PREP

Pollution Reduction Efforts for the Potomac

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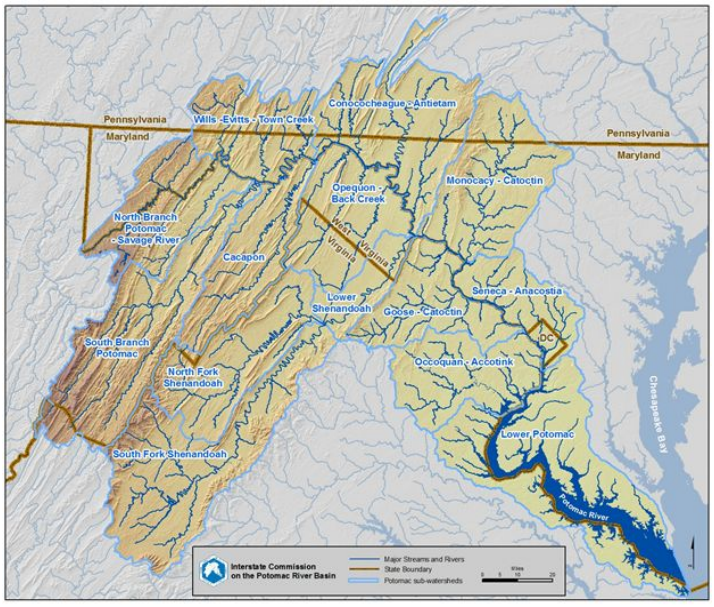
Overview

The PREP initiative was organized based on the observation of multiple pollution challenges present in the Potomac River Basin. Narrowing down our efforts, PREP identified three major sources of contamination facing the Washington, DC region specifically - sewage discharge, agricultural inputs, and stormwater piping issues. After gaining an understanding of this watershed's physical characteristics and basic history, PREP analyzed each of these three pollution challenges and designed strategies for improvement. Efforts were focused on formulating holistic land management practices and requiring water quality standards for all influents into the Potomac.

Watershed Characteristics

The Potomac Basin covers more than 14.5 thousand square miles across Pennsylvania, Maryland, West Virginia, Virginia, and the District of Columbia. PREP will be focusing on improving water quality for the D.C.; however, only 69 square miles of the watershed are within the district and 39 miles of perennial river—the other 99.53% of the watershed lies in the four other states. Most of the drainage area is upstream of the metropolitan area. An estimated 54.6% of the land is forested, with 5.9% water and wetlands, 14.1% developed land, and 26% agriculture. A variety of industries are established in this region including agriculture and forestry, chemical production, coal mining, pulp and paper production, technology, fishing, and military and government.

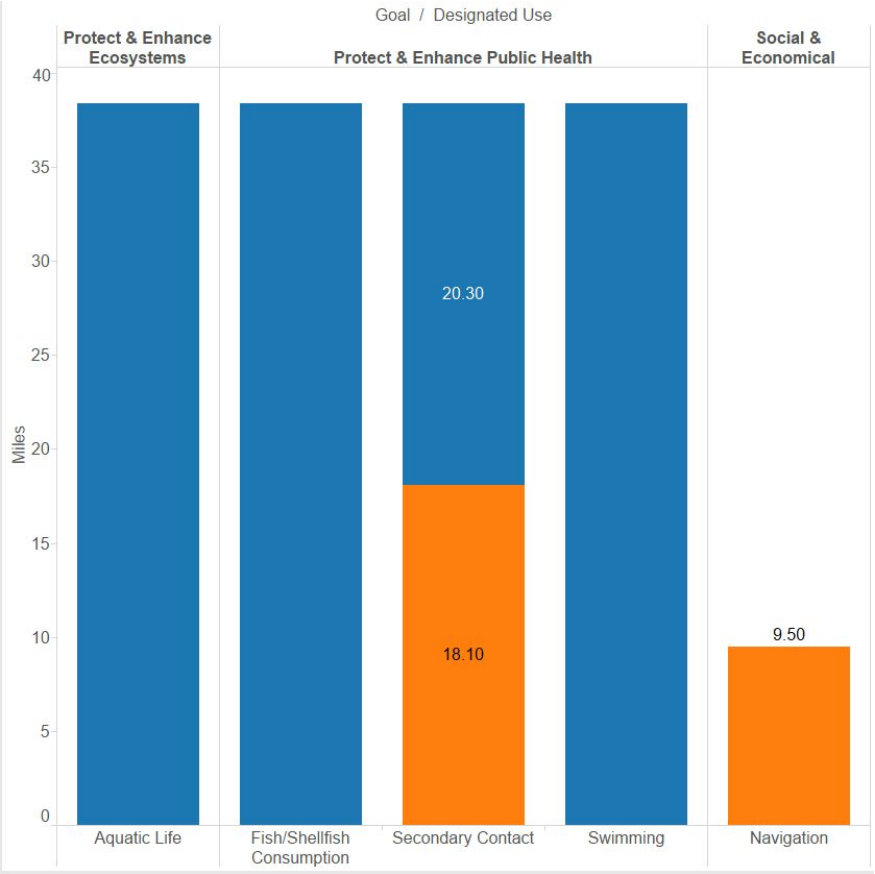


14 sub-watersheds compose this basin; Washington D.C. is located within the Seneca-Anacostia sub-watershed with only 2 other sub-watersheds downstream, as shown in the map to the left.

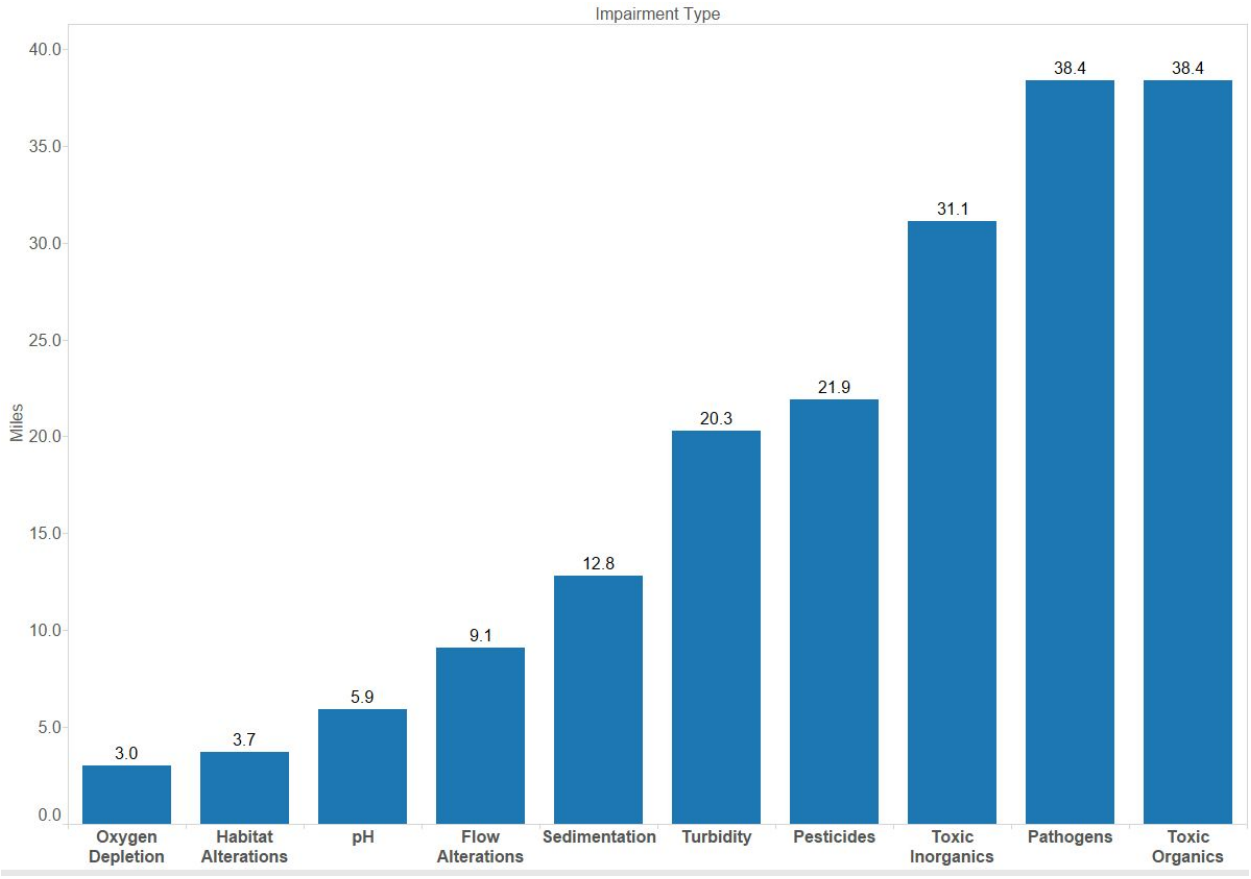
The drinking water for the District of Columbia is provided by the portion of the Seneca-Anacostia sub-watershed within district limits, as well as a small portion of the Occoquan-Accotink sub-watershed and an even smaller portion of the Goose-Catoctin watershed. 602,723 people in 2010 had access to this water—a population density of 8,735 people per square mile.

Four USGS stream gages located with the district limits; Potomac River at Wisconsin Ave, Rock Creek at Sherrill Drive, Anacostia River Aquatic Gardens, and Watts Branch. Approximately 3.3 square miles of drainage flow through the Watts Branch gage, located 1 miles upstream of the mouth. This gage has recorded since June 1992 and has recorded water quality information

since January 2013. The Anacostia River Aquatic Gardens gage only records water-stage and has been operational since June 2004. Located 78 feet upstream from a tidal marsh, this tidal gage is not used to determine. Located in Northern DC, Rock Creek at Sherrill Drive captures flow from approximately 62 square miles and is located 7.5 miles upstream from mouth. Used to record gage height and discharge, measurements have been taken since October 1929, with intermittent quality observations. The Potomac River, Wisconsin Ave, stream gage has been recording gage height since October 2009. All four stations are managed by the MD-DE-DC Water Science Center.



Organic enrichment and low dissolved oxygen levels, caused partially by sewer overflows and urban runoff described late, as well as increased levels of bacteria and toxins impair the Potomac. Even though large portions of watershed, such as the Potomac and Anacostia Rivers, are able to support wildlife, many of the small streams are not able. The Potomac Basin is at risk for water quantity and quality issues. In 2014, there was insufficient information to assess river and stream swimmable use with 100% not supporting fish consumption but 100% of all available for navigation is feasible. The figure to the right details the usage assessment with blue as unsuitable and orange as suitable, noting that only 47% of the rivers and streams have met water quality standards for secondary contact while only 9.5 miles are available for navigation. Water quality is further broken down in the figure below; the most startling impairment is 100% of the rivers experience toxic organics and pathogens, predominantly PCBs and fecal coliform, while 81% experiences impairment from toxic inorganics, predominantly copper, zinc, and arsenic.



History / Governance

History

The Potomac river is more than two million years old, likely extending back ten to twenty million years before present when the Atlantic Ocean lowered and exposed coastal sediments along the fall line (https://en.wikipedia.org/wiki/Potomac_River).

The river was described as most variety of fish had ever been seen by captain John Smith in 1608 and fisheries started from 1700s including striped bass and herring. 1810, first sewer system in Washington was constructed within the watershed. Since then, the water quality in Potomac river started to decay as growing of population in Washington area. In 1894, The US public health service reported “at certain times of the year the river is so loaded with sediments as to be unfit for bathing as well as drinking and cooking purpose. It contains fecal bacilli at all times. ” Till 1898, first biological survey of Potomac was conducted and Federal governments started to pay attention to the water quality for human health and wildlife. However, untreated wastewater from metropolitan area population of 575,000 in 1932 was continuing flow into the Potomac river. Bacterial contamination forces closing the river for swimming from Three Sisters Island to Fort Washington. In 1938, Blue Plains wastewater treatment plant was completed as primary treatment. Two years later, the Interstate Commission on the Potomac River Basin

(ICPRB) was authorized by an Act of Congress in order to conduct action at water basin level to relieve the long time suffering from discharge, acid mine drainage, erosion, sedimentation, and apathy. Wastewater treatment was the high priority for ICPRB and partners. A number of efforts from different levels of partners and stakeholders were made to improve the water quality of Potomac river, including numerous water treatment corporations, a new Enforcement Conference, publication of "Silent spring" by Rachel Carson, etc. In 1976, the largemouth bass reappeared and pleasure boaters rediscovered in the river. The Potomac began healing. More and more efforts and corporations were accomplished to restore and improve the Potomac river, though it experienced several droughts during the last 40 years. Watershed cleanup, drought exercise, wastewater treatment brought better and better situations basinwide. Vegetation, trout, shad, etc were all coming back in recent 30 years. The river basin experienced sincerely disappointed situation but great efforts were made to recover the ecology situation for more than a century. It is becoming clean and all life welcome. The mission to protect and improve the river basin is continuing with a bright future.
(https://www.potomacriver.org/potomac-basin-facts/timeline75/early-history/)

Governance and Cooperation

CO-OP Low Flow Allocation Agreement(1978)
CO-OP: Cooperative Water Supply Operations on the Potomac
Parties: State of Maryland, Commonwealth of Virginia, the District of Columbia, the Washington Suburban Sanitary Commission, and the Fairfax County Water Authority.

Introduction: In order to avoid the possibility of withdrawing all the flow of the river during a drought, Maryland Department of Natural Resources conducted the Potomac River Environmental Flow-By Study (1981). The parties to the Potomac River Low Flow Allocation Agreement (1978) agreed to abide by the study's recommendations for the maintenance of in-stream flows to meet minimum aquatic habitat requirements.

CO-OP Water Supply Coordination Agreement(1982)

Baltimore District, Corps of the Engineers, U.S., Washington Aqueduct Division, Fairfax County Water Authority, Washington Suburban Sanitary Commission, District of Columbia, and the Interstate Commision of the Potomac River Basin.
Background: The study showed that coordinated management of the water resources from a systems perspective led to gains in reliability of the water resource. The results of the latter analysis and its lower cost non-structural features led to the adoption of its results with the signing of the Water Supply Coordination Agreement in 1982.

CO-OP Drought Monitoring and Operations

CO-OP begins daily drought monitoring when flow at the U.S. Geological Survey (USGS) stream gage at Point of Rocks, Maryland, falls below 2,000 cubic feet per second. During drought

monitoring, CO-OP sends out daily email reports to stakeholders summarizing flow, weather, and demand conditions.

Source water protections in the Potomac Basin(2004)

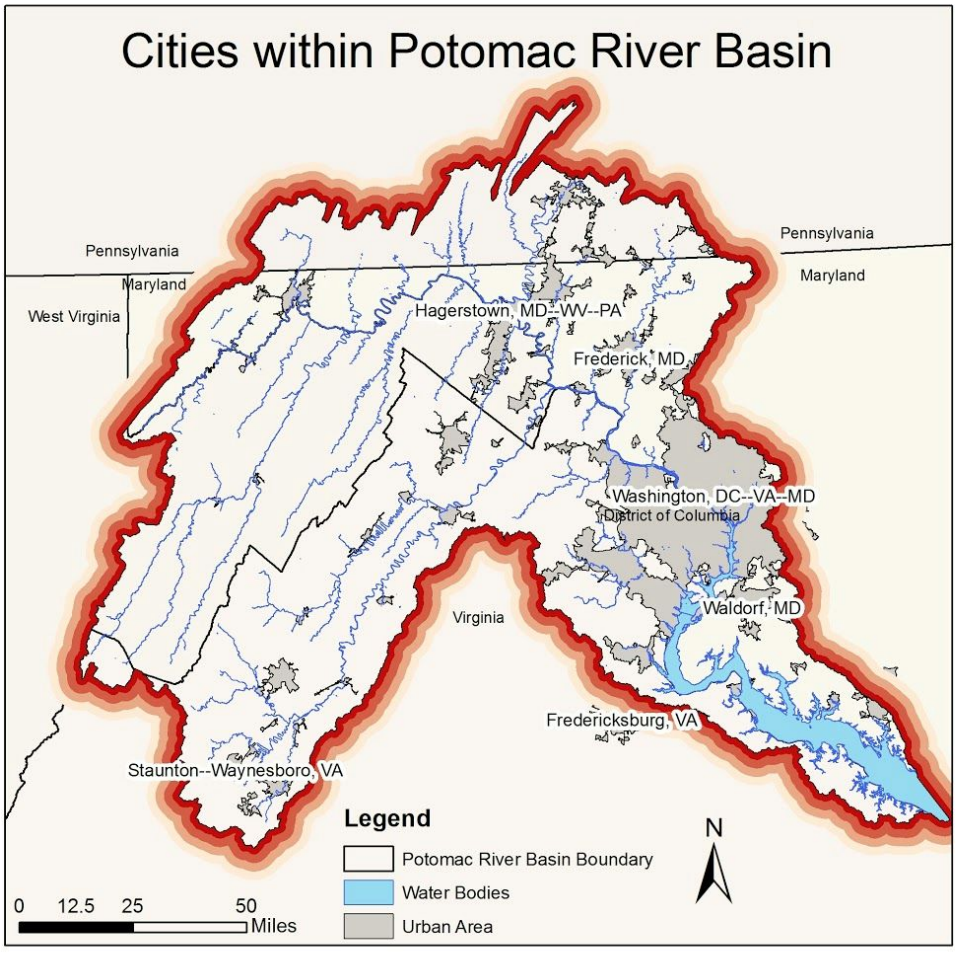
By undertaking a collaborative approach, the unique Potomac River Basin Drinking Water Source Protection Partnership (DWSPP) – almost two dozen water suppliers and government agencies – helps to ensure that people's most basic need for clean, safe and abundant water is reliably met.

Water resources planning and assessments

National, basin-wide, state, and local or regional levels governments or partners participates in water resources planning efforts. Impervious cover assessment, groundwater monitoring, surface/groundwater flow modeling, watershed water budgets and investigations of coastal plain water resources issues has been conducted by ICPRB, USGS, and CO-OP etc. (https://www.potomacriver.org/focus-areas/water-resources-and-drinking-water/cooperative-water-supply-operations-on-the-potomac/)

Potomac River and Chesapeake Bay

The 2014 Chesapeake Bay Watershed Agreement intended to advance the restoration and protection of the Bay watershed. A number of goals and specific outcomes tried to achieve based on corporation with multiple partner agencies, including sustainable fisheries, vital habitats, increased stewardship, public access, improved monitoring capacity, and education awareness. Another important Plans- 2017 Watershed Implementation Plans (WIP) aimed reduce 60 percent of the nutrient and sediment pollution load by 2017 and by 2025, have all practices and controls installed to achieve the Bay's dissolved oxygen, water clarity/submerged aquatic vegetation and chlorophyll a standards as articulated in the Chesapeake Bay TMDL document. Same ICPRB role for this Outcome as for the 2017 WIP Outcome. (https://www.potomacriver.org/focus-areas/icprb-and-the-chesapeake-bay/)



Map of towns/cities along the Potomac river
(Data sources: USGS National Map, US Census Bureau)

Pollution Challenges

Sewage

The first of three major pollution challenges facing the Washington, D.C. region of the Potomac River is sewage discharge. The issue of wastewater discharge in the Potomac River Watershed has been monitored for many decades now. In the 1960's, it became apparent that the local wastewater treatment plants desperately needed to initiate improvement plans for their facility's outflows. The poor quality of the river attracted the attention of even the President at the time - Lyndon B. Johnson - who said the river was "a national disgrace" (The Hoya, 2015).

Luckily, improvements are starting to be noticed. According to the Potomac Water Quality Fact Sheet created in January of 2014, nutrient loadings attributed to wastewater discharge have drastically decreased. Phosphorous has seen a 96% decrease within the last 35 years, and in

1990, only accounted for 4% of the phosphorous loading to the Potomac River Basin. Nitrogen levels have decreased by 44% within the last 20 years, and accounted for 12% of total nitrogen loads to the Potomac in 1990.

More progress still necessary, however, as studies have discovered confusing trends in water quality conditions along the estuary - areas meeting habitat living requirements are worsening, while other locations that do not currently meet such standards are improving. During three major flood events analyzed in 1996, high amounts of ammonium and organic nitrogen led the analysts to believe wastewater discharge was largely involved in contributing to the very high nitrogen loads. Overall, the effective strides made thus far have provided great optimism for PREP in achieving continued reductions in the future.

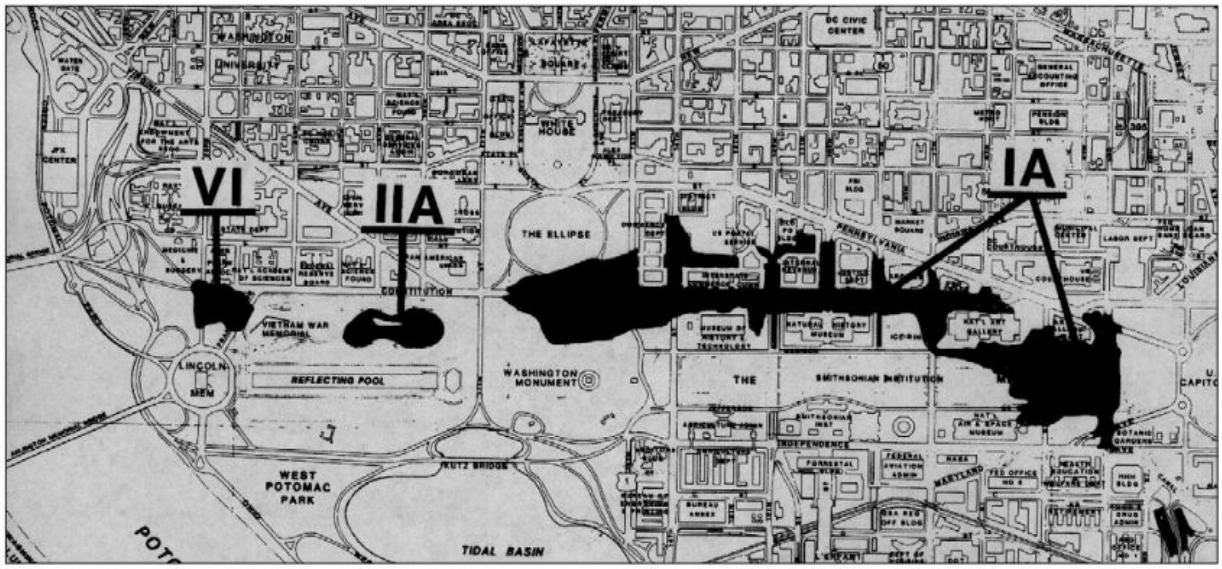
Agriculture

According to the Environmental Protection Agency (EPA), agricultural runoff is the greatest contributor to pollution in U.S. waterways today. The farming industry produces over 500 million tons of waste each year. Within the waste, contaminants include: phosphorus, nitrogen, sediment, pathogens, parasites and some dangerous metals. All of these contaminants pose a threat to environmental health of the Potomac River watershed. Some poultry farms are located near the South Branch of the Potomac River and continue to discharge manure from livestock directly into ditches that lead to tributaries in the South Branch. Local and national activist groups are working on confirming that commercial animal farms are complying with the Clean Water Act. Due to the agricultural pollution, the South Branch of the Potomac River suffers from algae blooms, fish kills, and intersex fish. Water levels indicate that there are bacteria hot spots located near large scale animal farms.

Stormwater Piping

With a population density of over 8,000 people per square mile, the 69 miles of D.C. is a very urbanized district. This increase in urbanization increases the amount of impervious land and therefore urban runoff. The storm sewer system is outdated and often unable to meet the capacity of stormwater flows; especially since the district operates a combined sewer system. With ⅓ of the district operating a combined sewer system, it is very easy for the discharge to meet or exceed the capacity of the system. During large rain events, the discharge, both urban runoff and raw sewage, is released into surface waters. When the system is at capacity, it is likely that it will reject any additional flows, leaving stormwater to flood the district. This type of flooding is extremely difficult to manage, as there are very few warning signs but significant amounts of water to manage. Similarly, if the discharge in the surrounding rivers is higher than stormwater outflows, the system will flood with river water. In addition, tidal flooding has been a long experienced issue; the map below shows areas of ‘residual flooding’ around sensitive government buildings and monuments.

1990 ACOE MAP SHOWING AREAS OF RESIDUAL FLOODING



PREP's Approach / Strategy

Sewage

As previously mentioned, great strides have been made in the reduction of pollution contributed to the Potomac River Basin by the local wastewater treatment plants. Therefore, PREP encourages a continuation on the strategies already implemented, as well as a couple of additional tactics. First, because there are multiple wastewater treatment plants along the Potomac in the Washington, D.C. region, PREP advises the implementation of a Cap-and-Trade policy among these plants more stringent than before. This will enhance the incentive to minimize effluent concentrations of pollutants such as phosphorus and nitrogen. Secondly, the Washington, D.C. region has already utilized the partnership of multiple levels of government in order to fund phosphorus and nitrogen reduction efforts. PREP advises an additional federal grant in order to promote a further reduction of effluent concentrations.

Lastly, there were multiple instances in PREP's research where uncertainty was expressed concerning their pollutant measurements from the local wastewater treatment plants. Environmental variables such as the effect of the tide, salinity, and water temperature have made the assessment of this watershed's water quality a challenge. Therefore, PREP recommends increased efforts in identifying the optimal method of measuring the pertinent water quality parameters to ensure collected data is reliable. Perhaps this could also be funded by the aforementioned federal grant.

Agriculture

In order to reduce agricultural runoff, PREP suggests that both local and commercial farmers plant natural buffers around farms, especially around areas that are nearest waterways. Natural buffers can include: native trees, shrubs and grasses. Using these natural buffers can help gather any nutrients that were not absorbed by the ground and reduce the amount of unabsorbed nutrients that enter nearby water. PREP also plans to implement new strategies to monitor the application of fertilizers to fields. With a better understanding of acceptable nutrient loads for fields, farmers can minimize the amount of fertilizer applied, thus reducing runoff due to fertilizers. PREP also emphasizes a need for better management of livestock manure. As mentioned before, livestock manure can also be carried away with existing runoff and further decrease water health. PREP would like to partner with local and national activist groups to help the public better understand the problems that are at stake.

Stormwater

In 2006, the National Capital Planning Commission discussed action plans to be set in place in order to control flooding and other stormwater issues in Washington, DC. Since this align with the goals of PREP, these strategies will be continued, in addition to other tactics. With many homes and monuments in areas predispositioned for flooding risk, it is essential that FEMA maps include areas at risk for intermittent tidal flooding, in addition to being updated regularly. These maps will be essential to evaluate risk of development in or near floodplains, which PREP advises undergoing strict review. Many historical, cultural, and functional government landmarks are located in this at risk region and PREP suggests this flooding be taken as a security risk. For this reason, PREP advises regular review of the Army Corp of Engineers Flood Emergency Plan for the district, with the addition of 50 year storm event response. Local government is responsible for local emergency plans; PREP advises plans be developed and reviewed every three years.

PREP recommends these local flooding plans account for urban runoff. Since flood events caused by urban runoff or at capacity sewers, there is little time to develop a plan. In order to remediate the cause of increased runoff, increased imperviousness, PREP suggest a local, community driven approach to introducing a green stormwater infrastructure. With so many beautiful sites in this district, the addition of rain gardens would introduce attractive landscaping and green spaces--two things that help develop a sense of community and satisfaction with a city. These spaces would help increase infiltration, decreasing the load on the storm sewer system, as well as decreasing runoff allowing pollution to be naturally filtered rather than dumping into local rivers. Other community green spaces could include green roofs, providing a building's employees a unique environment for lunches and communication, and pervious pavement along footpaths. PREP plans to evaluate similar plans put in place by other cities to develop a unique green infrastructure plan for the district by involving all possible stakeholders.

Conclusions and Recommendations

In conclusion, it is imperative that PREP continue to work with all current stakeholders. Increased legislation and regulation concerning pollutant loads is necessary for any improvement of water health. Accurate and consistent data measurements must be made to ensure reliable water quality data. With sufficient data, plans can then be made on how to reduce pollutant loads. Lastly, an increase of funding and awareness is vital for any change that can be made to benefit the Potomac River.

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Appendix

Additional Sources

History:
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