Rehoboth Bay **A**ssessment **P**lan

RAP

Group 6:

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UAPP411/611: Regional Watershed Management

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Mission Statement

RAP's goal is to explore how anthropogenic activities impact the Rehoboth Bay watershed. RAP also seeks to give recommendations that will yield real progress by 2030. The plan should lead to more balanced nutrient levels and significantly less habitat loss and pesticide use by the aforementioned date.

Background and History

The Rehoboth Bay Watershed mainly consists of 3 interconnected bays in the southern part of Delaware, which include the Indian River Bay, Little Assawoman Bay, and Rehoboth Bay. The bays and their corresponding tributaries make up the watershed that covers a land mass of about 320 square miles. Due to the shallow depth of the bays, which averages about 5-8 feet of depth, and the poor flushing from tidal waves, the bays are susceptible to any environmental changes. These factors increase the sensitivity of the watershed to any external change that develops in the area. Freshwater infiltrates the bays via various tributaries and saltwater from the Atlantic Ocean permeates the bays through entry points such as the Indian River Inlet, Lewes and Rehoboth Canal, Roosevelt Inlet, and the Assawoman Canal, which interlinks Little Assawoman Bay to Indian River Bay. The Indian River Inlet, serving as the primary conduit, has experienced fluctuations in-depth and shoaling. Notably, between 1935 and 1939, there needed to be more direct connection between the bays and the ocean, resulting in the disruption and replacement of marine ecosystems by freshwater organisms. However, in 1940, establishing a new channel—the Indian River Inlet—marked the creation of a stable and enduring link between the coastal upland and the sea, consequently fostering a more sustainable and permanent estuarine environment.

The watershed was once praised for its farmland, forest, and open space that surrounds the area. However, development has caused a strain on the watershed as proximity to major cities like Baltimore, and Philadelphia, as well as general eastern Pennsylvania and New Jersey, make it a tourist destination. This increases the need for projects to maintain ecological health as the watershed system develops and the population increases. Significant population growth and the subsequent land development have had profound effects on various ecosystems in and around the Inland Bays. Coastal Sussex County has witnessed unparalleled expansion in the last five decades. Notably, in 1950, the county's population stood at 61,336, whereas by 2030, estimates from the Delaware Population Consortium suggest it will surpass 253,00.

In addition to the pressures discussed earlier, the Rehoboth Bay watershed faces further challenges stemming from agricultural activities in Sussex County. The runoff from agricultural lands, laden with fertilizers, pesticides, and other chemicals, finds its way into the watershed's tributaries. These contaminants are then carried downstream and eventually deposited into the bay itself. Unlike deeper bodies of water where tidal forces aid in the natural circulation and flushing out of pollutants, the relatively shallow nature of the bays limits the effectiveness of such processes. Consequently, these pollutants accumulate within the bay, of particular concern are excess nutrients like nitrogen and phosphorus. As agricultural runoff enters the bay, it introduces elevated levels of these nutrients. Over time, these nutrients accumulate and can lead to harmful algal blooms, oxygen depletion, and disruptions to the overall balance of the ecosystem. Addressing these agricultural runoff challenges requires a multifaceted approach, including improved land management practices, enhanced regulation and monitoring, and community engagement initiatives aimed at promoting sustainable agricultural practices.

Figure 1: Delaware Inland Bays Map

Policies and Mandates

Due to the watershed's location, the Delaware government monitors and implements policies to maintain the Rehoboth Bay watershed. In 2008, Delaware's Department of Natural Resources and Environmental Control (DNREC) finalized the Inland Bays Pollution Control Strategy (PCS) along with other regulations to improve the water quality of the inland waterways that make up the watershed; this policy complied with the Federal Clean Water Act. The DNREC would work along with the EPA in submitting annual reports of the watershed quality year-over-year.

Initial inspection found that the bays and their tributaries contained elevated nutrient levels that contributed to a lowering in the dissolved oxygen levels in the water. This reduces the amount of habitable area in the bays and diminishes the amount of fish communities in the watershed. It was concluded that environmental degradation of the watershed would result in a lowering of tourism and a lower standard of living in the area as well as less habitat for animals living in the area surrounding the watershed.

The establishment of Total Maximum Daily Loads (TMDLs) by DNREC sets strict limits on pollutant levels, particularly nitrogen and phosphorus, in key water bodies such as the Indian River, Indian River Bay, Rehoboth Bay, Little Assawoman Bay, and their tributaries. These limits require substantial reductions in both point and nonpoint sources of pollution, with the Inland Bays Watershed facing some of the most stringent targets. Enforcement and implementation are carried out through a Pollution Control Strategy, emphasizing the need for comprehensive actions to restore and maintain water quality standards in these vital ecosystems.

Governance Structure

As the Rehoboth Bay Watershed is entirely in Delaware the DNREC conducts all the policies for the watershed, reporting annual reports on water quality to the EPA. Along with the DNREC stakeholders to this watershed include Delaware Center for inland bays, sussex county residents, local property owners, and local business owners.

Problems

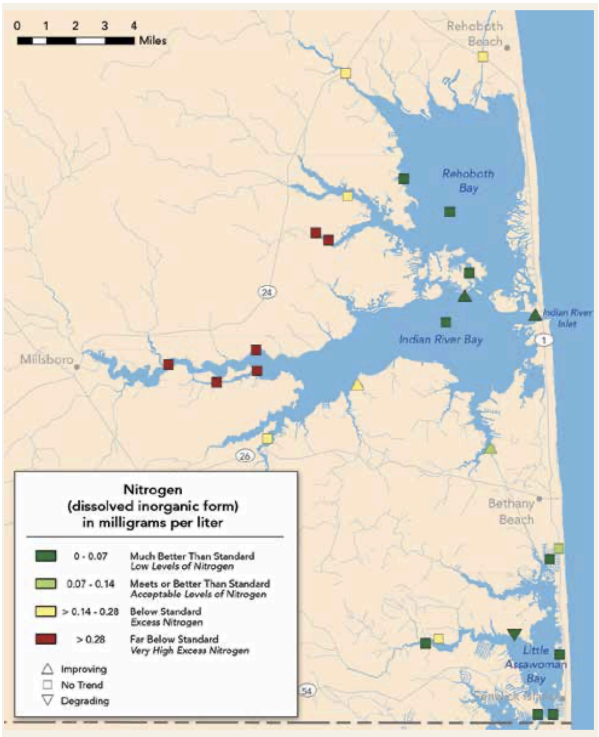
Problem	**Description**	**Cause**
High Nutrient Levels: Nitrogen and Phosphorous	Nitrogen and Phosphorus are present in the Rehoboth Bay in abundant amounts. Plant	

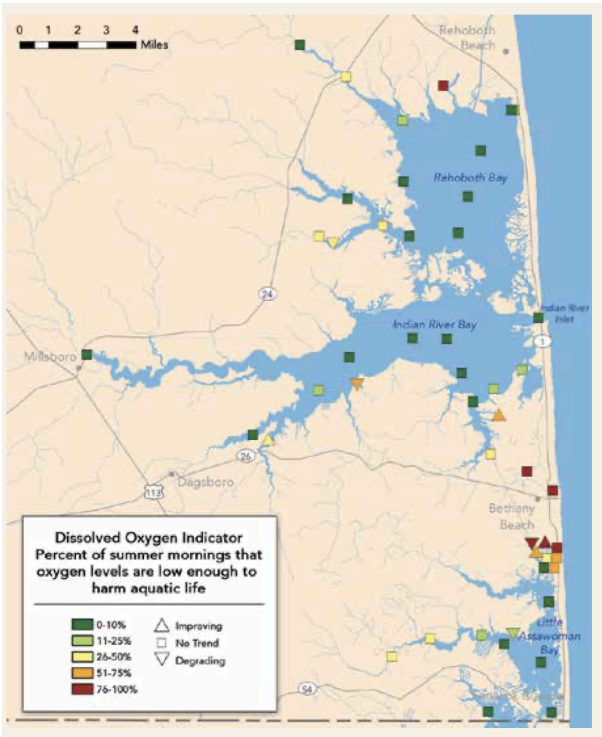
	growth in the watershed is increased due to these excess nutrients leading to eutrophication and decreased water quality. This increases algal growth leading to decreased dissolved oxygen which makes it harder for organisms to live.	Urbanization Agricultural activities Low flushing rates
Habitat Loss	The degradation of habitats in Rehoboth Bay is a primary threat to the survival of wildlife and ecosystems. Habitat loss occurs when there is a reduction or alteration in the conditions that are necessary for native species.	Urbanization Agriculture Sea level rise
Pesticides	Pesticides are any chemical used to control pests, which includes herbicides, insecticides, and fungicides. They are used to increase crop yields, making it an essential component of Delaware's agricultural industry.	Agriculture Run-off

Problem 1: High Nutrient Levels - Nitrogen and Phosphorous

In December of 1998 a TMDL was created for nitrogen and phosphorus in the Rehoboth. The TMDL tried to make the waterway fishable and swimmable. The TMDL is trying to decrease all point source pollution and nonpoint source pollution by 40%. Our goal is to continue to reduce the nutrient load allowed in the Rehoboth Bay Watershed by ensuring that as land use continues to change. There is an increased focus on nutrient loading and best management practices to the watershed.

Figure 2: Inland Bays Nitrogen Trends ***Figure 3: Inland Bays Dissolved Oxygen Trends***





Goal 1: Reducing High Nitrogen and Phosphorus Levels

Solutions for reducing nitrogen and phosphorus include improving stormwater systems and sewage treatment plants, using nitrogen technologies on septic systems, and decreasing fertilizer application onto lawns and agricultural land. Since agriculture is often the biggest source of pollution farms should implement conservation measures that will reduce pollution runoff into Rehoboth Bay. These practices include planting cover crops, fencing animals out of streams, implementing nutrient management and conservation plans, and installing and maintaining grassed or forested buffer strips along farm fields.

Problem 2: Habitat Loss

Rehoboth bay is home to habitats for wildlife such as horseshoe crabs, oysters, and diamondback terrapins. However, the rise in urbanization is leading to exacerbated habitat loss. Between 1990 and 2020, the county's population more than doubled which also led to excessive development near the bay. Despite a record number of building permits issued in 2020 there continues to be inadequate buffer policies or laws that require space between development and the bay.

Figure 4: Inland Bays Land Use Change

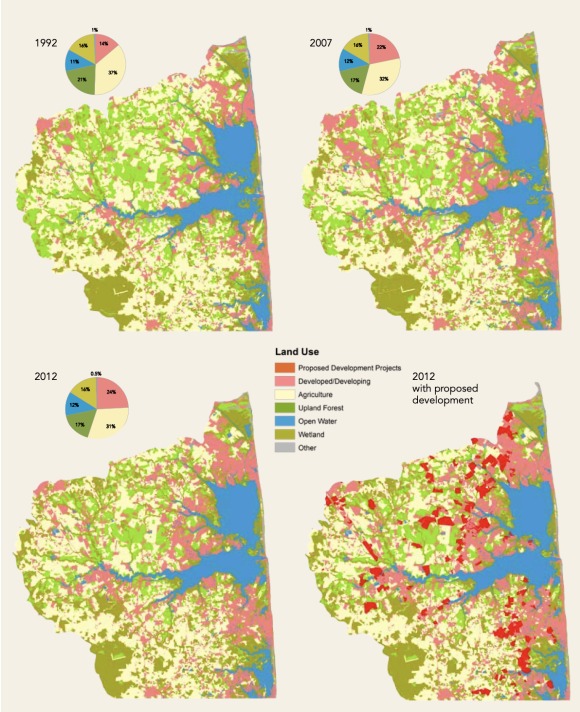
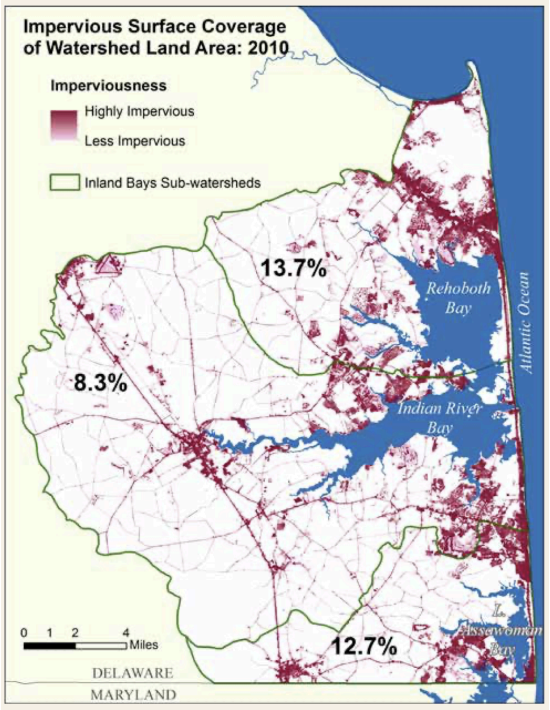


Figure 5: Inland Bays Impervious Surface



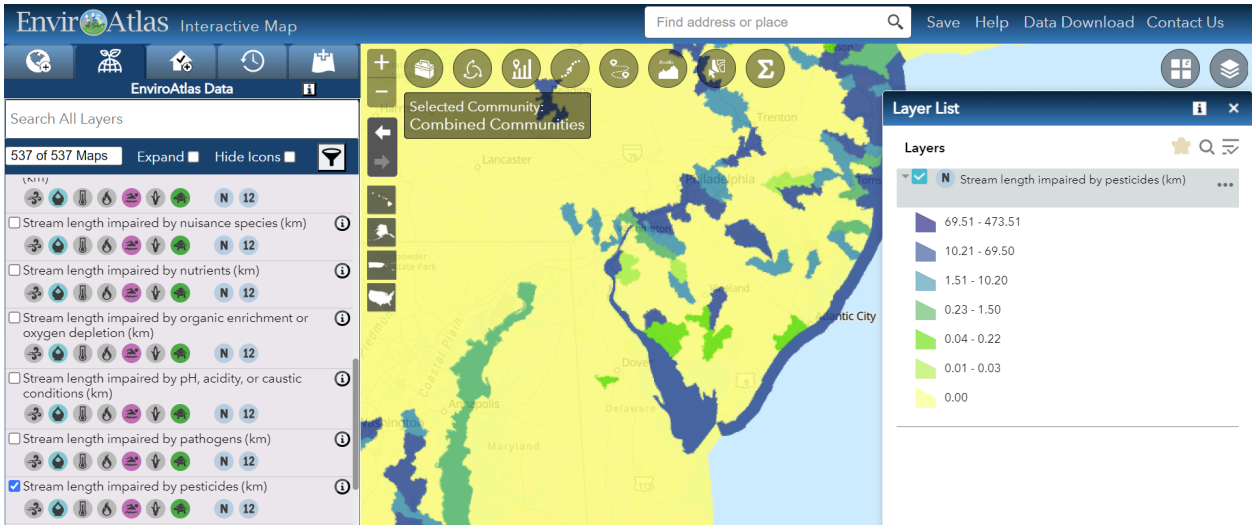
Goal 2: Preserve Biodiversity

Restoring habitats can aid in preserving biodiversity in Rehoboth Bay. This can be done by removing ecologically detrimental dikes, removing dams to allow for tidal freshwater wetland migration, reducing clear cutting in forested non-tidal wetlands, and by restoring non-tidal wetlands that were previously converted into cropland.

Problem 3: Pesticides

Delaware Department of Agriculture's Pesticide section began monitoring the state's groundwater for pesticides in 1995, and has collected more than 1,000 individual groundwater samples since then. The health effects of pesticides depend on the type of pesticide, with some affecting the nervous system, hormone or endocrine system, and some can be carcinogenic. Delaware has a high water table, meaning that the distance from the soil surface to the groundwater is relatively small. Monitoring the groundwater for the presence of pesticides is extremely important for Delaware because of this, coupled with the agricultural reliance on pesticides for crop yield. Our goal is to expand monitoring programs and sample collection for pesticide presence in the Rehoboth Bay Watershed.

Figure 6: Delaware Pesticide Use



Goal 3: Reduce pesticide use near the Rehoboth Bay watershed

Pesticide use can be reduced on agricultural land by adopting more environmentally conscious practices. These include crop rotation, the use of resistant crops, integrated pest management, organic agriculture, and agro economic practices. Implementing these strategies would greatly reduce the need for pesticide use which in turn would aid in improved water quality in Rehoboth

Bay. Adding riparian buffers improves water quality and helps all three of our goals by reducing the spread of pesticides, decreasing nitrogen and phosphorus, and improving local biodiversity. The enforcement of proper pesticide storage is vital. Locking pesticides inside fire-resistant and spill-proof storage systems is the best way to prevent accidental spills. Using more natural pest controllers, such as bats, could also help decrease the use of chemical pesticides. Insectivorous bats are generalist eaters, and their diet includes a variety of pests, including those that may damage crops. They can suppress resident pest populations and act as a more natural pest control for farmers.

Recommendations

We recommend many best management practices (BMPs) to ensure that there are improvements to Rehoboth Bay by 2030. This includes improving stormwater and sewage treatment to reduce levels of phosphorus and nitrogen in the water. Due to large agricultural land use, it is important to fence livestock off from water and to limit fertilizer use. Adding riparian buffers to sensitive areas is a great step to reduce the impact of agricultural land use. Through restoration of the land and preventing the removal of native species, there can be big improvements to the Rehoboth Bay Watershed.

Conclusions

The Rehoboth Bay Watershed encompasses 320 square miles of land. Excess nutrients and pesticides in the watershed can negatively affect numerous people and wildlife who depend on that water source. In order to foster and preserve healthy biodiversity, efforts from the EPA and DNREC are required to uphold BMPs to improve water quality. Reduction of phosphorus,

nitrogen, and pesticides along with the addition of riparian buffers must be implemented to achieve the desired remediation by the year 2030. The Rehoboth Bay Watershed still possesses the ability to flourish for many decades to come.

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