

**PAWS**

# **Plan for the Appoquinimink Watershed**

Group 4

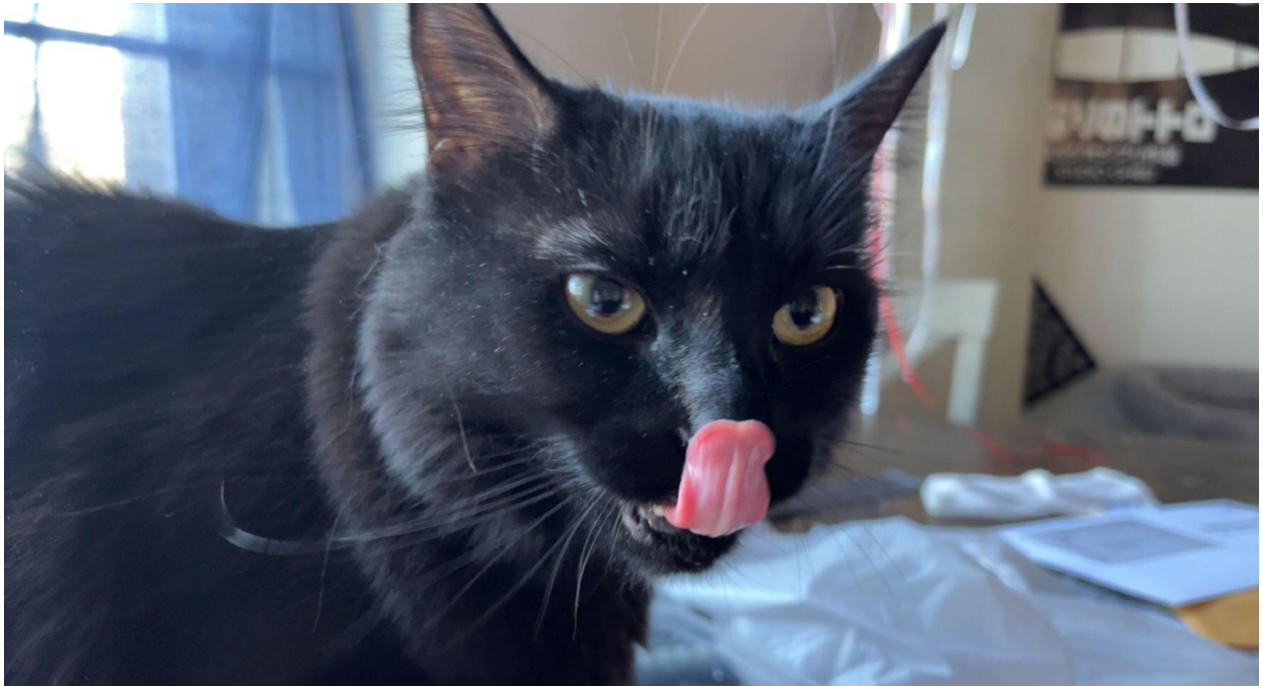
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**Figure 0:** Team Mascot Spring the Cat <3

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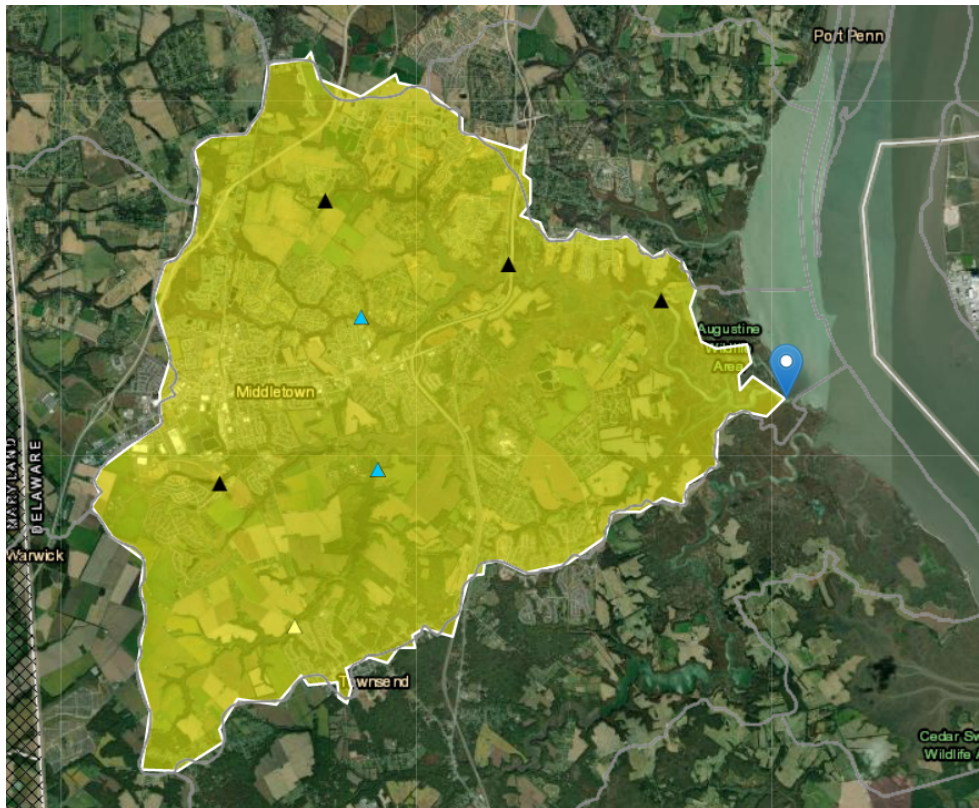
## **Mission Statement**

PAWS mission is to assess the Appoquinimink River Basin of Central Delaware and provide recommendations to attain water quality standards, as well as restore wetlands and reduce invasive species by 20%. Our goal is to identify solutions, generate federal and state funding to begin implementation by May 30, 2033.

## **History and Background**

The Appoquinimink River watershed is located in northern Delaware. It starts to the west of Townsend and runs through the rapidly developing towns of Townsend, Middletown, and Historic Odessa. The Appoquinimink River is approximately 15.3 miles long and has a drainage area of 43 square miles. The main tributaries of the Appoquinimink watershed are Appoquinimink (Appo). River main stem, Doves Nest Branch, Drawery creek, Deep creek, Noxontown pond, and Hangman's Run.

The Appoquinimink River watershed was first inhabited by a branch of the Algonquin or “real-men” Native American tribe. The branch was called the Lenni-Lenape or “grandfather.” When the Lenape controlled the watershed, the land was mainly covered by wetlands and wooded forests. The Native American tribe hunted, fished, and grew crops in this region. The Lenape worked hard to keep the soils in the Appoquinimink well nourished, and made sure that their farming practices did not deplete the land of nutrients. Their practices worked so well that the Lenape were one of the few branch tribes that could sustain a high population. Not only did they use the watershed for food, but they also frequently used the Appoquinimink River to transport goods to and from Maryland via its connection to the Chesapeake bay.



**Figure 1:** An image of the Appoquinimink River watershed delineated.

In the 1620's and 1630's the Appoquinimink River watershed was colonized by the Dutch for three main reasons. First, the Appoquinimick was an easy trade route to the Chesapeake Bay and therein Maryland. Second, the Dutch needed a place to stake their claim on the Delaware river to deter the Swedes and English from moving to gain full control of the Delaware river. Lastly, the Dutch saw the major farming potential of the area around the Appoquinimick river. As the colonists started to take over the Appoquinimick the Native American tribe of the Lenape were driven out of the land and forced to move westward.

Over time, the Appoquinimick became a large colonial agricultural area with the main

products being corn, and wheat. Industry started to bud within the Appoquinimink River watershed, the main forms being sawmills and grist. However, the colonists did not take care of the land like the Native Americans did, and instead cleared forests for farming and depleted the once nutritious soil.

The Appoquinimick watershed has undergone many changes; in the late 1990's and early 2000's as engineers, scientists, and policy makers worked to get the watershed off of the impaired watershed list. The engineer and scientist were successful at getting the Appoquinimick watershed off the impaired list, but the watershed is still under threat.

Today the Appoquinimink River watershed is mostly made up of tidal marshes, wetlands, and several ponds and lakes. The land in the Appoquinimink is mainly used for farming, but there has been, and continues to be, an increase in land used for residential and commercial properties. The fast residential and commercial development, along with sea level rise due to climate change and an influx of invasive species overpopulating the area is threatening the wetlands of the Appoquinimick watershed. This is troubling because wetlands provide inland and coastal infrastructure protection from storm surges and ocean flooding. They also provide homes to the already strained native species of Delaware and provide the crucial service of cleaning water as it moves out towards the ocean. The main goals of our plan is to protect the Appoquinimick's wetlands so that we can continue to benefit from the ecosystem service it provides.

### ***Policies and Mandates***

- Clean Water Act: This is a federal law that establishes a way to prevent, reduce and eliminate pollution in The USA's waters to restore or preserve the physical, chemical and biological aspects of a waterway.
- Delaware Wetlands Act: Stops the dredging, dumping, filling and overall destruction of wetlands in Delaware that are 400 or more contiguous acres large.
- Subaqueous Lands Act/Regulations Governing the Use of Subaqueous Lands: protects waterways in Delaware from being impaired by new construction in the area. Sets up a way to find out if the proposed change to water way will be harmful to the water way or not.
- National Pollutant Discharge Elimination System: This regulation makes sure that pollutant discharges for industries are regulated and permitted so that the water quality is safe for drinking, fishing or swimming.
- Guidance and Regulations Governing the Land Treatment of Wastes: Regulates how sludge for wastewater facilities and how animal solid wastes are stored, and used in order to minimize damage to groundwater.

### ***Governance Structure***

The Appoquinimink River watershed is governed under Delaware state laws and is overseen by the Steering Committee, which is made up of members from the Delaware Department of Natural Resources and Environmental Control (DNREC), the municipalities within the watershed, the New Castle County Conservation District, Appoquinimink River

Association, Delaware Department of Transportation, and other interested parties. All parties are very committed to restoring and maintaining the health of the Appoquinimick watershed.

## Problems

Problem	Description	Causes
P1: Invasive species	Most sites in the Appoquinimick watershed have some invasive species present, with some sites being completely overtaken.	Human involvement and adaptability of invasive species that allow them to outcompete native species.
P2: Wetland Loss	Over 3000 acres of wetlands were lost in the Appoquinimick Watershed between 1992 and 2007, with many more being put under stress. This is greatly reducing the benefits provided by wetlands.	Wetlands are quickly being destroyed by invasive species and humans for the purpose of agriculture or development.
P3: Water Level Rise & Flooding	Increasing flooding in the Appoquinimick Watershed is decreasing bank stability and undermining wetlands. The flooding of surrounding roads and urban areas is also increasing the residual urban runoff into the river.	As a result of climate change, flooding is becoming more frequent and more extreme. With more impervious cover from urbanization, the adverse effects have become even more severe.



**Problem 1:**

Invasive plant species pose a large threat to the Appoquinimink watershed, especially in wetland areas. These plants can overtake an area completely, making it uninhabitable for native plants and wildlife. Invasive plant species in the area take advantage of stress on the environment due to human development, as they tend to be hardier than native species. Once these plants take place, they can spread rapidly and overtake large areas. The spread of invasive species in Appoquinimink wetlands is extremely extensive. In particular, tidal estuarine wetlands are stressed, with the Delaware Department of Natural Resources and Environmental Control finding invasive species in every location sampled.

The two most common species in tidal estuarine wetlands are European Reed Grass and Narrow leaved cattail. In non-tidal wetlands, European reed grass was also present along with Japanese stiltgrass and Japanese Honeysuckle. Because of the hardiness of invasive species and speed of reproduction, complete removal is tedious and expensive. For example, Japanese stilt grass has seeds that can remain viable in the soil for seven years and produces 100-1000 seeds per growing season.

***Goal 1: Reduce the Extent of Invasive Species***

Solutions to invasive species can vary from herbicides to nutrient control, but the most important component of this goal is the education of the public. Expanding the Phragmites Control program to include more invasive species would be the most effective way to tackle this issue. Also, a core understanding of original Lenape methods to manage the invasive species in state owned land has a promising prospect (Beacham et. al, 2017). However, informing the

public about the resources available to them in terms of removal as well as the benefits would help to greatly reduce the spread of invasive species and the stress on the Appoquinimink watershed.

## **Problem 2: Vegetated Wetland Loss**

One of the most significant issues to be addressed in the Appoquinimink River Watershed is wetland loss. By 1992, nearly 2,000 acres of wetlands had been lost, and 3,000 more had been lost in the 15 years following 1992. With the Appoquinimink River Watershed totaling 14,415 acres of wetlands, it has lost 17% of its wetlands from 1992 to 2007. An additional 66% of them are under stress. Wetlands provide a value in the hundreds of millions of dollars in water quality benefits, wildlife habitats, and flood control. In order to retain these benefits, we need to protect and restore wetlands.

The damage done to wetlands is further heightened by the rise in sea level. As the sea level rises and flooding gets worse, more wetlands are lost to erosion. In addition, salt concentrations can increase in soils in the surrounding areas when storms allow seawater to make its way inland. The excess salt could ruin ecosystems that are not built to deal with these increased salt concentrations. Saltwater intrusion can also be detrimental to the farmland in the watershed, which makes up a substantial portion of the watershed area. Farmers could see a significant decrease in crop health and yields as saltwater migrates inland.

***Goal 2: Increase Restoration Efforts and Legal Wetland Protections***

As stated in the Delaware Wetlands Act, the State of Delaware only restricts damaging activities in wetlands larger than 400 acres. With this as the law in place, there are not enough protections on wetlands. Our proposition is that Delaware protects all wetlands, no matter the contiguous area. It is important that we address some of the significant stressors of wetlands as well, such as invasive species, agriculture, and development. A great deal of success in restoring the wetland to its natural state as the sponge to absorb and store the floodwater lies in freeing it by conducting a state level, or federal buyout (FEMA fund) program (Kayode et. al, 2021 ). This, in combination with wetland restoration efforts, will be greatly beneficial to the overall watershed health in the Appoquinimink River Basin. Our goal is to have a net positive change in the wetland area in the Appoquinimink Watershed by the year 2033.

**Problem 3: Water Level Rise and Flooding**

DNREC reports that the water level in the state of Delaware has risen more than a foot over the past century, and this rate is set to only increase over the next 100 years. Combined with the lack of quality shoreline protection and the abundance of manmade impervious cover surrounding the Appoquinimink, this has troubling implications for the sustainability of the watershed.

Coastal wetlands would naturally tend to migrate inland when they are submerged due to sea level rise or flooding, but manmade infrastructure prevents them from doing so, forcing the coastal wetlands to remain submerged. Additionally, rising water levels lead to an increase in the frequency and severity of flooding, which subsequently leads to the erosion of shorelines.

DNREC reported that the sustained submergence of wetlands and coasts in combination with erosion has accounted for most of the acreage loss of tidal wetlands in the past few decades. These effects will only get worse without proper prevention and mitigation protocol. In 2012, DNREC predicted that 97% of tidal wetlands in the state of Delaware will be affected by a 0.5 meter sea level rise this century. This was even their low estimate of sea level rise; the high estimate is 1.5 meters and the middle estimate is 1.0 meters.

The negative effects of sea level rise and flooding are being further exacerbated by impervious cover that occupies much of the wetlands of the Appoquinimink. About a quarter of the estuarine wetlands contain some sort of manmade impervious structures, such as docks. There are also roads and other impervious surfaces nearby the Appoquinimink, such as the Odessa bridge. Not only do these surfaces impede natural filtration, but the flooding and water level increases are submerging these surfaces. This permeates any pollutants or otherwise harmful human-made residuals directly into the watershed.

### ***Goal 3: Implement Living Shorelines***

In order to combat flooding and soil erosion, living shorelines along the waterfront of the Appoquinimink should be added. The shorelines increase resilience using natural barriers, such as oyster shells, biologs, and native plants. They also decrease impervious cover, resulting in less initial flooding. As a result, the ecosystem is left with a more natural barrier to erosion, which allows for change and adaptation as the shore floods. In order to implement living shorelines, there will need to be an increase in community outreach and education. Since many private landowners have personal docks, reaching out to the community with information discussing

shoreline implementation and upkeep will encourage owners to switch. In addition, incentive programs will increase the number of households willing to transition to living shorelines. Therefore, PAWS recommends not only education and outreach programs, but also adding a funded incentive program to encourage owners to switch.

### **Summary of Goals**

In order to improve the quality of the Appoquinimink Watershed, one must understand all factors that could lead to achieving the above goals. First, identifying the problem using data and history allows one to understand why these issues have arisen. On the other hand, knowing the cause of the problem generates goals that are not only problem specific, but also allow for policy changes to help with future watershed management. With the help of new and amended policies, community outreach, and continued programs, PAWS believes that the Appoquinimink Watershed will reduce the extent on invasive species, increase restoration efforts and wetland protection, and implement living shorelines to address the problems of invasive species, wetland loss, and erosion and flooding.

### **Recommendations**

To control the extent of invasive species along the watershed, PAWS stresses on;

- Empower the local communities living along the watershed by including them in the educated conservation of native flora and fauna, which involves their informed status on the necessity of native species for sustaining a ecologically healthy watershed.
- Broaden the scope of the existing Phragmites Control program to include the invasive

species prevalent in the watersheds.

- A state and community level adoption of traditional Lenape practices such as controlled burning and facilitating the native species spread along the watershed.

To effectively restore the wetland to its the state of a natural flood water sponge, we propose:

- Delaware should protect all wetlands, not just those larger than 400 acres, to ensure adequate protection for these critical ecosystems.
- Efforts should be made to address significant stressors on wetlands, such as invasive species, agriculture, and development. Incentivizing sustainable agricultural practices.
- A state or federal buyout program, funded by FEMA, should be implemented with wetland restoration efforts to free up wetlands and restore them to their natural state as sponges for absorbing and storing floodwater. These efforts will benefit the overall watershed health in the Appoquinimink River Basin to achieve a net positive change in the wetland area by 2033.

To address the challenge of water level rise and flooding, we propose;

- Introduce living shorelines using natural barriers to address flooding and soil erosion, while reducing impervious cover, along the Appoquinimink waterfront.
- Enhance community outreach and education efforts to encourage private landowners with personal docks to adopt living shorelines, providing information on implementation and maintenance.
- Develop a funded incentive program to increase the adoption rates of living shorelines among households in the Appoquinimink Watershed.

**Conclusion**

The Appoquinimink River Basin faces numerous challenges to its ecosystem health, including invasive species, wetland degradation, and flooding. The solutions proposed by PAWS aim to address these challenges and improve the watershed's overall health. The watershed can be significantly enhanced through wetland restoration and invasive species control by empowering local communities, implementing traditional practices, and incentivizing sustainable agriculture. A state or federal buyout program funded by FEMA will free up wetlands and restore them to their natural state. Additionally, implementing living shorelines and outreach programs will reduce flooding and soil erosion while promoting community involvement and education. With these efforts, the Appoquinimink River Basin can achieve a net positive change by 2033, ensuring a healthy and sustainable future for the watershed and its inhabitants.

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