstock collected in the river and raised by our partners at a mussel hatchery at the Virginia Fisheries and Aquatic Wildlife Center. Once we get juvenile mussel 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 is monitored frequently by volunteers, Master Naturalists, students in SEA, and more. After that time, mussels are released into the river, with 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 to the river ecosystem. It is estimated that these mussels are filtering more than 88 million gallons of river water per year, the equivalent of over 200 Olympic-size swimming pools annually. Our mussels play the same biofiltration role of the oysters in the Chesapeake

Bay, 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). 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 right 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. Just one adult mussel can filter between 10-20 gallons of water a day.

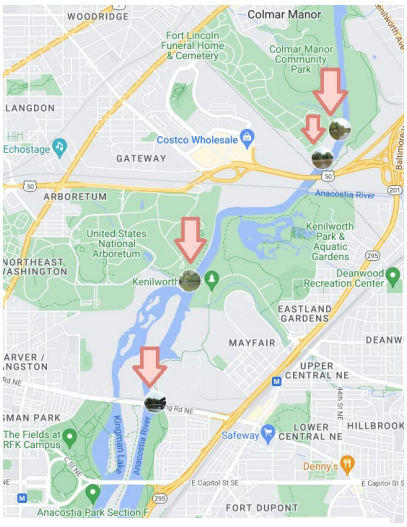
Signs of Improvement - River Otters

Close up of a river otter from our trail camera in January 2023

In 2016 AWS captured a photo of what we suspected 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 2023, we captured a photo on our critter cam in January, 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

Thanks to the water clarity improvement and the resident Canada Goose management by National Park Service, which started in 2016, AWS staff noticed during our routine water quality monitoring that wetland plants are emerging along the river voluntarily. Normally “natural” Canada geese stay in the Anacostia area only during the late Fall and Winter. It was human beings who created the resident Canada goose problem. Those resident Canada geese do not migrate and eat wetland plants all year round. Wetland plants had to be protected by fences in the past since those plants had been over-eaten by resident Canada Geese. Now the wetland plants are coming up voluntarily without the fences.



Voluntarily emerged wetland plants are spreading along the Anacostia River.

Comparing Year to Year

2023 Anacostia River Report Card

			2014 Report (2012 data)	2015 Report (2013 data)	2016 Report (2014 data)	2017 Report (2015 data)	2018 Report (2016 data)	2019 Report (2018 data)	2020 Report (2019 data)	2021 Report (2020 data)	2022 Report (2021 data)	2023 Report (2022 data)	Comment for 2023 Report
Water Quality Indicators	Dissolved Oxygen (DO)	%Score	48	41	58	54	48	54	33	52	49	55	Improving trend can be seen in MD Anacostia. Upper/Lower DC seem to be improving gradually in recent years
		Grade	F	F	F	F	F	F	F	F	F	F	
		Trend	Improving	Needs attention	Needs attention	Needs attention	Degrading	Degrading	Degrading	Needs attention	Needs attention	See Comment	
	Fecal Bacteria	%Score	69	64	60	56	63	39	60	46	55	53	MD Anacostia and Lower DC Anacostia seem to be degrading slowly in recent years. Overall improving.
		Grade	D+	D	D-	F	D	F	D-	F	F	F	
		Trend	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	
	Water Clarity	%Score	43	46	40	41	52	43	52	49	50	50	Long term trend is improving.
		Grade	F	F	F	F	F	F	F	F	F	F	
		Trend	Static	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	
	Chlorophyll a	%Score	71	78	72	74	80	81	81	81	85	82	The improving trend is steady.
		Grade	C-	C+	C-	C	B-	B-	B-	B-	B	B-	
		Trend	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	
	SAV	%Score	0	5	30	37	100	31	100	100	32	16	Trend is improving though the growth in 2022 (data year) was not good.
		Grade	F	F	F	F	A	F	A	A	F	F	
		Trend	Static	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	
	Stormwater Runoff Volume	%Score	49	51	45	47	59	46	60	48	42	34	Long term trend is degrading but it looks static in recent years.
		Grade	F	F	F	F	F	F	D-	F	F	F	
		Trend	Degrading	Degrading	Degrading	Degrading	Degrading	Degrading	Degrading	Needs Attention	Static	Static	
Remediation Indicators	Toxics	%Score	14	22	28	32	43	52	55	61	62	62	Steady improvement.
		Grade	F	F	F	F	F	F	F	D-	D-	D-	
		Trend	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	
	Trash	%Score	41	43	46	49	56	62	62	64	63	66	Steady improvement.
		Grade	F	F	F	F	F	D-	D-	D	D	D	
		Trend	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	
Entire Anacostia		%Score	42	44	47	49	63	51	63	63	55	52	Decline of SAV in 2022 (data year) contributed to the lower grade.
		Grade	F	F	F	F	D	F	D	D	F	F	
		Trend	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	Improving	

- AWS scoring method used for Stormwater, Toxics, and Trash. EcoCheck scoring method for all other parameters. (100% is best.)
- For Grade, the standard school grading system was used (below 60 = F)
- 2022 Data sets were used for all parameters.
- From 2017, AWS decided to use DOEE data for SAV since DOEE does survey on the ground and it is more accurate than VIMS data in the water of DC
- Trends represent a long term trend, which data sets are from 1984 to 2022. Trends for some parameters are NOT visible from the table. See trend graphs in Data Analysis section of our full report.

There are limitations when comparing water quality scores over a short period of time 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.

Despite the various weather patterns, dry weather or wet, the trend of water clarity has been improving gradually and steadily in terms of % Score though it is difficult to see the trend clearly in the year-to-year comparison in the above table (See Data Analysis to better see trend). The long term improving trend toward clearer water was also seen in the return of submerged aquatic vegetation (SAV) as reported in the 2015 Report Card for the first time since it disappeared from the Anacostia in 2003. However, the large amount of precipitation in the wettest year of 2018 made the water cloudy and the acreage of SAV bed significantly decreased in 2018 (data year). In 2019, the precipitation was average and the water clarity became better than that in 2018 and SAV is back. The acreage of SAV in 2019 was 92.6 acres according to the DOEE SAV report published in March 2020. Though 2020 was very wet with 57.34 inches of rain, the SAV acreage remained relatively high and was 67.2 acres. In 2021, the river had only 6.41 acres of SAV. In 2022 there was only 3.1 acres of SAV in the Anacostia River. It is likely that the water was cloudy during the early growing season and the SAV did not grow well. The goal of SAV acreage in the Anacostia is 20 acres.

Again, for some parameters the improving trend is not clearly visible in the table. When we examine trends, it is very important to see a long term analysis. See our Data Analysis for detail.

AWS streamlined the scoring system in 2018 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 Declaration of Fishable Anacostia by Governments and Declaration of Trash Fee Anacostia since we are not sure if these ever happen. 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 and the Washington Navy Yard, 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 happened 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 $52M to the district. 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 has 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, kudos must go to the Department of Energy and Environment (DOEE). The % Score increased from 0 (in 1989) to 62 (in 2022 data year) thanks to the strong leadership and investment by DOEE. Without their work, this improvement would have not happened.

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. Stepped up 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) should soon produce more substantial results. This includes new laws 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 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; however, these efforts have been unsuccessful thus far.

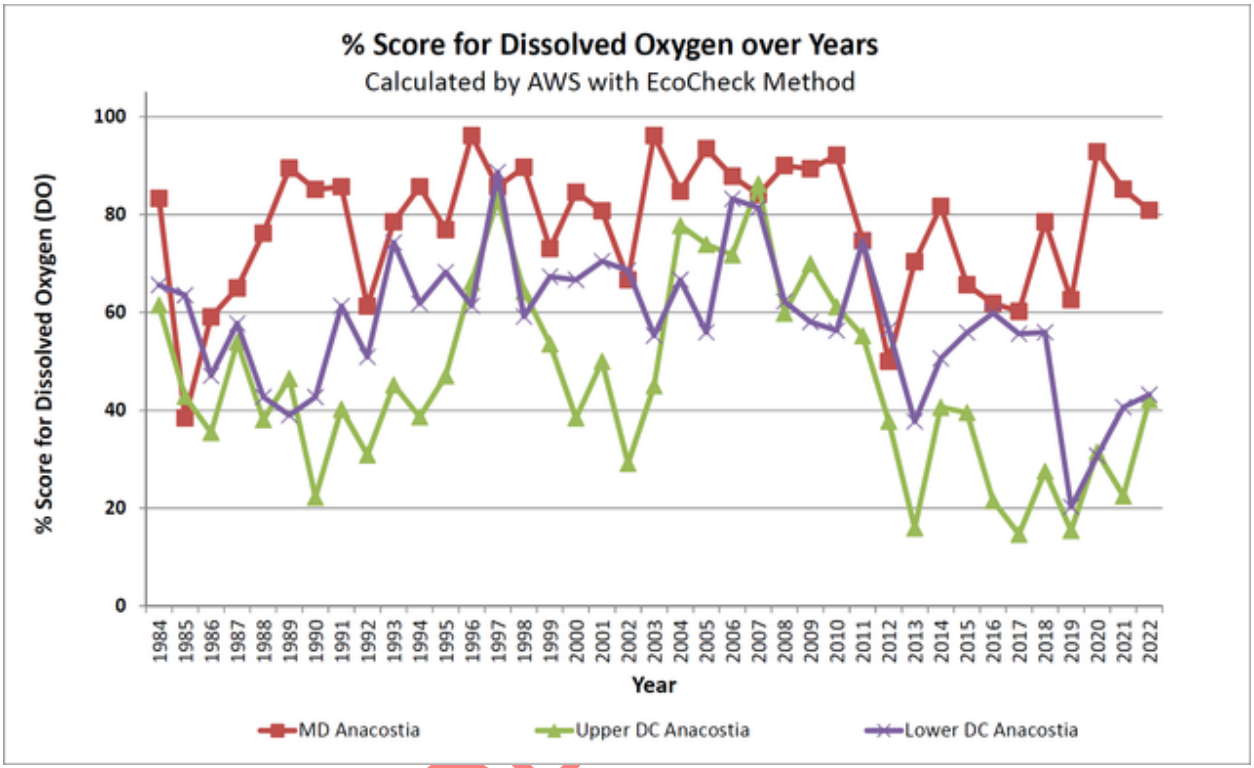
Non-floatable trash is also a significant problem; AWS trash monitoring at Nash Run shows about 70% of trash by count is non-floatable. More work needs to be done to address this larger problem, likely through enforcement repercussions for illegal dumping and littering, or lifestyle and landscape change. Our landscape has been slowly changing to infiltrate stormwater into the ground. It is stormwater runoff that

carries trash to streams. In the long run the landscape change will help reduce trash in streams significantly. Also a law that requires Extended Producer Responsibility would reduce trash significantly at the very sources: producers. For example, the Break Free From Plastic Pollution Act requires producers to design packages well. It also requires them to pay for the cost of trash disposal, recycling, and cleanups. If they do not want to pay for the cost, they have to design their packages better. This will start a good cycle of thinking to reduce single use plastics.

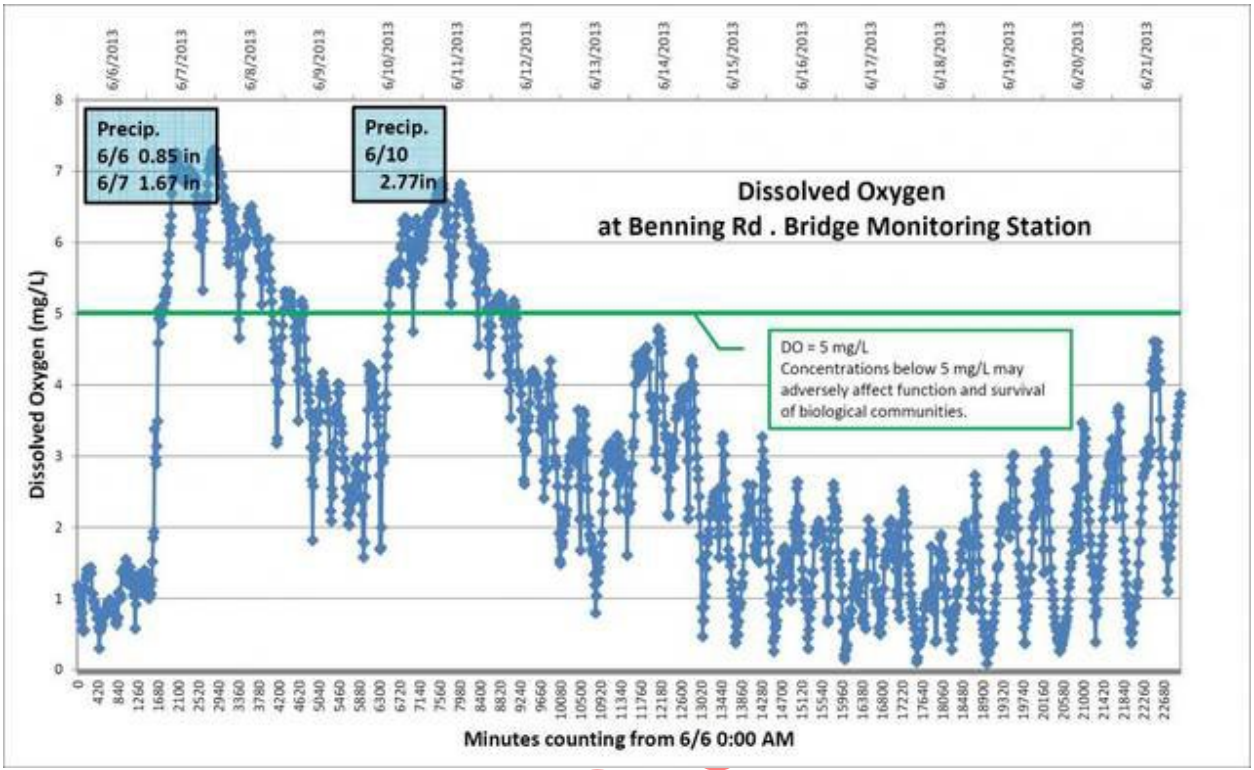
The % Score calculation table for Toxics and Trash is shown below.

Data Analysis

Dissolved Oxygen



The amount of dissolved oxygen (DO) has been steadily improving in all three sections of the river except in recent years. DO values have been low recently resulting in a lower % Score. The sharp drop in 2013 seems to be because of weather patterns that were not favorable to DO. There were many intense rainfall events that regularly caused Combined Sewer Overflow events in downstream DC in 2013. The CSO events dump raw sewage mixed with rainwater into the river when it rains heavily. The discharge includes organic matter which will later be decomposed by bacteria. The decomposition consumes oxygen in the water. See the example graph below that shows how DO changes in an intense rainfall.



Because the CSO discharge is churned up, the discharge itself has high DO values. As the time passes by, decomposition will proceed and it consumes oxygen in the water resulting in prolonged low DO values. It seemed that this was not the case in 2018. According to DC Water, 90% of CSO discharge was captured and sent to Blue Plain thanks to the Anacostia Tunnel System. And significant rain in 2018 brought DO-rich water into the tidal Anacostia resulting the higher % Score in 2018.

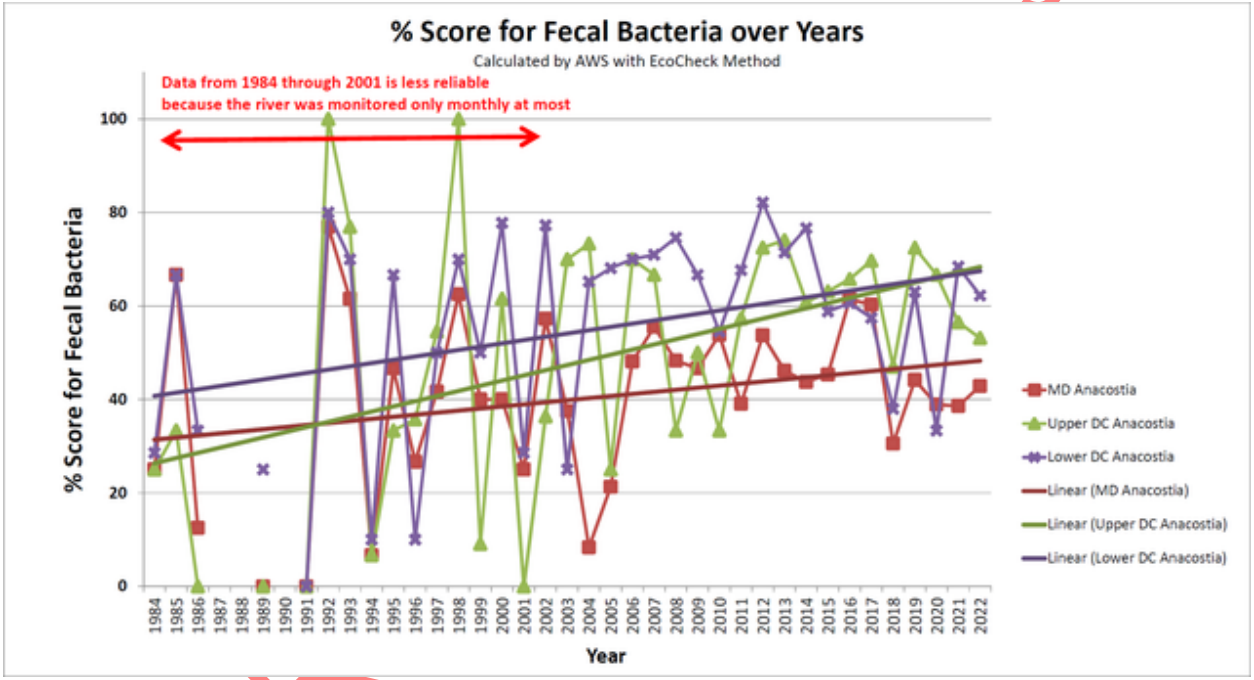
Very dry weather also reduces the amount of oxygen especially in a tidal river. Rainfalls with moderate intensity with no CSO events will bring oxygen-rich water into the tidal river. Without these oxygen supplies during very dry weather, the amount of oxygen tends to become low.

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. In 2020, a sign of improvement could

be seen 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.

In 2020, we reported a sign of improvement in the MD Anacostia. In 2021, we see the similar trend. In addition, the Upper DC Anacostia seems to be gradually improving though the % Score is very low. We hope to see this trend continue.

Fecal Bacteria



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. Further, the project will reduce combined sewer overflows by 98% at completion.

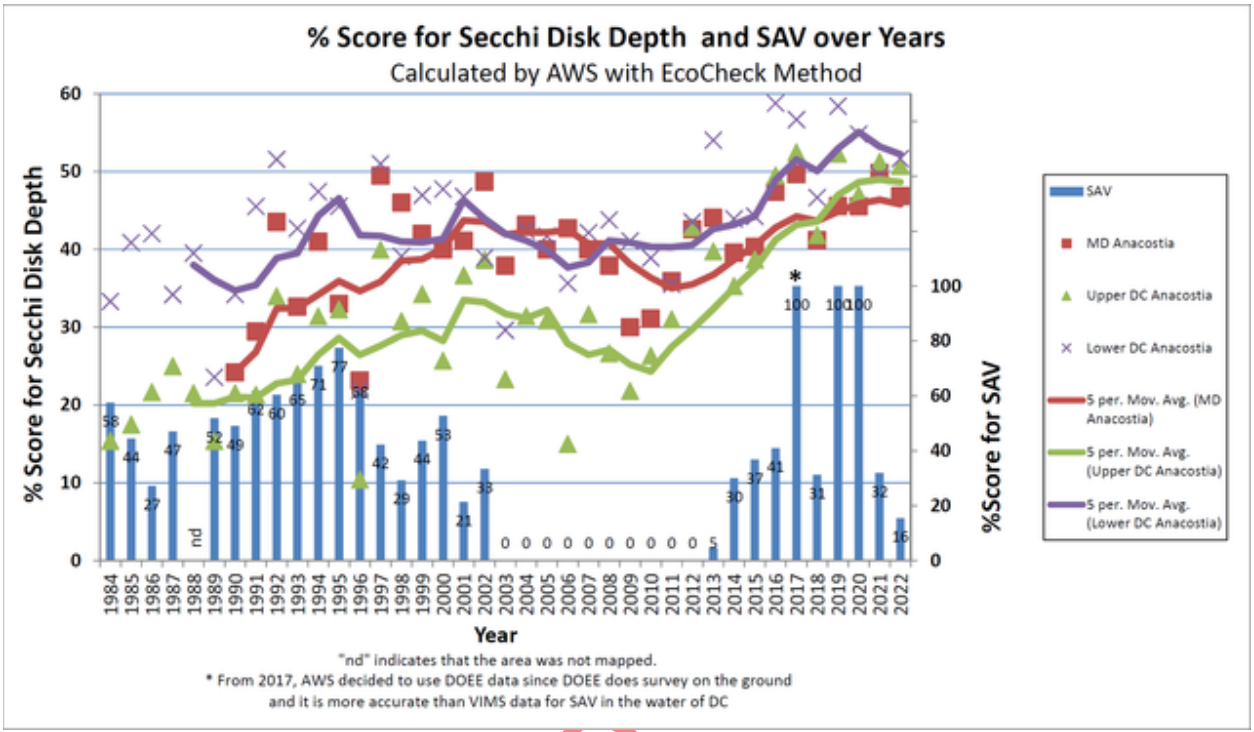
Many Anacostia watershed residents know of the Combined Sewer Overflow problem in DC. The sewer system in DC was designed to overflow into the river when a rain event

exceeds approximately a half inch. However, contrary to public perception, downstream DC water is cleaner than the upstream MD water in the Anacostia in terms of fecal bacteria. There are two possible reasons that might 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. Feces excreted on impervious surfaces by birds, squirrels, raccoons, deer, mice, rats, etc. is washed away by rainfall and is 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) became worse 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 of 2019 had an average amount of precipitation. Stormwater runoff inputs to the river were smaller than that in 2018. Thus, % 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 became worse. 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)



In the graph 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. 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 till 2017 though it became worse in 2018 due to the wettest year of 2018. Lower DC Anacostia had the highest %Score of 59% in 2016. After the wettest year in 2018, the improving trend has been continuing.

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 was in 2001. Since then, the average has been declining until recently. In the Lower DC Anacostia (Section 3) the best average score 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 below for details.)

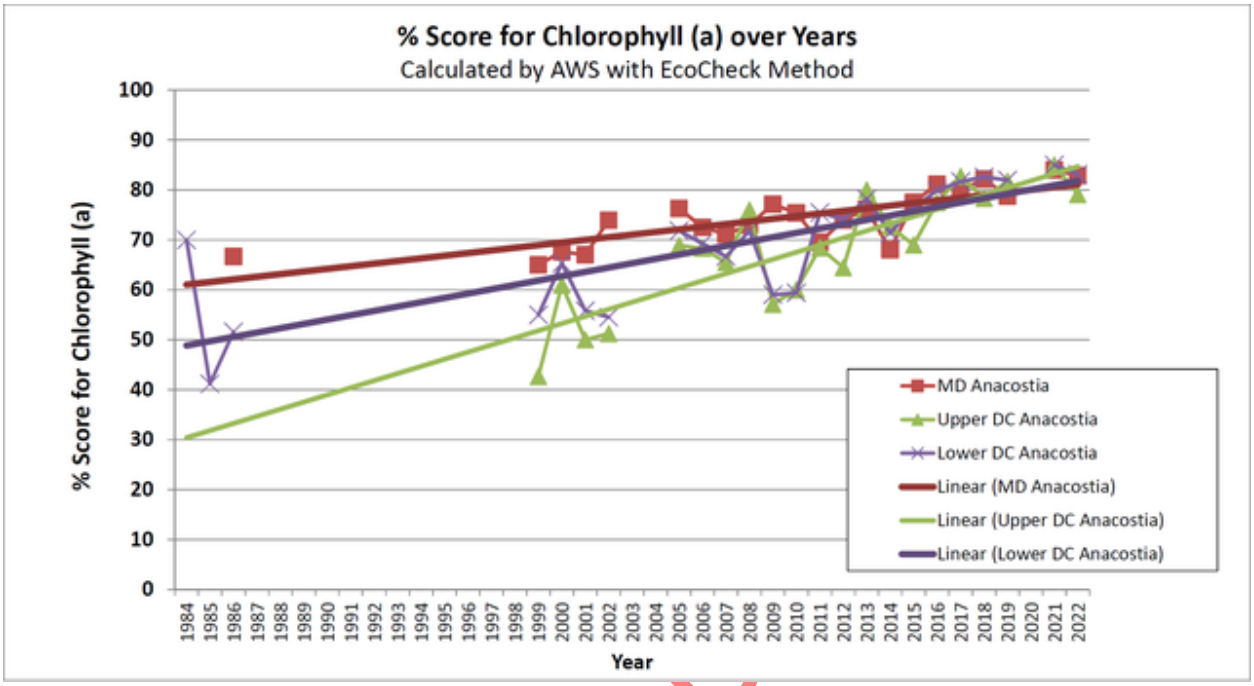
In order to accelerate water clarity improvement, stringent regulations on stormwater runoff should be implemented because the increased peak stream flows resulting from flashy stormwater runoff from increased impervious surfaces have been eroding the streambanks and scouring streambeds, making the water 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 CSO was reduced by 40%. Upper DC Anacostia, where it 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 in, especially, 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 trend shows a clear improvement. In 2021 the precipitation was average. The % Score remained similar to that of 2020.

Chlorophyll/Nutrients



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. Also, once an algae bloom dies, it depletes water of oxygen when it is decomposed.

% Scores for Chlorophyll *a* have 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.

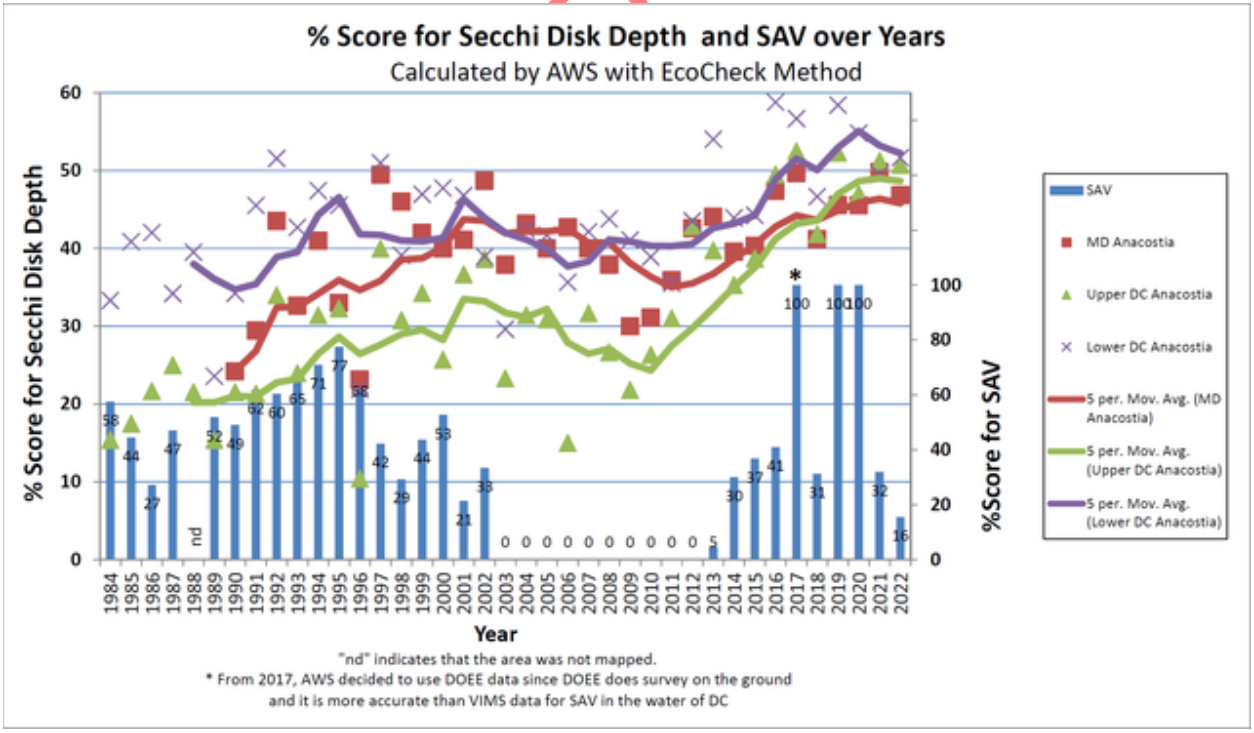
In the free-flowing tributaries of the Anacostia, discharged nutrients travel to the tidal Anacostia. Because the tidal river moves slowly, there is plenty of time for microalgae to

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 stop stormwater runoff that convey 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 due to the Anacostia Tunnel being operated from March 2018. The tunnel reduced 90% of CSO discharge. Also, the water was cloudier in 2018 that suppressed photosynthesis for algae to grow.

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, and 2019. Also, DC Anacostia is improving faster than MD Anacostia judging from the inclination of the regression lines.

Submerged Aquatic Vegetation (SAV)



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 constitutes 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).

In the graph as we can see that 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 had been observed in the Anacostia since 2003 until 2012, the score for the time duration had been zero (0) for over a decade. While there was no SAV in the tidal Anacostia, it is known that there has been SAV in non-tidal 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:

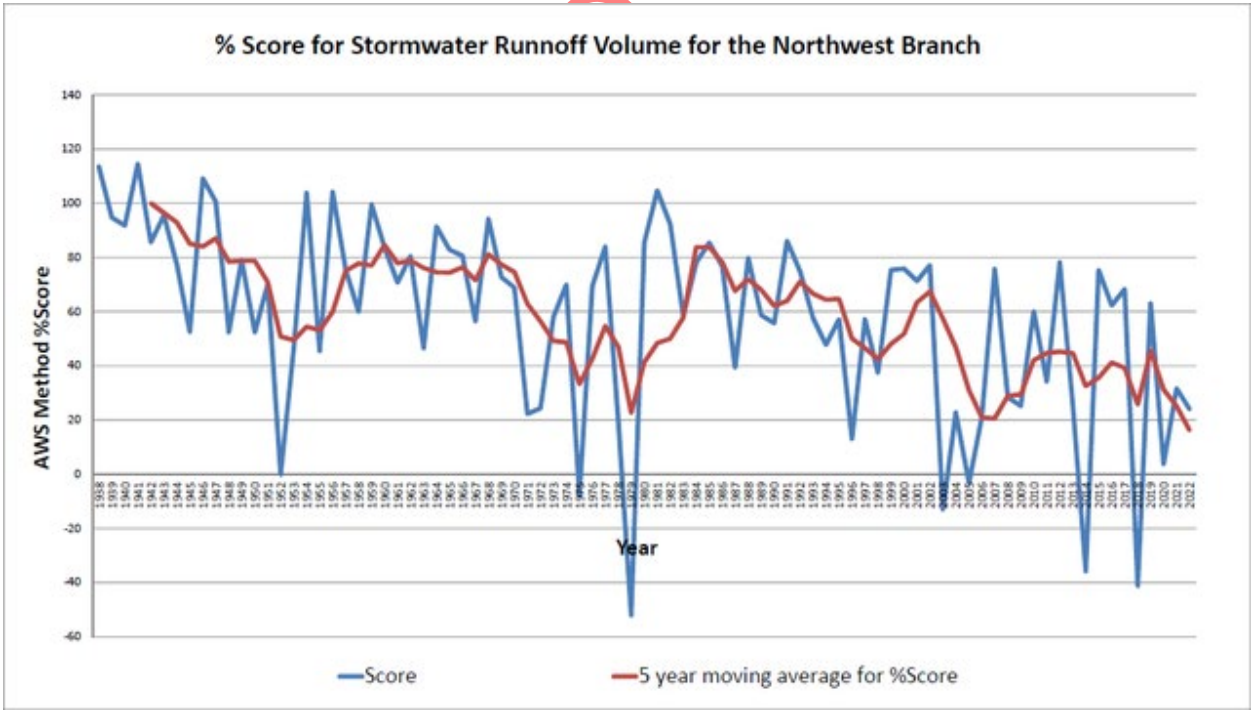
- The nature of the cloudiness of the water was different. There are many factors that make the water cloudy. Recent cloudiness may be a complex combination of sediment particles due to erosion, decaying organic matter from sewage, algae bloom, etc. while past cloudiness may have mainly come from sediment 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 became 24.71 acres. This is over the goal of 20 acres and the % Score for SAV is 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 which is an important time for SAV to grow. In 2022, the acreage was 3.1 and remained low.

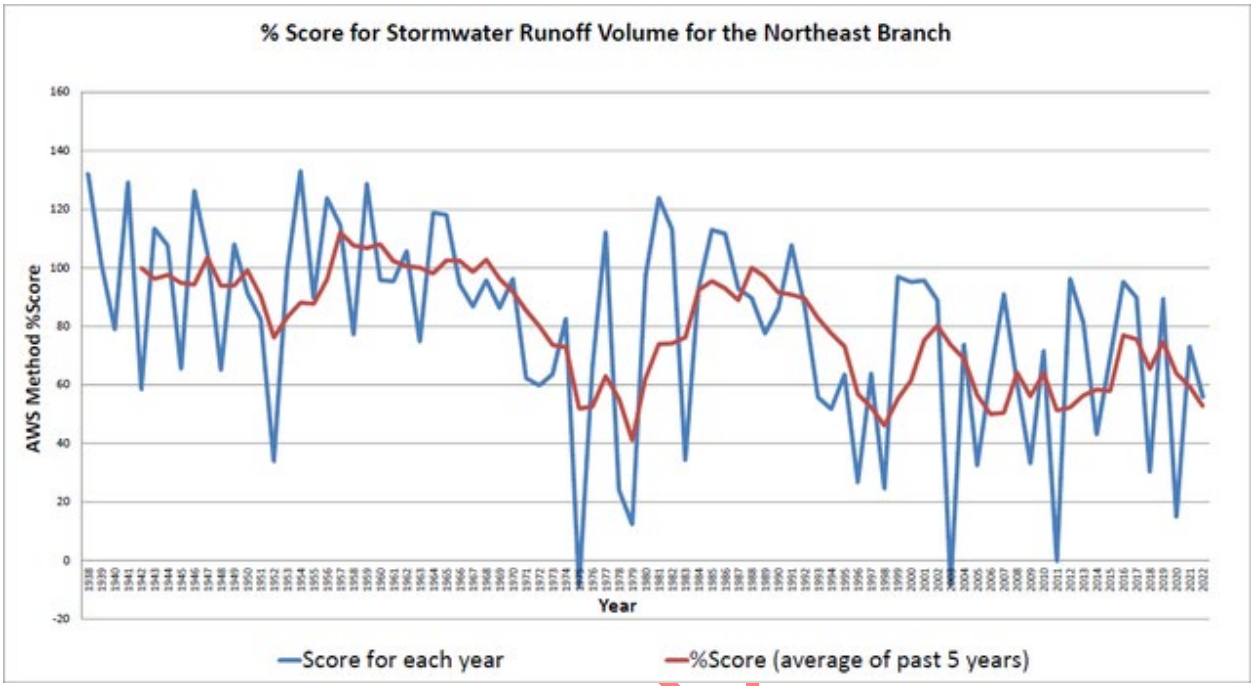
SAV data source until 2016: http://web.vims.edu/bio/sav/index.html Since 2017, AWS has used DOEE data because DOEE does an accurate on-the-ground survey.

Stormwater Runoff Volume

Northwest Branch



Northeast Branch



From the data, we see 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 which amount is different by jurisdiction. However, when we see the graphs, there is an improvement-degradation cycle approximately every 30 years. 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.

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 was 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).

Though AWS uses the EcoCheck protocol to calculate the %Scores for the water quality parameters, unlike other years, in 2014 and beyond 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

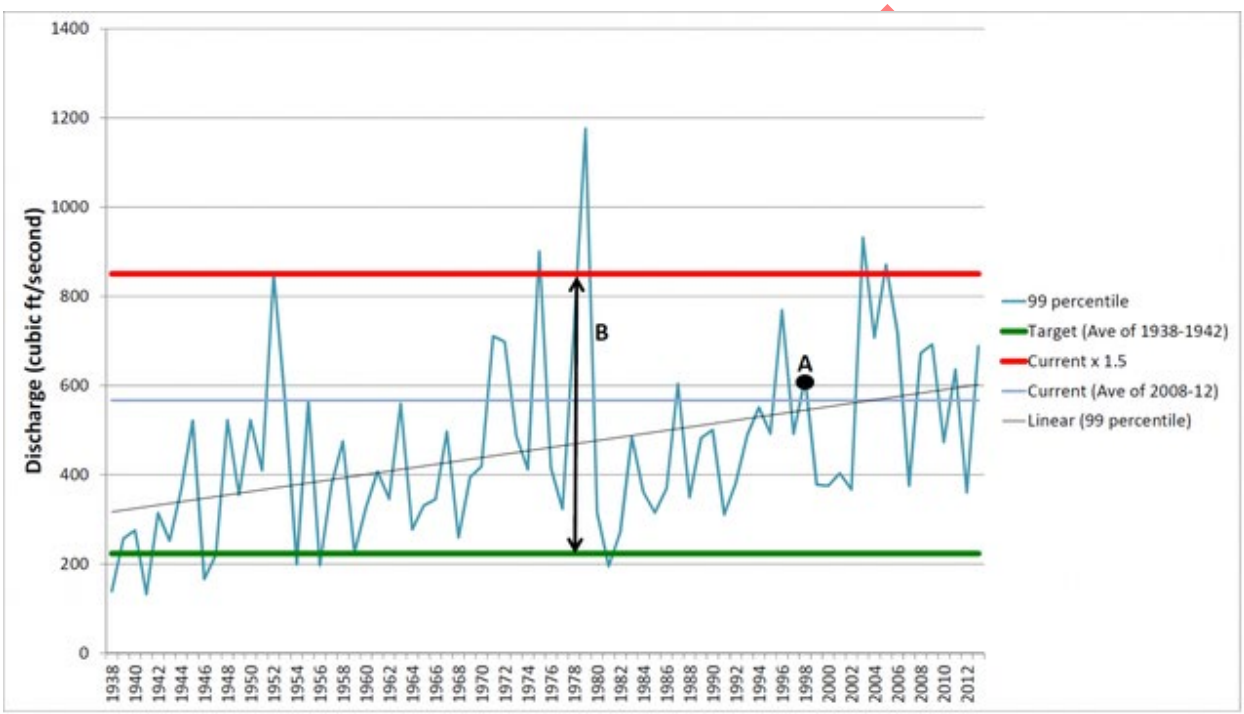
Initially, AWS wanted to measure the areas of impervious surfaces throughout the watershed. However, measuring impervious surfaces had various difficulties:

- 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.

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.



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 the graph).

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

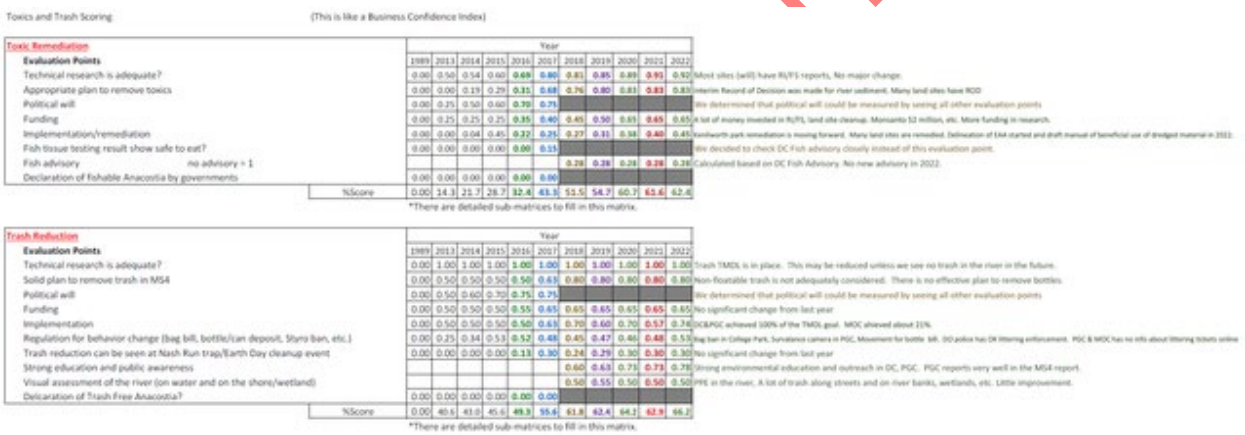
Calculating the score for Toxics and Trash is very difficult due to the complexity of assessing a wide range of factors. There are many toxic chemicals in the river such as pharmaceuticals, PCB, PAH, pesticide, herbicide, and heavy metals, to name a few. There are about 200 congeners of PCB and numerous chemicals in the group of Polycyclic Aromatic Hydrocarbons (PAHs). The standard toxicity level is different for each chemical. In addition, there are chemicals that even 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 the system will receive improvements as fit.

The table calculating our scores 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
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
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
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
Implementation/remediation		0.00	0.00	0.04	0.45	0.22	0.25	0.27	0.31	0.38	0.40	0.45
Fish tissue testing result show safe to eat?		0.00	0.00	0.00	0.00	0.00	0.33					
Fish advisory	no advisory = 1							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

*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
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
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
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	0.63	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
Regulation for behavior change (bag bill, bottle/can deposit, Styro ban, etc.)		0.00	0.25	0.34	0.53	0.52	0.48	0.45	0.47	0.46	0.48	0.53
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
Strong education and public awareness								0.60	0.63	0.73	0.73	0.78
Visual assessment of the river (on water and on the shore/wetland)								0.50	0.55	0.50	0.50	0.50
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	55.4	61.8	62.4	64.2	62.9	66.2

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

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