PRIME

Potomac **R**iver **I**ntervention**, M**anagement**,** and **E**valuation

Group 2

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UAPP 411/611: Regional Watershed Management

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Mission Statement

PRIME's mission is to analyze the Potomac River watershed and provide adequate recommendations to increase the water quality and fish populations by 30% while reducing flood risks by 25% by the year 2035.

Background

The Potomac River Basin is located in four states and the capital along the eastern coast of the United States: Virginia, West Virginia, Maryland, Pennsylvania, and the District of Columbia. The Potomac River Basin or the Potomac watershed houses many major tributaries including the Anacostia River, Antietam Creek, the Cacapon River, Catoctin Creek, Conococheague Creek, the Monocacy River, the North Branch, the South Branch, the Occoquan River, the Savage River, the Seneca Creek, and the Shenandoah River. The estimated basin population is seven million people through the four states and capital.

Dating back to the 1600s, the Potomac was a large fish-inhabited watershed, supported in the 1700s by fish hatcheries established by George Washington. In the late 1800s, 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 for drinking and cooking purposes. It contains fecal bacilli at all times …". In 1914, the District of Columbia sewer system carried waste from 340,000 people to the Potomac. A US Public Health Service study of pollution in the Potomac found the river in "generally good condition" with "ample oxygen." In 1932, untreated waste from the metropolitan area, with a population of 575,000, was flowing into the Potomac. Bacterial contamination forced the closing of the river for swimming from Three Sisters Island to Fort Washington. Low dissolved oxygen levels between Geisboro Point and Fort Foote endangered fishery. In 1940 Congress gave its consent for the creation of the Interstate Commission on the Potomac River Basin (ICPRB) and the Potomac Valley Conservancy District. With continued poor water quality from the 1940s through the early 1960s, the Potomac was deemed unswimmable. Levels of dissolved oxygen were low, killing thousands of fish. In 1972, D.C. City

Council banned contact with the water. Up through the 2000s water levels and quality have been monitored, fishing moratoriums per state have been enacted, and the ICPRB is working towards a healthier Potomac.

Problems:

Problem:	**Description:**	**Causes:**
P1: Flooding	Flooding is caused by climate change from glaciers melting off the coast of Greenland and Antarctica, causing the sea levels to rise. This is not only changing ecosystems, but poses a threat to large metropolitan areas in this watershed, such as Washington DC.	● Upstream events such as heavy rains, rapid snowmelt, remnants of a hurricane (NPS) ● Shape of the land creating a chokepoint (NPS) ● Riverine, coastal, and interior floods (NCPC) ● River has risen 11 inches in the past century (PCR)
P2: Decrease in Fish Population	The fish population has been gradually decreasing in the Potomac watershed. Within the past decade, Potomac River health grade has declined from a grade B to a B-. Through the 1950's-1970's visible outfalls of raw sewage were found throughout the Potomac River polluting the waters.	● In the 1940's 173,000 pounds of acid from abandoned coal mines were added daily to the River. ● 11% of sewage that is put into the River is completely untreated ● Sewage worms were the only living organisms found in the bottom of the river ● Increased population resulted in an increase of complications for wastewater processing.
P3: Bacteria and Pathogens	Several areas of the Potomac River have experienced low passing rates for bacteria	● Higher temperatures allow for bacteria to proliferate. Dissolved

	level tests. The Potomac Area is largely unswimmable, with significant sewage overflow and stormwater runoff contributing to the increasing numbers of pathogens in the water. This poses significant public health risks and environmental consequences.	oxygen levels are directly impacted by water temperature, with colder temperatures holding more oxygen and allowing for aquatic life to thrive. ● Sewers overflow when it rains, when pipes break or leak, or backup. The raw sewage spills into the Potomac River, and is a major contributor to the high pathogen counts. The Clean Water Act made sewage overflow illegal. ● Stormwater running off from streets, buildings, and impervious covers contributes to pathogen levels by both directly contributing bacteria to the water source and by increasing the temperature of the water, which in turn allows bacteria to increase in number.

Problem 1: Increased Flooding

The Mid-Atlantic Region is one of the most affected regions globally when it comes to sea level rise. Because of this, there is an increase in coastal and interior flooding in the Potomac watershed, because it is a tidal river. This is because the river has risen eleven inches in the past century, while the earth moves below it due to post-glacial rebound (PCR). Additionally, the

Atlantic Gulf Stream is weakening due to the large amount of freshwater flowing into the ocean as glaciers melt off of Greenland. Thus, it is not as easy for water to be pulled off the Atlantic coast as it once was, causing saltwater infiltration in sensitive ecosystems (PCR). Finally, this could cause most water adjacent towns to be underwater by the end of the century.

Problem 2: Decreasing Fish Population

The Potomac watershed was once seen as a dump for untreated sewage water because of overloading. There had been a huge explosion in the population surrounding the watershed, with no way to manage the increase in sewage wastewater. On top of that, hundreds of thousands of pounds of acid from old coal mines was also being dumped into the watershed at the same time the sewage was. This left the majority of the Potomac streams barren and incapable of sustaining any kind of aquatic life. Eventually with laws and regulations limiting the sewage dump into the River, the problem switched to sediment transport into the watershed due to the increase of urbanization which brought a different kind of pollutants into the waters, still resulting in a decrease in aquatic life throughout the Potomac.

Problem 3: Bacteria and Pathogens

Swimming in the Potomac River is banned due to high levels of sewage and stormwater, thus causing high levels of pathogenic bacteria. The swimming ban will not be lifted until the legislative demands are met to reduce sewage output into the Potomac. Some of the sites which fall under the overview of the Potomac River had acceptable bacteria levels in the 2021 annual report. However, there were three sites that rarely passed the acceptable standards for bacteria levels. The failure of these sites indicated a high level of fecal coliform bacteria. Fecal coliform bacteria is not itself pathogenic, but high numbers indicate a higher possibility for other, pathogenic bacteria. The major contributors to high bacteria levels in the Potomac are raw sewage, stormwater runoff, and high temperatures. Septic leaks and sewer overflow run directly

into the Potomac and are the significant major source of bacteria levels. Higher temperatures, largely due to global warming, allow for bacterial proliferation. Stormwater runoff, largely coming from impervious coverings, also bring their own bacteria and raise the water temperature, both contributing to increasing bacteria levels.

Goals:

Goal 1: Improve stormwater management systems to handle 100+ year storm events

Significantly reduce flooding during 100, 500, and 1000 year storm events by upgrading stormwater management systems, implementing BMPs, and reducing the use of impervious cover while designing new developments. This will increase infiltration and redirect unwanted water from vulnerable areas and populations. Additionally, this water can be collected and used as drinking water. Finally, increasing preparedness for these events will significantly reduce terrible outcomes.

Goal 2: Increase fish population

In order to improve the fish population within the Potomac, the issue of pollution needs to be addressed. Due to the wastewater being dumped into the River, this has resulted in a major increase in Nitrogen levels in the water. In order to treat the waters that have already been polluted, efforts need to be made in order to reduce the nitrogen levels in the water to at or below the EPA's goals of nitrogen reduction. On top of this treatment, there needs to be a policy on local discharge sources to ensure the wastewater effluent contributions are minimal in the Potomac watershed.

Goal 3: Decrease pollution from bacteria and pathogens

Significantly decreasing polluted runoff quantities into the watershed will decrease the amount of bacteria and pathogens present in the river. The biggest goal is to reduce sewage overflows.

Legislation is already in place for sewage overflow, and Alexandria, VA is on track to meet the demands of the legislation by 2025. Public notification programs should be implemented to inform citizens of unsafe water conditions. This will require wastewater treatment plans to notify any sewage leaks within two hours to the Department of Environmental Conservation and within four hours to the public. The implementation and support of Rapid Response Teams is also essential in decreasing pollution. These teams will serve to sample, test, and document water quality and bacteria immediately after sewage spills into the Potomac. Making the water boatable, fishable, and then swimmable is of the utmost importance.

Policy and Mandates

- The Potomac River is designated as a “public water supply” by the Maryland Department of the Environment.
- Clean Water Act (CWA): Primary federal law in the U.S. that protects the health of our nation’s waters, including rivers and reservoirs.
- Water Quality Standards from the CWA form the basis for controls on the amount of contaminants entering waters from sources such as industrial facilities, wastewater treatment plants and storm sewers.
- National Pollutant Discharge Elimination System (NPDES): Created by the 1972 Federal Pollution Control Act and authorizes discharges from point sources to waters of the United States. The Federal Clean Water Act requires wastewater discharges to have a permit establishing pollution limits, and specifying monitoring and reporting requirements.
- Safe Drinking Water Act (SDWA): Individual states have the opportunity to set and enforce their own drinking water standards if the standards are at a minimum as stringent as EPA's national standards.

- Climate Solutions Now Act of 2022: Sets goals for 60% global warming emissions reductions by 2030, and net zero emissions by 2045.
- The Chesapeake Bay Preservation Act (Bay Act): Enacted by the Virginia General Assembly in 1988 as a critical element of Virginia's nonpoint pollution source management program.
- The Potomac Basin Comprehensive Water Resources Plan: The plan will focus on sustainable water resources management that provides the water quantity and quality needed for the protection and enhancement of public health, the environment, all sectors of the economy, and quality of life in the basin.

GIS Watershed Inventory

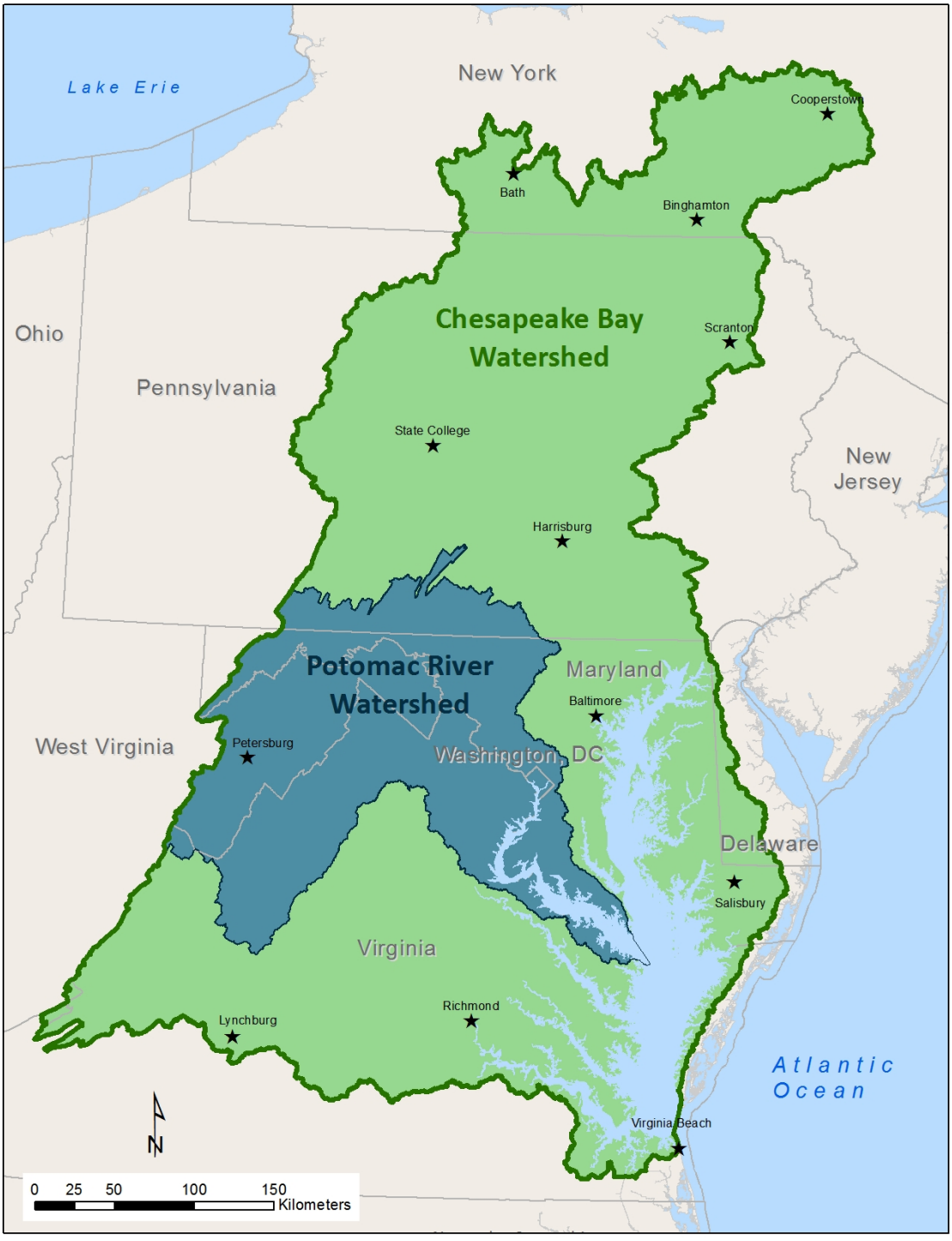

Figure 1: Location of the Potomac River Watershed

Figure 2: Subwatersheds delineated within the Potomac River Watershed

Alternatives Analysis:

In addition to the problems and goals stated above, there are many subsequent solutions that could aid this watershed. First, the installation of BMPs wherever possible would slow the flow of polluted runoff into the watershed and lessen the effects of erosion. Some ideas that could be implemented in newly urbanized and growing areas, such as Frederick, MD, Winchester, VA, and the greater metropolitan area of Washington, D.C., include green roofs,

retention ponds, detention ponds, and flow through planters. Next, the separation of sewage and stormwater pipes in older cities would reduce the amount of toxic organic matter being released into the watershed, increasing water quality. Finally, the introduction of more descriptive local water mandates would increase the water quality monitoring of local authorities and decrease the amount of necessary treatment. This could be accomplished by educating the public on water saving policies, such as using a car wash instead of the driveway, not watering the lawn, and planting solely indigenous plants in lawn spaces. Overall, the team has hope for this watershed, and thinks that it could truly heal if the current residents were more aware of the issues that their local watershed faces.

Recommendations:

To mitigate flooding, PRIME recommends:

- Improving the stormwater management systems by implementing BMPs
- Reducing the amount of impervious surfaces in any new developments
- Increasing preparedness

To increase fish population, PRIME recommends:

- Decreasing introduced wastewater as much as possible
- Implementing a nitrogen treatment plan
- Implementing a policy on local discharge sources.

To decrease pollution from bacteria and pathogens, PRIME recommends:

- Treating polluted runoff especially sewage overflows
- Implementing public notification programs
- Delegating a rapid response team to test the water after sewage spills

Conclusion

The PRIME plan hopes to make the Potomac River Basin (PRB) more robust by improving neighboring BMPs, decreasing nitrogen content, and reducing the amount of overall pollutants. Although the PRB comes with many challenges, PRIME has come up with viable solutions that increase the likelihood of improving the PRB. Some of these solutions include implementing better BMPs and stormwater facilities to decrease the amount of flooding, introducing a nitrogen treatment plan to improve water quality, and treating polluted runoff.

With the solutions mentioned, the PRIME plan will be prioritizing the safety of all ecosystems and wildlife that live within the PRB. It is utmost important that the quality of this water remains within legal limits as deemed by the EPA. This will ensure the safety of those who get their drinking water from the PRB.

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