

Trinity Restoration Action Plan (TRAP)

Final Report by the Members of Group 9: Ben Horney, Brenna Derby, Esse Orkeh, Garrett Reed,

Grace Wootten, Jack Palevich, James Sidlowski, and Leah Gallagher

UAPP411 S23: Regional Watershed Management

Dr. Gerald Kauffman

Table of Contents

| | |
|--|-----------|
| Mission Statement | 2 |
| Watershed History & Description | 2 |
| Brief Description | 4 |
| Problems & Issues | 5 |
| P1. Impervious Cover | 6 |
| P2. Industrial Pollution | 6 |
| P3. Invasive Species & Vegetation Issues | 7 |
| Goals & Objectives | 7 |
| G1. Reduce Impervious Surfaces | 7 |
| G2. Clean Industrial Pollutants | 8 |
| G3. Management of Invasive Species and Vegetation Restoration | 8 |
| Regulations & Ordinances | 9 |
| GIS Watershed Inventory | 10 |
| Alternatives Analysis | 11 |
| Conclusion & Recommendations | 12 |
| References | 14 |

Mission Statement

TRAP intends to make restoration progress to the Trinity Watershed of New Castle, Delaware. Currently, the watershed is negatively impacted by impervious cover, industrial pollution, and invasive species/vegetation. TRAP should be implemented by 2044, and its goals are inspired by the 1994 “Northern Delaware Wetlands Rehabilitation Plan.”

Watershed History & Description

The history of the watershed dates back to the colonial era; the watershed was juggled between different world powers in its early days. The Dutch originally claimed the area, setting Fort Casimir and a small colony, which was soon conquered by the Swedes from Fort Christina (in modern day Wilmington). The Swedes renamed Fort Casimir to Fort Trinity, due to the date of their conquest on Trinity Sunday. Following that, the British claimed and held the land. During these times, much of the landscape and, consequently, the water was modified for the uses of the colonizers. For example, dike systems were created by the Dutch for agricultural and environmental power – improving crop yields and pest control. Most importantly, the dikes were used for flood control of the surrounding land. The watershed since then has been utilized for industry and residence of neighborhoods in a growing community. This population growth came from the onset of increased industry and economic incentives nearby, thus incurring pollution and creating brownfields and contamination sites.

New Castle County has a storied history of industrialization, though always at a cost. For example, the Wilmington riverfront (home of the Wilmington Blue Rocks) was a shipbuilding mecca in the early 1900s. Major companies like Harlan & Hollingsworth, Pusey & Jones, Jackson & Sharp, and Dravo bustled alongside the Christina River – especially to support the

efforts during World War I and World War II (*History Matters: Shipbuilding Industry along the Wilmington Riverfront*). While production capacity was celebrated during these wars, it left a stain on the water. There was a brownfield site until the mid-1990s and the west side of the river suffered for more than 40 years. Luckily, a slew of reclamation projects revitalized the waterfront as it features new restaurants, apartments, and more. The east side of the river is now receiving the same attention with a \$100 million budget (Eichmann).

Approximately 6.5 miles southwest of the Wilmington riverfront, down the Route 9 corridor, the city of New Castle has also experienced effects of industrialization (see Figure 1). However, this waterfront has not experienced equal attention and financial backing as the Wilmington riverfront.

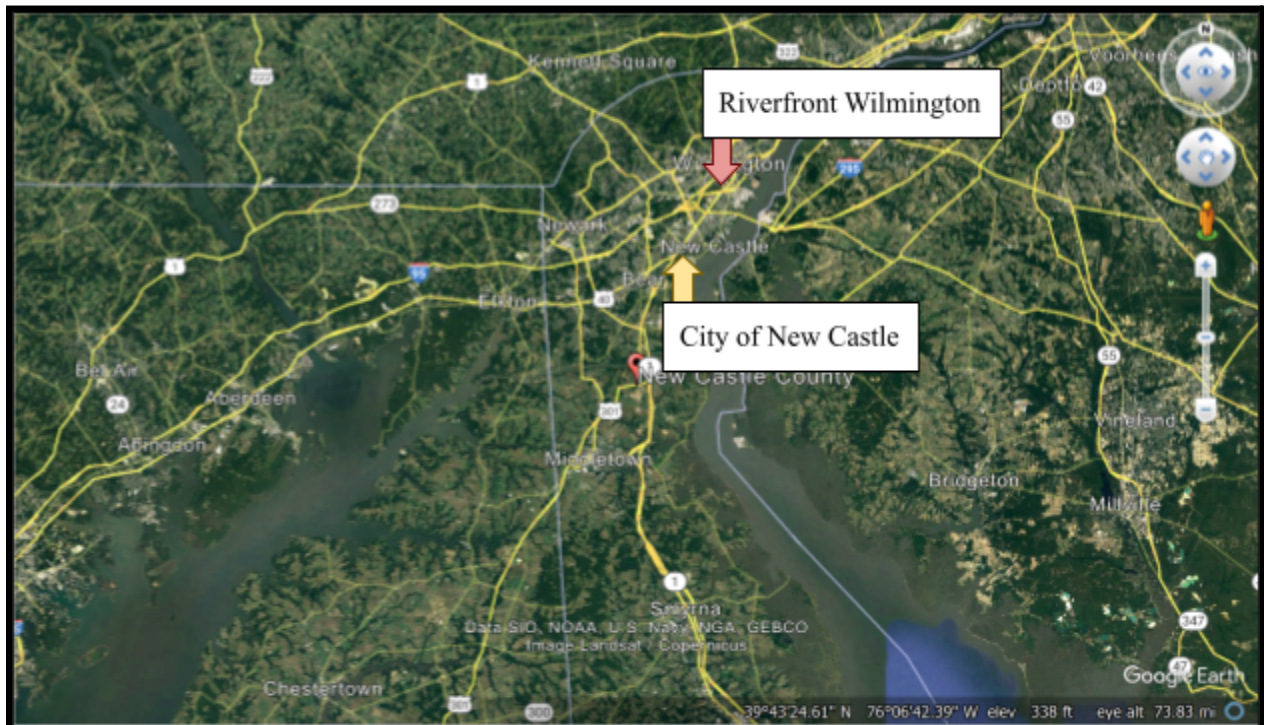


Figure 1. City of New Castle relative to the Riverfront Wilmington.

Brief Description

Known as Broad Dyke Watershed, the group decided to rename it Trinity Watershed because it comprises three main tributaries that flow into the Delaware River. The watershed is just south of the Delaware Memorial Bridge and encompasses the city of New Castle (see Figure 2).



Figure 2. Trinity Watershed aerial view.

As shown in the highlighted areas in Figure 2, New Castle is a developed community. Therefore, Trinity Watershed is covered with impervious surfaces, which stem from the 20th century. To further this point, a United States Geological Survey map from 1906 depicts the “urban” layout of New Castle. Outside the small city grid were different industries: steel, cotton, iron, and flour. Two steel mills, Baldt and Brylgon, are particularly interesting to Group 9 because of their merger under Penn-Seaboard – an anticipated major polluter. In addition, the gas and locomotive industries were in the center of the city and also attracted suburbia (*Industry in New Castle*).

As New Castle and Wilmington continued to grow, in terms of industry and population, so did the Delaware road network. In 1968, Route 9 was expanded to connect the two historically commercial hubs (*State Route 9*). At this time, Wilmington was an established city due to its unique Court of Chancery that corporations favored. Similarly, banks relocated to the city after the Financial Center Development Act of 1981 and other incentives in the 1980s (*City History*).

All of the factors mentioned above contributed to a steadily rising population of the city. This increasing population has led to an increased strain upon the local watershed, both in terms of the amount extracted in order to serve personal and commercial needs, and in the amount of impervious cover within the area.

Problems & Issues

Matrix 1. Trinity Watershed problems and descriptions

| Problem | Description | Causes |
|--|---|--|
| P1. Impervious Cover | Major urbanization of the area led to mostly impervious cover. This causes a larger volume of runoff with a greater amount of pollutants and movement of soils. | <ul style="list-style-type: none"> - Urban and suburban area - Impervious surface and cultivated lawn cover most of the watershed - Highway development |
| P2. Industrial Pollution | The watershed has been an industrial area for many years. Both legacy and new contaminants exist in the area and are carried into the water, including heavy metals. Continued development along the Route 9 corridor worsens this issue. | <ul style="list-style-type: none"> - Heavily industrial area - Lack of heavy metal testing - Continued development - Lead Poisoning |
| P3. Invasive Species & Vegetation Issues | Phragmites and other invasives are taking nutrients from the soils. This makes the soil inhospitable to vegetation. The lack of vegetation and compacted soil make floods more likely. | <ul style="list-style-type: none"> - Poor land management and abuse of lands - Invasive species spread |

P1. Impervious Cover:

The New Castle area is composed mostly of urban and suburban sections. About $\frac{1}{2}$ of the Trinity watershed is impervious cover and another $\frac{1}{4}$ is cultivated lawns. This causes a larger volume of runoff containing a greater amount of pollutants. Impervious cover prevents water from soaking into the ground so it instead flows into the streams and eventually the Delaware River. Both the impervious cover and cultivated lawns contain pollutants, such as oil or fertilizer, that the runoff picks up as it flows across them. This results in lower quality water in the Delaware River which is responsible for the water of more than 17 million people.

P2. Industrial Pollution:

As a tributary of the Delaware river, the Trinity watershed shares similar issues with it in terms of pollution. The Penn-Seaboard Steel Company was formerly stationed directly upon the watershed. While the practices the plant employed have not been preserved, the fact that it was producing steel at the time indicates that pollutants such as silicon or acidic compounds could have made their way into the watershed (the acidity and silicon levels of the watershed must be tested in order to confirm this suspicion). Silicon in water is not harmful unless it is in large quantities, which can be an issue if other companies continue to pollute the surrounding water that later goes into the Delaware River. As mentioned before, the Delaware River supplies drinking water for more than 17 million people and, if the silicon quantities rise, it becomes a health issue for those that consume it. More toxicity in the water on top of more silicon can contribute to many health problems in the future. Additionally, local middle and high schools in the area have reported instances of lead poisoning from failures in pipeline infrastructure.

P3. Invasive Species & Vegetation Issues:

The Trinity River currently struggles with a variety of invasive plant species, especially phragmites, which compete with local wildlife. Smaller vegetation is competing with local vegetation for the limited nutrients in the soil, and the canopy of invasive trees is blocking access to sunlight for local species. This, in combination with the former agricultural usage of the area, results in depleted and compacted soil. Recent development of the land in suburban areas has resulted in a decrease in overall vegetation which formerly acted as a natural floodplain. This leads to a greater risk of flooding in these newly inhabited areas.

Goals & Objectives

G1. Reduce Impervious Surfaces

Group 9 hopes to introduce rain gardens, swales, perennial beds, or other forms of planted areas in urban spaces to reduce impervious cover and encourage stormwater infiltration. Impervious cover is a major factor on the health of a watershed, and with the Trinity watershed being largely urban and suburban, any reduction of impervious surfaces by planting areas within the urban spaces will help improve watershed quality. Land contours and vegetation result in the infiltration of the water and decrease the rate of pollutant-carrying stormwater runoff. Plants help to filter out many of the sediments and pollutants prior to the surface runoff reaching the closest body of water or wetland. Additionally, the soil and sediments are held in place by the plants' root systems to prevent erosion.

G2. Clean Industrial Pollutants

The first step to cleaning industrial pollutants is to test the watershed area for the presence of such pollutants. While much is known about the history of industry in the area, knowledge is lacking on the lasting effects of those potentially harmful activities. Tests for heavy metals such as lead, silicon, and acidic compounds will be conducted across the watershed. One test may be to measure absorbance of water in the watershed to see how many particles are contained within it after filtration of larger detritus from the water, following it up with a silica test for the water. When tests are completed, and the watershed area has been assessed for industrial pollutants, an action plan can be made for addressing them. This plan will prioritize the most potentially harmful pollutants and most affected areas in cleanup as well as restoration. Monitoring levels will also be key to ensuring that the cleaning of industrial pollutants will be factored into the long term management of the watershed.

G3. Management of Invasive Species and Vegetation Restoration

Group 9 plans to actively remove invasive species from the Trinity Watershed area. Organizing removal events and public outreach efforts are ways to encourage people to identify and properly remove invasives like phragmites. Additionally, being able to remove these species and encouraging the growth of less nutrient intensive species will help resolve the issue of compacted and nutrient deficient soil. Less nutrient intensive species will also be planted in available areas within the spreading development in order to help protect the floodplain and reduce risks of flooding. This is an especially important effort in highly inhabited areas where there is little vegetation and more lives are at risk. This objective goes hand-in-hand with Goal 1,

since reducing impervious surfaces can include planting vegetation in urban and suburban areas, which helps increase water quality, restore habitats, and reduce flooding in the watershed.

Regulations & Ordinances

As the Trinity River watershed falls within the confines of New Castle and is connected to the Delaware River, several groups are responsible for its regulation. On an interstate scale, the Delaware River Basin Commission (DRBC) is responsible for the overall management of the Delaware River Basin. The commission consists of five separate bodies, four being the states connected to the Delaware River Basin (Delaware, New York, New Jersey, and Pennsylvania) and the Federal Government. Each body on the commission has an equal vote as they discuss issues of water quality, flood and drought management, and other issues within the watershed (*Introduction to DRBC*).

On a more local level the city of New Castle is managed in accordance with the Vulnerability Assessment and Adaptation Plan which, among other subjects, describes plans to reduce flooding and sea level rise along with encouraging public participation in the preservation of the local watershed (*Vulnerability Assessment and Adaptation Plan*). This plan was developed and implemented by the Delaware Department of Natural Resources and Environmental Control (DNREC) who performs a wide variety of environmental services for the state of Delaware, and more specifically its Division of Water. The Division of Water is responsible for the licensing of water allocation permits, stream and wetland protection, assessment of water quality, and monitoring contaminants in the water among other activities (*Division of Water*). The plan that this report is inspired from is the Northern Delaware Wetland Rehabilitation program which was produced and enacted by DNREC. This program intended to restore Delaware wetlands along

the Christina and Delaware rivers, much of which were either reduced in size due to surrounding industrial and suburban development, or cut off from the surrounding rivers in order to prevent the wetlands from replenishing. The program involved a stretch of several thousand acres of wetlands, and among this area was the Broad Dyke Canal (Trinity River Watershed). In terms of the Broad Dyke Canal, the plan involved the installation of a tidal gate to introduce a method for the wetlands to replenish, the curtailing of invasive plant life (phragmites), and alterations to the environment to make it more appealing to local wildlife (*Northern Delaware Rehabilitation Program*).

GIS Watershed Inventory

As mentioned in the Watershed History & Description section, Trinity Watershed encompasses the city of New Castle, part of the Route 9 corridor, and the surrounding mostly urban and suburban areas (see Figure 3). It comprises three main tributaries that flow into the Delaware River.

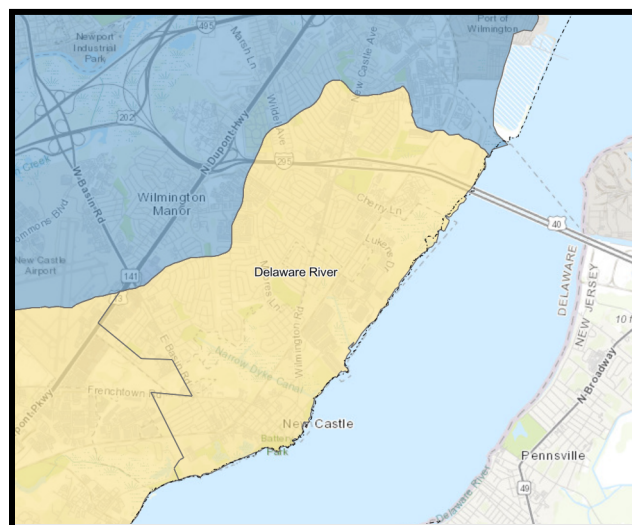


Figure 3. The Trinity Watershed delineated on a map.

It is the northernmost watershed in the Delaware Bay basin (see Figure 4). Actions taken in the Trinity Watershed, both negative and positive, affect all of the Delaware Bay.

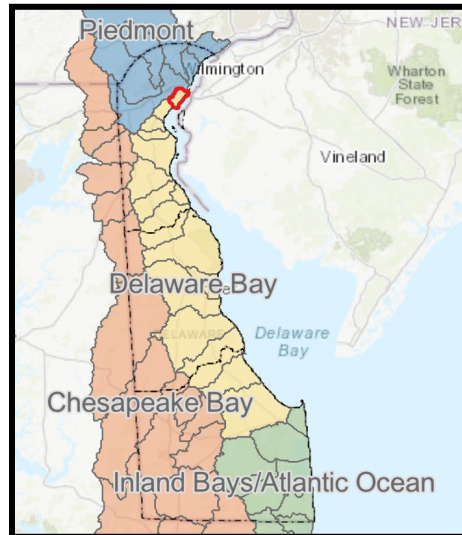


Figure 4. The Trinity Watershed shown in comparison to other Delaware watersheds and within the major basins.

Alternatives Analysis

The alternative solutions examined in the matrix below address Problem 3: Invasive Species and Vegetation Issues. Each option is ranked on a scale from 1-5, 1 being the worst and 5 being the best, for each of several characteristics. The scores were totaled to help select the most effective option for addressing the problem.

Matrix 2. Analysis of Goal 3 Options

| Options for Goal 3 | Monetary Cost | Labor Requirement | Previous Executions | Required Government Participation | Time Requirement | Predicted Effectiveness | Total Points Earned (X/30) |
|--------------------------------|----------------------|--------------------------|----------------------------|--|-------------------------|--------------------------------|-----------------------------------|
| Planting Native Vegetation | 3 | 2 | 5 | 4 | 4 | 5 | 23 |
| Best Land Management Practices | 4 | 3 | 5 | 1 | 2 | 4 | 19 |
| Community Outreach | 5 | 4 | 2 | 4 | 2 | 1 | 18 |

Planting native vegetation involves removing invasive species and planting native species to help restore vegetation in both natural and urban areas. Implementing best land management practices requires updates to land use practices and zoning laws. Community outreach concerns educating the public about invasives and vegetation issues as well as promoting events and stewardship to encourage watershed residents to come in and help address the problem.

Based on the decision Matrix 1, planting native vegetation was chosen as the best method for the Trinity Watershed, with a total score of 23. It has been shown to be an effective method in the past by DNREC (*The Northern Delaware Wetlands Rehabilitation Plan*), who planted native wild rice in marshlands to help reduce invasive species and restore habitats and vegetation. The effort has proved to be successful and the area is mostly covered in wild rice today. The option of planting native vegetation provides the additional benefit of helping with Problem 1: Impervious Cover as well.

Conclusions & Recommendations

TRAP intends to increase the health of the Trinity Watershed, located in the Newcastle, Delaware area. The three main problems that TRAP focuses on addressing are impervious cover,

industrial pollution, and invasive species and vegetation issues. The goals and methods chosen to undertake this effort are introducing planted areas in urban spaces, increasing testing to assess pollution, and planting native vegetation. Together, governments and organizations, with the support of residents, will help work towards these goals to improve the quality of the Trinity Watershed for all stakeholders in the area by 2044.

In regard to recommendations, TRAP should be spearheaded by DNREC and especially backed by New Castle County Government, Trustees of the New Castle Commons, and other organizations that have a stake in the jurisdiction over this area. Larger entities from the state and national level are expected to provide the majority of funding for this project. Group 9 referred to the Northern Delaware Wetlands Rehabilitation Plan as a basis for the cost. In 1994, the plan anticipated about \$500,000 of funding directed toward the Broad Dyke Marsh – one of the three main tributaries in the Trinity Watershed. After multiplying this initial number by three, and accounting for inflation, the total project estimate is \$3,000,000.

In addition, the project may be supported by The Route 9 Corridor Land Use and Transportation Plan. Those involved in TRAP should consult this plan and work in coordination with organizations like Delaware Department of Transportation to achieve the best results while maximizing funding.

References

1. (Modified 2023, April 4). *An Introduction to the DRBC*. DRBC
<https://www.nj.gov/drbc/about/>
2. Barrish. C (2023, February 1). *Momentum builds to install filtered water stations in all Delaware schools to 'get the lead out'*. PBS
<https://whyy.org/articles/filtered-water-stations-delaware-schools-lead-problem/>
3. *City History*. The City of Wilmington Delaware,
www.wilmingtonde.gov/about-us/about-the-city-of-wilmington/city-history.
4. *Division of Water*. Delaware Department of Natural Resources and Environmental Control. <https://dnrec.alpha.delaware.gov/water/>
5. Eichmann, Mark. *\$100 Million Overhaul Planned for Wilmington's "Other" Riverfront*. WHYY, 18 May 2021,
whyy.org/articles/100-million-overhaul-planned-for-wilmingtons-other-riverfront/#:~:text=After%20they%20closed%20in%201965.
6. Figure 3: University of Delaware and Delaware Department of Natural Resources and Environmental Control. [Delaware River Drainage map of Trinity Watershed]. Retrieved April 3rd, 2023 from <https://delawarewatersheds.org/watershed/?wsid=7>
7. Figure 4: University of Delaware. [Delaware Watersheds and School Locations map of Trinity Watershed]. Retrieved April 3rd, 2023, from
<https://udel.maps.arcgis.com/apps/mapviewer/index.html?webmap=55119b9641864f33bf209e09657ef5c1>
8. *History Matters: Shipbuilding Industry along the Wilmington Riverfront*. Delaware Public Media, 22 July 2016,

www.delawarepublic.org/culture-lifestyle-sports/2016-07-22/history-matters-shipbuilding-industry-along-the-wilmington-riverfront.

9. Hossler. R (1994, February). *The Northern Delaware Wetlands Rehabilitation Plan*. National Oceanic and Atmospheric Administration.
<https://repository.library.noaa.gov/view/noaa/235>
10. *Industry in New Castle*. New Castle, Delaware Community History and Archaeology Program, nc-chap.org/chap/industry.php.
11. Meeke. J. *Industry in New Castle*. New Castle, Delaware Community History and Archaeology Program,
<http://nc-chap.org/chap/industry.php>
12. *Northern Delaware Wetland Rehabilitation Program*. [Brochure] Delaware Department of Natural Resources and Environmental Control
<https://documents.dnrec.delaware.gov/fw/mosquito/Documents/NDWRP%20brochure%2006-18-08.pdf>
13. Schmidt. S (2019, June 7). *DNREC hosts 'environmental justice roundtable' in Route 9 corridor*. Delaware Public Media.
<https://www.delawarepublic.org/science-health-tech/2019-06-07/dnrec-hosts-environmental-justice-roundtable-in-route-9-corridor>
14. Swiatek. W(2017, May). *The Route 9 Corridor Land Use and Transportation Plan*. Wilmington Area Planning Council
http://www.wilmapco.org/Rt_9/Report/Rt9CMP_lowres.pdf
15. *Take Action Against Invasive Species*. National Invasive Species Information Center
<https://www.invasivespeciesinfo.gov/take-action>

16. Titus. J et al. (2009, October 27th). *State and local governments plan for development of most land vulnerable to rising sea level along the US Atlantic coast*. Retrieved 4/3/2023 from <http://papers.risingsea.net/ERL/>
17. Seitz. G et al. (2018, March) *Vulnerability Assessment and Adaptation Plan*. Delaware Department of Natural Resources and Environmental Control, <https://documents.dnrec.delaware.gov/coastal/Documents/ResilientCommunityPartnership/city-of-new-castle-resilient-community-partnership-plan.pdf>
18. *State Route 9*. AARoads, 2 Jan. 2023, www.aaroads.com/guides/de-009/.
19. Wilson. M (2022, February 03). *Delaware offers litmus test for Biden's EJ plan*. Energy Wire. <https://www.eenews.net/articles/delaware-offers-litmus-test-for-bidens-ej-plan/>