Prioritization of Potential Streambank Stabilization and Habitat Restoration Projects in the Rancocas Creek Watershed

A scenic view of the South Branch Rancocas Creek.

BURLINGTON COUNTY SOIL CONSERVATION DISTRICT
Tiffany Square, Suite 100, RD #2, 2615 Rt. #38, Mt. Holly, N.J. 08060
(609) 267-7410 FAX# (609) 267-3347

Dear Reader:

The Board of Supervisors of the Burlington County Soil Conservation District is pleased to provide you with this opportunity to review our assessment of the Rancocas Creek Inventory. We invite you to participate in our efforts to assess and address the many water quality issues that we face.

Our District undertook this effort, with the realization that this is only the first small step towards reversing a trend of declining water quality, diminishing flora and fauna, and an overall reduction in the quality of our environment.

New Jersey Conservation Districts and their soil and water conservation programs are recognized nationally. We are committed to providing the residents of our county the benefits of our sixty plus years of expertise in addressing water quality issues. As watershed health becomes a primary environmental concern and a challenge of the new millennium, we must approach these challenges as opportunities ripe for change.

We welcome the involvement of all concerned parties that share these same goals and look forward to establishing new partnerships that will allow us to meet our objectives and achieve a healthier natural environment.

Thank-you,

Burlington County Soil Conservation District
Board of Supervisors

John Traino
(Chairman)

William Haines Sr.
(Vice Chairman)

Catherine A. Costa
(Sec./Treasurer)

Henry Metzger
(Supervisor)

Vincent Farias
(Freeholder)

Table of Contents

Foreword

Various government and private entities are joining forces to create watershed management plans statewide, and the Rancocas Creek Watershed has become the focus of one of these efforts. Watershed Management Plans are long-term ventures by nature. Unfortunately, the Rancocas Creek has many existing problem areas along its shorelines that require immediate attention. In instances such as this, it is not prudent to wait until a watershed management plan is complete to address these issues.

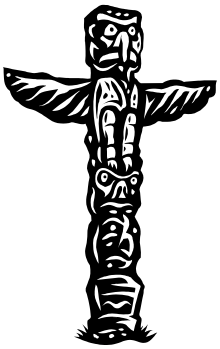
The Watershed Management Area 19 planning process was initiated with a kick-off meeting hosted by the Department of Environmental Protection. Many of the groups and individuals that attended were searching for their niche in the process. The Burlington County Soil Conservation District was contacted by several of these organizations with the intention of developing partnerships whose expertise varies from technical proficiency to educational experience. Each expressed an interest in getting the best possible results for the limited amount of money and resources available.

In January 1999, the Burlington County Soil Conservation District was awarded contract number 100-042-4850-099-6120 in the amount of $76,767.00 from the Department of Environmental Protection to identify those problem areas along the Rancocas Creek and its associated tributaries that would benefit from stabilization and restoration projects. The following report is the product of the District's efforts to provide a detailed and in-depth look into the problems that exist along the Rancocas Creek.

We would like to thank the following agencies for their assistance in completing this project:

New Jersey Department of Environmental Protection
USDA Natural Resources Conservation Service
Burlington County Data Processing Office
Big "D" Valley Marina

History of the Rancocas Creek



Until the early fall of 1677 the Delaware Indians were the only inhabitants of Burlington County. At that time, the Indians referred to the Rancocas Creek as "Lenape-wihittuck," the rapid stream of the Lenape.

In early deeds and surveys created after the arrival of the early settlers, the spelling varies to "Rankokus," which is pure Indian. The name, Rancocas, is believed to derive from King **Ramcock,** a sachem of the Delaware Indian Unami Tribe that lived along the Rancocas Creek, as they generally formed their villages or camps near a stream or a spring. The Indians navigated the Rancocas Creek by utilizing a dugout canoe. This canoe was made from a solid log and was capable of carrying heavy loads up and down stream.

Owning property along the creek provided early settlers with an efficient means of conducting business. The property here was considered so valuable in fact that by 1682, the West Jersey Assembly passed an Act prohibiting any person from taking up 40 acres or more of navigable stream, or occupying land on the opposite side of the stream to prevent any one person from having monopoly control over local commerce. Early settlers went through great pains to obtain access to the creek. This can be evidenced today by the numerous areas along the creek that have been altered either by importing fill material or constructing docks and piers to facilitate access to the waterway. One of the more popular industries that relied heavily on the Rancocas for its success was the lumber industry because it enabled companies to float logs downstream into Mount Holly where they were sawed into lumber and then continued on to the Delaware.

Later, pioneers began utilizing a variety of early watercraft that varied in size and design to navigate the waterways, facilitating the transportation of farm produce, lumber, and charcoal to the Philadelphia market. The intensified usage of the creek for commerce and the changing land uses within the watershed began contributing to increased sediment levels in the Rancocas Creek. Even before the great steamboats graced the waterways of the Rancocas Creek, efforts were already underway to dredge the North Branch to make it more navigable.

In 1823, the first steamboats ferried up the Rancocas facilitating passenger travel and the transport of produce and other products to Philadelphia. In addition, these boats weighing 30 to 50 tons came up the Rancocas with cargos of merchandise that were often unloaded in Mount Holly. The upstream segments were used for a variety of industrial and commercial purposes including mills, mining and manufacturing. Navigation of this type came to an end when the Rancocas Creek became too shallow and additional attempts to dredge it had failed.

Problems with navigating the Rancocas Creek are no different today than they were in 1888, when steamboats stopped traveling the creek. Storm flows, soil erosion, increased water velocity, debris, blow downs, and other natural causes in conjunction with the navigational problems caused by increased human activity in the watershed continue to plague the overall condition of the Rancocas Creek. The modernization of local industry in coordination with a growing population gave rise to other problems such as impaired water quality and habitat reduction. Direct discharges of pollutants into the waterway from commercial and industrial ventures degraded water quality, altering the chemical and biological makeup of the stream and its riparian zones. Land altering activities such as clearing and grading for farms and commercial/residential development also contributed to increased sedimentation problems and habitat reduction that affected the diversity of plant and animal communities both on land and downstream.

These environmental impacts can be observed in the Rancocas Creek when comparing the aerial photographs taken by the State of New Jersey in 1940 (Map #1) with those taken in 1963 (Map #2) on Page 7. Notable changes when comparing these photographs include the development of the New Jersey Turnpike that facilitated access to the Rancocas Creek Watershed from the tri-state area and beyond. This resulted in an increase of commercial and residential development within the watershed region. This increase in population and development contributed in part to the expansion of previously existing sediment bars and the formation of new sediment bars in the creek.

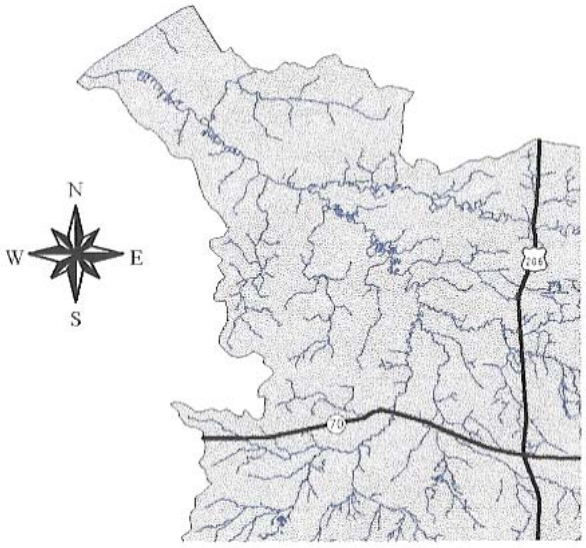
Map #1: 1940 Aerial photograph of the Rancocas Creek.

Map #2: 1963 Aerial photograph of the Rancocas Creek. Note the increased sediment levels in the Main Stem as well as the additional infrastructure.

As a result of this burgeoning human activity, non-point source pollution became increasingly problematic. Point source discharges, particularly those from sewage treatment plants, began to be addressed in the 1960's and 1970's with fairly good results. It is only recently, however, that non-point source pollutants found in stormwater runoff such as fertilizers, pesticides, animal waste, sediment from land use activities, and petroleum based products from streets and parking lots have received the focus that they warrant.

As a result, the Burlington County Soil Conservation District formed a partnership with the New Jersey Department of Environmental Protection to explore and identify specific problems along the Rancocas Creek and its tributaries so that they may be addressed in the future and therefore reduce their impact on the overall condition of the creek.

Proposal



The purpose of this grant proposal was to survey the Rancocas Creek and its tributaries in order to locate and prioritize potential sites for streambank stabilization and habitat restoration projects. The Burlington County Soil Conservation District utilized the New Jersey Department of Environmental Protection's 1994 State Water Quality Inventory Report as a guide in determining the project area. As a result, the project focused on the portion of the Rancocas Creek watershed that is bordered on the east by Route 206, on the south by Route 70, and on the west by the Delaware River.

The 1994 State Water Quality Inventory Report indicated that a majority of New Jersey's freshwater streams contained elevated levels of nutrients and bacteria. However, there are a number of other pollutants that are known or suspected of causing water quality problems throughout the State. These sources are pesticides, priority organics, metals, ammonia, pH deviations, and temperature changes. It is important to note, however, that although sediment is listed in the Report's summary of pollutants, there is a lack of data indicating the overall impact that sediment has on our waterways.

It was the intention of the Burlington County Soil Conservation District to identify problem areas along the Creek that would benefit from stabilization and restoration projects, and in addition, to provide useful information that would serve as a guide in future water quality monitoring projects. It was therefore determined that the most effective method of examining the stream banks and adjacent habitat was by traveling the waterways themselves, which would then assist in avoiding many land barriers and problems associated with private ownership. Therefore a small utility craft was needed so the inventory of the target sites would be based on a complete analysis rather than relying on a fragmentary knowledge of the Rancocas and its tributaries.

The District then developed a ranking system in which the following assessment elements were evaluated: environmental attributes, economic feasibility, site access, visibility, current land use, degree of environmental degradation, and public welfare. By following this outline, the District was able to develop a well-defined list of sites that are ranked in an easy to understand manner that would highlight the most cost-effective and beneficial sites for potential restoration projects.

This assessment provides a basic level of stream health evaluation, based primarily on physical conditions within the assessment area. It may not detect some source problems caused by factors located beyond the area being assessed. The use of higher tier methods is required to more fully assess the ecological condition and to detect problems originating elsewhere in the watershed. However, it provides a good indication of the current conditions and the value of the sites inventoried.

Procedures

District personnel initiated background research during the fall and winter of 1999 for the purpose of gathering information about the Rancocas Creek in order to efficiently begin an inventory process later in the year. Some of the resources referenced to gather this information were aerial photos, road maps, USGS maps, wetlands maps, etc.

This Tracker boat was used to navigate the Rancocas Creek during the course of this project.

During the spring and summer of 2000 the actual investigative work on the Rancocas Creek commenced. A 16-foot boat, purchased through this grant project, was used to travel the main branch and parts of the north and south branches of the Rancocas Creek. This made it possible to travel larger distances more quickly and to assess the condition of the stream banks from the waterway, thereby negating the need to obtain permission from individual landowners to cross their property. In addition, it provided a stable and safe observation platform for the investigative team to assess potential sites from within the stream at an optimum visual angle. In general, the utilization of the boat was a quicker, more efficient means to assess the condition of the Rancocas Creek.

It is important to note, however, that when boat travel was restricted due to dams, low stream depth, or obstructions in the waterway, the creek was then inventoried by stream walking or by canoeing. The North Branch and the South Branch of the Rancocas Creek were inventoried by canoe, beginning at Route 206, the eastern boundary of this project. The assessment of smaller tributaries, such as Laurel Run in Delran or Buttonwood Creek in Mount Holly, was executed by walking alongside the stream bank. If the property appeared to be privately owned, permission was obtained from the homeowner to access their property.

The District utilized a variety of locations as launch sites depending on the specific area of the creek to be assessed that particular day. The assessment team, which typically was made up of two staff members, traveled upstream or downstream from the launching point visually inspecting the creek for areas of erosion. Once an area had been located, the team either anchored the boat or navigated it to an area where it could be safely beached.

This location in the Rancocas Woods section of Mount Laurel, was one of several locations used to launch the boat during the course of the investigative process.

The investigative team recorded information on a form referred to as the "Rancocas Creek Site Assessment Report." This report requested information on the following site characteristics:

- Existing problem at the site
- Condition of the slope
- Existing vegetative and habitat conditions
- Present land use
- Site accessibility
- Site ownership
- Site visibility (i.e. private, public, waterway only, etc.)
- Potential safety hazards
- Important ecological observations and features of the site

The assessment report was then used as a reference to prioritize each site as a high, medium, or low priority. A numerical value was attached to each condition on the form based on a scale from 1 – 9, 1 being a minor condition and 9 being severe or high. These values were then totaled and the priority ranking was assigned to the potential site. The overall scale used was as following:

- 49 or less = Low Priority
- 50 – 74 = Medium Priority
- 75 – 100 = High Priority

Technical data was then collected by utilizing the following scientific instruments to assist us in gathering more detailed information about the natural environmental influences on a site:

- A Swoffer Instruments Model 3000 Current Meter was used to measure the stream flow velocity at a specific point in units of feet/second (ft/s).
- A Secchi Disk was also utilized to assist in evaluating the turbidity of the water at various locations along the Rancocas Creek.

- A Geographical Positioning System (GPS) was employed at each potential site to record its longitude and latitude. The information gathered by using the GPS unit will enable others to easily locate the site in question for future evaluation.
- Photographs were taken with 35 mm cameras and with digital cameras to provide documentation as to the severity of the erosion at the potential remediation sites.

District staff members Robert Reitmeyer (left) and Craig Fisher (right), are using the current meter in front of a prospective site.

The last step to the evaluation process included the compiling of a daily log describing the sites inventoried and other information pertinent to the day's events.

During the length of this project, District staff identified 22 sites that have moderate to severe erosion problems that could be the focus of a stabilization or restoration project.

The Rancocas Creek Flood Plain

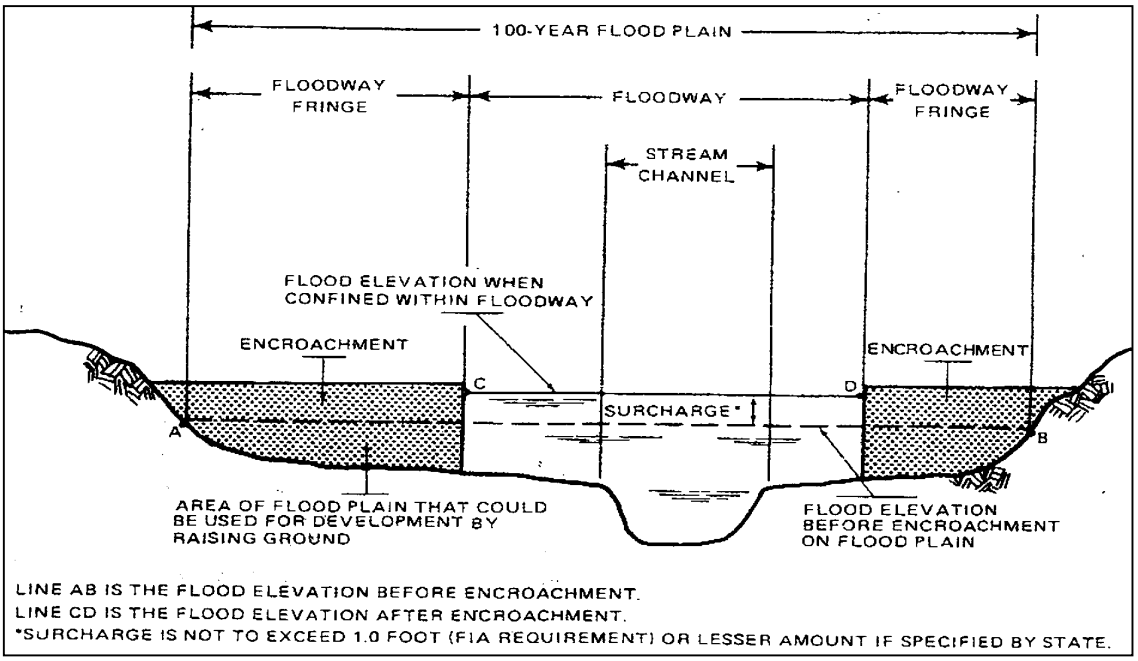
All of the potential priority sites included within this report can be found within the flood plains that surround Rancocas Creek, and throughout the investigative process, it was important for staff to evaluate the site based on the following:

1.) The current erosive condition was created by encroachments into the surrounding flood plain.
2.) Any future repair work would also impact the flood plain and the health of the watershed.

A flood plain is defined as any area that would retain stormwater as a result of a storm event. When there is encroachment in the flood plain, whether it is a natural obstruction or man-made structure, it essentially reduces the water carrying capacity of the waterway. This encroachment, in turn, creates a larger area that can be affected by a flood event, and ultimately causes erosion of both the stream channel and the streambank. The information contained in flood plain studies is important in helping determine what areas may be more susceptible to erosion if the waterway is not properly cared for (see diagram of 100-year flood plain on the next page.)

There are several factors that affect the severity of flooding in the flood plain during a storm event. These factors include the curvature of the shoreline, the surrounding topography, the runoff generated by overland flows, the surrounding soil conditions, and the influences of tidal action and riverine flows. The negative affect of the above factors enlarges the area that is prone to erosion and, in turn, increases the sedimentation levels of the Rancocas Creek.

It is important that any stormwater structures along the Rancocas Creek be kept free of debris. During times of severe flooding, it is more likely that obstructions of these stormwater structures will occur. These blockages can increase the possibility of experiencing situations of supercritical flows that are hazardous to private citizens, causes damage to property, and can



This diagram, which was published in a FEMA Flood Insurance Study demonstrates the theory of encroachment on a 100-year flood plain.

severely undermine the stability of the streambanks. However, the instances of encroachment into the flood plain can be significantly reduced by maintaining our waterways and by educating the public about watershed health.

In addition, flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management. Although these recurrence intervals represent the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one (1) year are considered.

The chart on the following page reflects the flooding potential at varying locations based on the conditions that existed when the Federal Emergency Management Agency (FEMA) conducted their flood insurance studies in the 1970's and 1980's.

Table 1. Summary of Discharges

Flooding Source and Location		Drainage Area (Square Miles)	Peak Discharges (cubic ft/ sec) 10-year	50-year	100-year
Eastampton					
North Branch Rancocas	Upstream of confluence with tributary to Mill Race (Mt. Holly)	144.9	1675	2565	3030
	Downstream of confluence with Budds Run (Pemberton)	128.3	1530	2340	2765
Medford					
South Branch Rancocas	Upstream of confluence with Little Creek (Lumberton)	59.3	1450	2345	2830
	Downstream of confluence with Sharps Run	55.6	1440	2320	2800
	Upstream of confluence with Sharps Run	51.0	1315	2130	2565
	Downstream of confluence with Haynes Creek	49.7	1300	2105	2545
	Upstream of confluence with Haynes Creek	20.7	770	1265	1535
	Downstream of confluence with Barton Run	20.1	740	1220	1480
	Upstream of confluence with Barton Run	5.5	630	1035	1275
	Downstream of confluence with unnamed tributary (Evesham)	3.4	425	705	870
Delanco					
Rancocas Creek (Main Stem)	At confluence with Delaware River	354.5	3275	5020	5925
	Downstream of confluence with Mill Creek (Willingboro)	348.8	3230	4955	5850

Tables show the peak discharge-drainage area relationships as designated.

Inventoried Priority Site Descriptions

Throughout the investigative process, District staff observed numerous eroded areas within the boundaries of the Rancocas Creek Watershed. Many of these sites, however, were considered to be a non-priority for the following reasons:

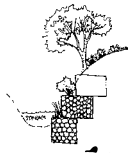
1) The erosion occurring at the site was minor in nature. There were no significant undercuts along the streambank and there was no evidence of severe soil loss.
2) The overall size of the eroded area was insignificant.
3) The habitat value of the site would not be significantly increased by a restoration project.
4) The location of the site would make it difficult to access in the future to implement remediation efforts.

Using the "Rancocas Creek Site Assessment Report", it was determined that there were 22 locations that met the previously discussed criteria to qualify as a priority site. In addition, these sites were visited on varying occasions to gather pertinent data and to view the site under different weather conditions for the purposes of compiling this report.

In addition, we have organized our recommendations to repair the erosion problems at each of these potential sites by utilizing the icons below:

Bioengineering

Riprap Armament 



Engineered Solutions

General Site Improvements 

Farm Conservation Plan

Public Education 

The following is a breakdown of the conditions noted at each of these 22 priority sites:

Hawk Island

The height of the cliffs at Hawk Island are greater that six feet tall.

Site # 1: Hawk Island, Delanco Township

The Hawk Island peninsula is located at the confluence of the Rancocas Creek and the Delaware River adjacent to an area of high-density residential development. It is an excellent example of man-made influences on our environment. The island is composed of a variety of habitats including areas containing dredged spoils; areas containing previously dredged spoils that are converting to forested land; and areas of mature forest that may include remnants of the original forested island. Over the past 60 years, dredge spoils have been deposited on Hawk Island eventually connecting it to the main land. Prior to this, the Delaware River and Rancocas Creek inundated much of the island, with most of the land area being no more than 10 feet above sea level. Hawk Island is considered to be an active dredge spoil site by the State of New Jersey.

Description of Site and Problem:

Recently the ecological value of Hawk Island has become more appreciated. The Burlington County Office of Land Use Planning identified the island as an environmentally sensitive area, recommending that it be acquired and preserved for passive recreational uses. Over time, two

This particular section of shoreline that faces Pennsylvania illustrates the shoreline erosion existing around Hawk Island.

ponds were created in the center of the island in an effort to make room for additional dredge spoils. In 1988, new spoils were dumped into one of the ponds, completely filling it in and destroying the valuable habitat that had developed there. However, this site has not been used as a disposal area since 1988, and Hawk Island has developed a rich and diverse habitat, colonized by a wide variety of plants and animals. Hawk Island, according to Delanco Township is zoned a waterfront commercial district, and is owned in part by the township, the state, and by private individuals. There are several unimproved roadways that cross the island, however, gates have been erected to prevent public access to them. Due to the location of the island at the joining of the Rancocas Creek and the Delaware River, many people visit the island via watercraft. The diverse ecosystem that has been created here makes it a popular area for water sports, fishing and recreational boating.

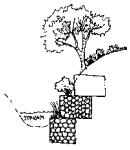
The soil type here is Made Land (Ma), both at the water's edge and upland of the erosion problem. This type of soil is defined as dredged coarse material, mostly from the Delaware River and has boulders, cobblestones and pebbles settled throughout it. Made Land, however, contains large amounts of mica, which includes enough fine material to make re-vegetation possible.

Large cliffs have been created as a result of tidal effects and lack of vegetative cover.

On the south side of Hawk Island, the topography gently slopes toward the Rancocas Creek. On the western side is the District's potential restoration site. At this location, there is severe erosion with cliffs ranging from eight to fifteen feet in height and they extend for great lengths along the island. The dredge spoil disposal projects did not account for the potential erosion and sediment deposition from a man-made landform such as Hawk Island. The initial slopes created by these projects were too steep to withstand the erosive forces of wind and water. Stabilization measures were not properly implemented or ignored completely. This area has been influenced by both the tide and by the currents of the Rancocas and Delaware. There are high incidences of upper bank failure due to the sparse or non-existent vegetation on these cliffs. As a result, an extensive silt pad has formed here. Tidal effects and water currents are adding to the sediment problems of the Rancocas Creek and the Delaware River since this large sediment pad is unable to re-vegetate itself due to regular flooding by the tide. The site rating was determined to be 82 or high priority due to the amount of public activity in the area, the diverse ecosystems forming here, and the severity of the erosion conditions.

It is important to point out at this time that any possible methods of correcting the erosion problems on Hawk Island must consider the many ownership and wildlife issues that exist here. Any proposed restoration project must not interfere with existing wildlife habitats. For example, some of the steepest areas are inhabited by Cliff Swallows and may need to be preserved.

Recommended Solutions:



A suggested method of stabilizing and restoring this site could be through the installation of revetments along the cliffs. Revetments are protective structures of rock, concrete, cellular blocks, or other material installed to fit the slope and shape of the shoreline. Revetments are effective because they are flexible and not impaired by settling or other adjustments and they function well where extreme wave action exists.

Once the cliffs have been neutralized from additional erosive effects, bioengineering methods could be installed along the top of the cliffs to provide a buffer strip and some additional habitats for waterfowl, migratory birds, and other wildlife. Additional vegetation would also increase the aesthetic value of the island.

Due to the unique nature in which Hawk Island was created and how it evolved, consideration should be given to using this location as a demonstration site for educating the public on environmental issues or as a park for recreational hiking, fishing, and bird watching.

Mill Creek Park

This park bench indicates a high public usage of this area in Mill Creek Park.

Site # 2: Mill Creek Park, Willingboro Township

This site is located along the main stem of the Rancocas Creek in Willingboro Township. It is situated along one of the many foot trails in Mill Creek Park, a Green Acres property. Walkers, bikers, and fishermen often recreate at this site due to its high accessibility and aesthetic surroundings. A park bench has been placed along the shoreline to facilitate many of these recreational uses.

Description of Site and Problem:

Due to Mill Creek Park's popularity among recreation seekers, this location is highly visible to park visitors and to boaters on the creek. The proximity of steep slopes to the trail magnifies the safety hazards at this location. People may lose their footing or trip over exposed roots where the soil has been washed from around them.

The soil immediately adjacent to the Rancocas Creek at this location is shown on the soil survey as Tidal Marsh (Mt). The characteristics of this soil type are highly organic silt flats near sea level that are flooded twice daily. It is a brownish material and has an average thickness of about three (3) feet. The native vegetation for tidal marsh areas is typically salt-tolerant grasses and

Poorly vegetated slopes in conjunction with foot traffic, tidal effects, and overland runoff contribute to the eroded nature of this site.

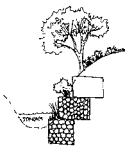
sedges, but there is no evidence of these species at this priority site because it has eroded away from the effects of stream flow, tidal action, and human impact. In general, tidal marshes such as this are converting to open water/mudflat habitats, having lost most of their native vegetation to tidal effects and human influences. Slightly upland and adjacent to the foot trail, the soil becomes that of the Galestown series, specifically Galestown sand (GaA), 0 to 5 percent slopes. This phase of the Galestown series is characterized as fine, sandy material that is low in organic material. In most cases fertilization and irrigation are necessary to sustain plant life. When exposed, this soil series is highly influenced by the effects of wind and water erosion. Existing at this location is a wonderfully diverse upland forest consisting of mixed oaks, hickory, sassafras, and wild cherry.

The erosion that is occurring at this site is severe due to the lack of vegetation that exists along the shoreline, further aggravating the effects of the tidal. The slopes are 1:1 and steeper, ranging anywhere from 3 to 8 feet in height along the project area. Some of these slopes are also damaged by heavy foot traffic from the trails to the waters edge and vice versa. The affected

Implementing stabilization methods on this slope would prevent additional erosion.

area is approximately 100 feet in length, which makes it a heavily impacted area. There are some significant undercuts in other areas that are a result of the creek's tidal fluctuations and heavy flows after storm events, leading to a recession of the streambank and a loss of habitat including the upland forest described above. As a result of the overall site conditions, this site received a high priority ranking of 78.

Recommended Solutions:




When analyzing how to restore this site, one might want to consider installing hard armor at the toe of the slope, and using a combination of engineered and vegetative methods above mean high tide. An example of this Best Management Practice (BMP) would be vegetated rock gabions. These rock gabions are rectangular galvanized steel wire containers that are filled with stone and then wired closed.

Vegetation could then be incorporated by placing live branches in between each consecutive layer of gabions, which would enhance the quality of the surrounding habitat.

If recreational access to the stream is prioritized at this site, it then becomes important to incorporate measures that will provide access to the waterway when preparing the repair designs. The scope of this project could be extended into the forested area by performing improvements on the trail. Holes and exposed roots could be filled in and covered, and overzealous brush can be trimmed back.

Signs could be erected highlighting historical and/or ecological facts regarding the park, thus providing an outdoor educational experience to visitors. These trail improvements would require a commitment from the Township to perform periodic maintenance.

Mill Creek Park

This site, which is situated along a bend in the creek, has erosion that extends 100-150 feet along the streambank.

Site # 3: Mill Creek Park, Willingboro Township

Mill Creek Park, obtained by Green Acres, is located in Willingboro Township along the Mill Creek tributary. It is a popular location for residents to run, ride bikes, study nature, etc. The site in question, however, is located within the boundaries of Mill Creek Park approximately 50–100 feet off of the roadway that visitors use to access Parking Area "A". A stand of trees separates the roadway from the site.

Description of Site and Problem:

Visible from the water, the erosion occurring at this site is moderate to severe and extends approximately 100 to 150 feet along the shoreline. This site is situated at a bend in the creek, subjecting the shoreline to toe erosion. The toe erosion and overland runoff during storm events is also contributing to the failure of the upper bank. The 7 to 12 foot slopes consist of predominantly sandy soils, and in addition, have very little vegetation, with the exception of some scattered bushes along the shoreline, to stabilize the slope. Upper bank failure has exposed tree roots, compromising their stability causing them to fall into the creek. These obstructions

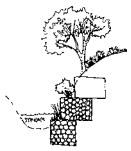
Sandy soils, poor vegetation, and upper bank failure has resulted in a significant eroded area at this location.

have created hazardous boating conditions, and in combination with the constriction of the waterway at the creek's bend, forces a faster current at this location, providing the catalyst for increased erosion at this site. An evaluation of the overall site conditions existing at this location resulted in a high priority rating of 77.

Many trees litter the shoreline at this site.

The dark grayish-brown sand that lines the exposed slopes at this priority site belongs to the Galestown soil series, particularly the Galestown sand (GaA) phase. Galestown soils have alternating layers of dark yellowish-brown sand and brown loamy sand. These soils are highly permeable and lose nutrients quickly through leaching. The loose, sandy structure of this soil is highly erosive when vegetative cover is not present as can be seen in the proceeding photographs. The native vegetation for these soils are deep-rooted trees such as oak, pine, and sassafras.

Recommended Solutions:



Because the length of the project area for this site is so great, it provides adequate room for a variety of different remediation practices to be implemented. If these practices were applied in conjunction with each other, it would provide an excellent opportunity for this site to be used for educational and demonstration purposes. Such practices could include in-stream deflectors, branch packing, brushmattress, and vegetated geogrids.

The installation of an in-stream deflector can be done with a single log deflector system or a log frame and stone deflector. Either system involves excavating the bank and installing rock riprap to act as a stabilizing support for the logs. The existing fallen trees that are currently in the waterway could be used to accomplish this instead of cutting fresh trees for this practice. The single log deflector would require additional rock riprap to be installed on the downstream side of the log to keep it from being washed away. This method would create a pool suitable for several fish species to spawn as well as providing an additional food source for waterfowl. The log frame and stone deflector method would require the installation of additional lumber, riprap, coconut fiber rolls, and plants to supplement the system.

Installing geogrids would be a more expensive form of stabilizing eroded slopes, but it is highly successful on slopes similar in size to those at this site. This process begins with the excavation of the toe of the slope and the installation of a geotextile. It is then filled with two to three inch rocks. Where stream flow begins, soil and branch cuttings are layered with the tips of the branch cuttings perpendicular to the stream flow. Another layer of geotextile is then placed on top of the branches and the process is continued until it is equivalent to the existing grade. It is necessary for the branch cuttings to be approximately six feet in length for this process to succeed.

Branch packing and brush-mattresses are similar in that they both use live branch cuttings. Branch packing typically is used for filling in holes on the streambank additional excavation is not required. Wooden stakes are driven into the ground at the lowest

point and spaced one to 1 to 1.5 feet apart. Branches are then placed between the stakes 4 to six inches thick. This layer of branches is then covered with compacted soil and the process repeated until the final grade matches that of the existing slope. Installing brush-mattress, however, requires that the slope be graded to at least 3:1. A trench is excavated at the toe of the slope to accommodate a live fascine bundle. Live and dead stout stakes should be installed and spaced about two feet apart in the designated area to be stabilized. Branches are layered vertically on the slope about one to two inches thick and between the stakes. Rope or twine is then wrapped around the stakes to help hold the branches against the slope. Last, the live fascine is installed at the previously dug trench and soil filled in to cover the branches except the top surface should remain exposed.

These methods would improve overall aesthetics of the shoreline and Mill Creek Park. In addition, it will improve the general habitat by providing a food source and cover for various species of waterfowl and fish. It will also improve water quality by preventing any additional sedimentation of the waterway. An educational seminar demonstrating the causes of the erosion problems at this site and the various methods involved in correcting them would be beneficial in increasing the public's awareness of erosion problems and their impact on our watersheds.

Upstream of the Rancocas Road Bridge

This pipe first drew the attention of staff to investigate this location further.

Site # 4: Upstream of the Rancocas Road Bridge, Willingboro Township

Mill Creek, a tributary of the Rancocas, is often utilized for bird watching, recreational boating, and fishing because it provides an excellent habitat for many species of waterfowl and fish to live. Mill Creek, however, is difficult to navigate by boat during low tide due to increased sediment levels.

Description of Site and Problem:

Our next site is situated along Mill Creek, was first noted by a lone pipe lying along the shoreline. Further investigation as to why this pipe was lying there led District staff to discover that it belonged to a poorly maintained Willingboro Township storm drainage system for its residential roadways. Even though the erosion problems that are occurring at this site are visible from the waterway, our opinion is that due to the obscure location of this drainage system from the nearby roadways, it proceeded to deteriorate, and is currently in need of having substantial repairs done.

This exposed pipe has contributed to a severely eroded condition in a nearby wooded area.

The storm drainage system in question originates near the intersections of Pageant and Parish Lanes where piping was installed through a low-lying area that sloped toward Mill Creek. Failure of the storm drainage occurred approximately halfway down the existing slope leaving the drainage pipe exposed and extending out from the slope by about five (5) feet, resulting in the creation of a substantial gully. This gully eventually compromised the stability of the trees

Severe erosion in the gully has compromised several trees in this wooded area.

that were located there and they currently remain precariously toppled over in the gully. The gully is approximately 150 feet long and ends at the shoreline of Mill Creek. A significant amount of sediment has been deposited along the creek's edge and, in addition, a fairly large sediment pad has formed inside the creek channel. During low tide, the damage that has been caused to Mill Creek can be easily witnessed as the silt pad created by the severe sedimentation that nearly reaches to the opposite bank.

There are great safety concerns for any person who hikes through the gully to reach Mill Creek. The slopes that have been created by the severe erosion are deep, and during high tide, these slopes are hidden beneath water level. During low tide, the saturated soils along the slopes become slick and treacherous. This site received a medium priority site rating of 65 because of

its low recreational value, the expense in repairing the site, and that the township is aware of the eroding conditions here.

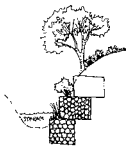
The soil type along the water's edge is characterized as Tidal Marsh (Mt), which are highly organic silt flats near sea level where they are flooded twice daily. It is a brownish material and has an average thickness of about three (3) feet. The native vegetation for those areas that are of

Increased sediment in the waterway in conjunction with low tide, makes this section of Mill Creek extremely difficult to navigate.

the Tidal Marsh (Mt) classification is salt-tolerant grasses and sedges, although they do appear to be present at this particular location due to the overland runoff. The upland soils at this site belong to the Sassafras series soils (SgC). This soil type is a dark grayish-brown sandy loam and on the surface is about ten inches thick. This soil is moderately permeable, but runoff is rapid due to the lack of the subsurface layer in this type. Erosion is a severe problem where there is no good vegetative cover, as is evident at this site.

Recommended Solutions:






There are several methods that could be implemented at this site to alleviate the substantial erosion problem occurring here. We would first recommend that the sediment in this portion of Mill Creek be dredged in order to facilitate navigational capabilities by boaters, to increase water quality, and to improve the general habitat of the area.


A drop structure should be installed at the top of the site that would discharge to the bottom of the slope. The gully, however, would receive hard armor in the form of

vegetated gabion structures and riprap. These erosion control measures would provide the most stability for the gully. In order to safely install the gabion structures, the loose saturated material would need to be removed and replaced with a more compacted material to help provide stability for the structures. The gabions could then be installed along the sides of the gully and live branch cuttings could then be inserted between, in, or around the gabion baskets.


The rock riprap could be placed at the base of the gully to help dissipate the flow of water during storm events. The added vegetation provided by the vegetated gabion structures would not only provide extra stabilization but it would provide an excellent cover for birds and other wildlife. To prevent access to this newly repaired area, the installation of a chain-link fence should be considered.


The general public should be educated on the harm of improper disposal of garbage, whether appliances or grass clippings in these drainage areas. The District has been informed by the Township engineer's office that they are aware that there are erosion problems with these drainage structures throughout the township.

Creek Road at Kendle's Run

This culvert is blocked with sediment and other debris creating a flooding problem during times of heavy rainfall.

Site # 5: Creek Road at Kendle's Run, Moorestown Township

During a routine stream walk investigation along Kendle's Run, a significant amount of sediment and debris was found to be impeding a culvert that passes under Creek Road in Moorestown Township.

Description of Site and Problem:

Kendle's Run, at the location of this site, travels through a private, residential area. It is approximately five to six feet in width and demonstrates moderately steep banks that are between two to four feet in height. The upstream condition of Kendle's Run exhibits some minor erosion along its streambanks that contributes to the sediment build-up in the culvert.

District staff contacted a private owner whose property encompasses a section of Kendle's Run to receive permission to enter his property. At this juncture, the owner informed the team members that during times of heavy rainfall, a flooding problem exists along this tributary due to the impeded condition of the culvert, and as a result of these elevated water levels in Kendle's Run during storm events, the streambanks that are located within this owner's property are lacking vegetative cover, contributing to the continuing erosion problem along the stream.

The bare condition of the adjacent streambank is clearly seen.

Alluvial Loamy Land (Ao) is located near Kendle's Run and is characterized as consisting of stream deposits adjacent to meandering perennial streams that are subject to stream overflow. In addition, Galestown sand (GaA), 0 to 5 percent slopes is also present in the vicinity of this tributary. This phase of the Galestown series is characterized as fine, sandy material that is low in organic material. In most cases fertilization and irrigation are necessary to sustain plant life. When exposed, this soil series is highly influenced by the effects of wind and water erosion. Existing at this location is a wonderfully diverse upland forest consisting of mixed oaks, hickory, sassafras, and wild cherry.

This site received a medium priority rating of 70. This rating was derived as a result of the future upstream impacts of continuous flooding and the resulting damage it may have on private property. In addition, increased flooding due to the blockage of the culvert may also impact the ease of passage by cars and other traffic on Creek Road.

Recommended Solutions:

It is recommended that the Burlington County Highway Department conduct a routine cleaning of the culvert to alleviate some of the flooding problem. It would also be useful to have the residents who live around Kendle's Run to not mow their yards straight up to the border of the stream. This would encourage the growth of native vegetation and create a natural wildlife habitat.

Another solution would be to install live stakes of native species. This would prevent further erosion, encourage plant growth to permanently stabilize the streambanks, and help the uptake of the water during storm events.

I-295 Stormwater Outfall

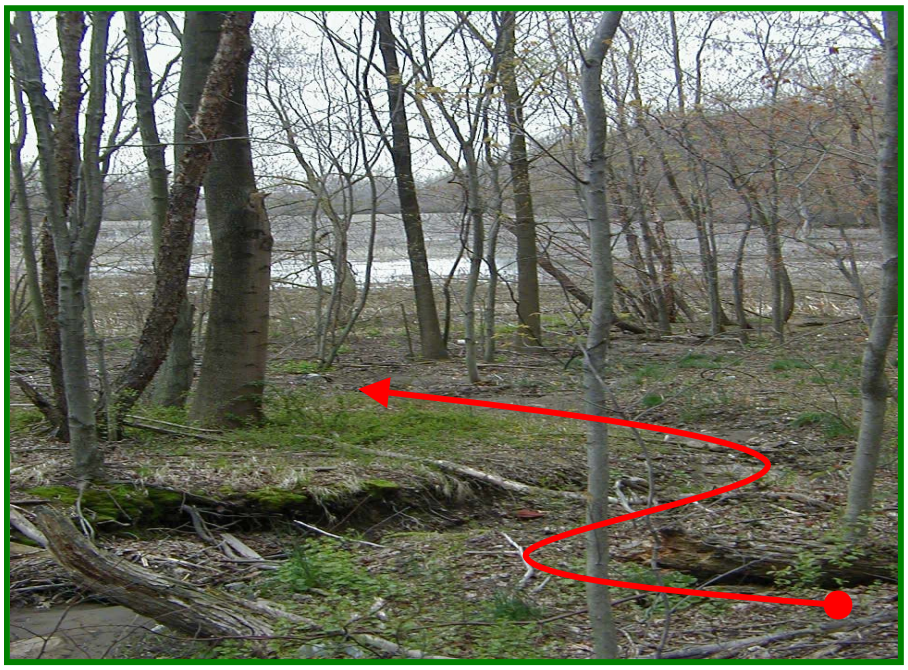
Excess runoff is able to by-pass the entrance to this storm drain, and instead, erodes underneath and around it.

Site # 6: I-295 Stormwater Outfall, Westampton Township

District staff noted a significant sediment buildup in the inter-tidal zone just downstream of the Interstate 295 overpass on the main stem of the Rancocas Creek. As a result of further investigation, the following problem was noted.

Description of Site and Problem:

A stormwater drainage system had been installed on the southbound side Interstate 295, and was designed to accept storm runoff from the roadway and channel it to Rancocas Creek. However, some runoff is by-passing the pipe and forming an eroded channel around it. In addition, the outfall of this pipe ends halfway down a moderately steep slope. Even though the vicinity of the discharge point is wooded, there is very little understory vegetation in place to aid in the dissipation of water. As a result, a gully is beginning to form and is channeling sediment into the tidal zone of the creek. The tidal zone located at this site is environmentally sensitive and increased levels of sediment loading could negatively affect the ecological system.

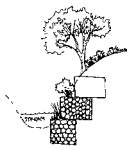


This gully continues to worsen as it meanders through this tidal area.

The soil immediately adjacent to the Rancocas Creek at this location is shown on the soil survey as Tidal Marsh (Mt). The characteristics of this soil type are highly organic silt flats near sea level that are flooded twice daily. It is a brownish material and has an average thickness of about three (3) feet. The native vegetation for tidal marsh areas is typically salt-tolerant grasses and sedges. In general, tidal marshes such as this are converting to open water/mudflat habitats, having lost most of their native vegetation to tidal effects and human influences. Urban land, sandy (Ug) is the soil type that surrounds the Interstate and consists primarily of cut and fill areas. Most of this land has been developed for residential, commercial, or industrial use or for multi-lane highways.

This site received a medium priority rating of 68. Even though the erosion existing at this site is currently not severe, it does pose a threat to both public property (drainage structures) and the local ecosystem.

Recommended Solutions:



Possible solutions to preventing additional erosion and repairing the existing problems would be to install a new drop structure that would not provide a mechanism for water to by-pass its proposed inlet. In addition, the water that the drainage system accepts should be discharged to a stable outlet. Therefore, a riprap or grassed waterway should be installed to finish taking the water down to the creek. This would dissipate the flow of water that would prevent erosion, and in addition, the grassed waterway would filter some of the non-point pollutants that come off of the impervious road surface. If possible, the removal of sediment in the tidal zone is also recommended.

Rancocas Woods Public Boat Launch

This site is a popular location for the launching and removal of recreational watercraft from Rancocas Creek.

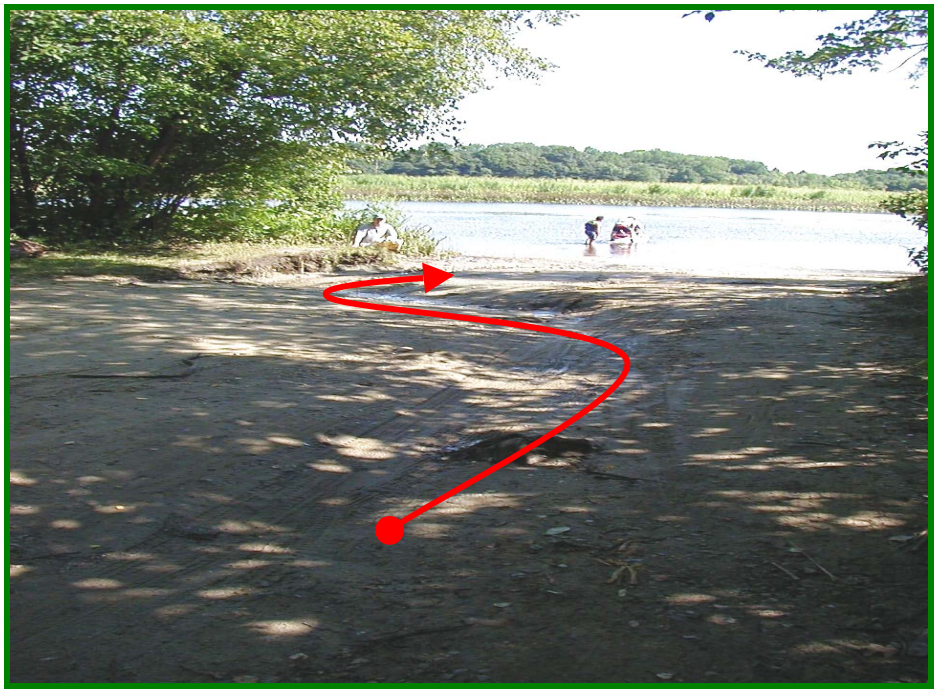
Site # 7: Rancocas Woods Public Boat Launch, Mount Laurel Township

Priority site Number Seven is nestled within the boundaries of Rancocas State Park on the South Branch of the Rancocas Creek. This site contains a pumping station for the adjacent in Rancocas Woods housing development that also functions as a public boat launching area because of its easy access from nearby roadways to the waterway.

District staff often used this launch site as it provided rapid access to the North Branch and to the main stem of the Rancocas Creek. Staff also noted that there was a high frequency of nearby residents launching wave runners, canoes, and other small watercraft. Conversations shared with these residents indicated that they often utilized this site as a launching area for their recreational watercraft.

Description of Site and Problem:

The launching area for this site consists of an unimproved roadway that gradually slopes toward Rancocas Creek. At the waters edge, glances up and down stream reveal beautiful and vast tidal



The arrow in this photograph delineates the gully that has formed due to upland runoff.

marshes that function as important feeding areas for migratory birds and other waterfowl such as wood ducks and blue heron. Hawks and some owl species hunt the marshes in winter.

The unimproved roadway appears to consist primarily of sand and gravel mixed fill material, and there is a small paved access way that serves as a transition point from the launching area to the paved roadways of the neighborhood. This paved transition area, however, is significantly lower in grade than the residential roadways, and therefore receives large volumes of stormwater runoff from the surrounding impervious roadways. The unimproved roadway then acts as a channel for the surface runoff, thus allowing sediment to wash directly into the creek. Gullies have formed in the unimproved roadway, and appear to expand with every storm event. The largest gully cuts directly across the launching area making it difficult to navigate trailers in tow down to the waterway, and it is currently so deep that it is unavoidable.

This site is also located within the tidal zone, and therefore there is some undercutting occurring along the immediate shoreline. The erosion can be easily seen during tide changes. This undoubtedly contributes to the sedimentation and various water quality problems that occur

Craig Fisher points out the native vegetation that thrives alongside the unimproved roadway.

within Rancocas Creek, and in addition impact the thriving nearby tidal marsh areas. This site was assigned a high priority ranking of 81 because of the heavy public use of the launch area and because access to the site facilitates any potential remediation efforts.

The Burlington County Soil Survey identifies this entire area as Tidal marsh (Mt), although a substantial amount of material has obviously been imported as fill to access the waterway. Salt-tolerant grasses and sedges, the native vegetation of tidal marsh soils, are highly noticeable throughout this site.

Recommended Solutions:

One possible solution is to install a more permanent structure for a boat launch. A paved concrete or asphalt access drive could be installed to prevent additional erosion of the unimproved roadway and this drive could also withstand heavy traffic unlike vegetative methods could. However, proper drainage must be installed in conjunction with any possible boat launch facility to address the excess stormwater runoff issues from the adjacent roadways.

The shoreline could also be repaired and protected through the installation of cylinder shaped coconut fiber rolls consisting of coconut fibers bound together with twine woven from coconut in conjunction with reed clump plantings and emergent native vegetation. These plantings are then trenched into the soil or placed directly into the coconut fiber roll. This method is highly effective where the water level fluctuates because it is able to protect the shoreline and encourage new vegetation. Once established, this method will promote beneficial and quality wildlife habitats while preventing further streambank erosion.

Rancocas State Park

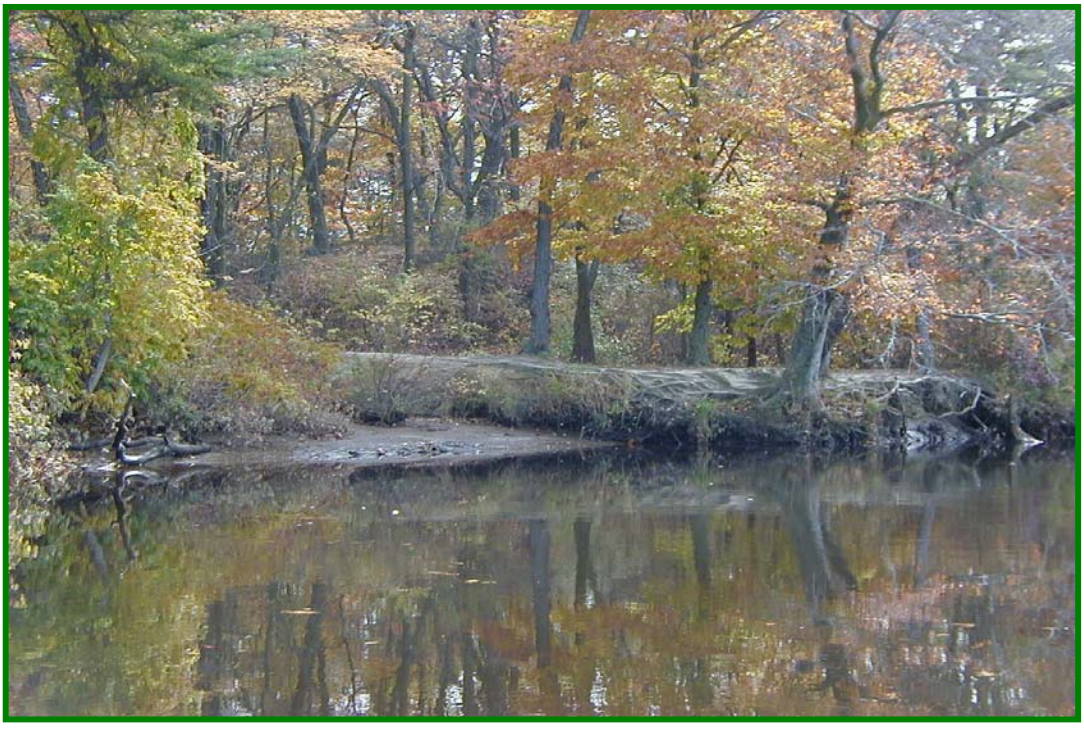
Tidal effects has caused moderate undercutting of the streambank and has compromised the stability of nearby trees.

Site # 8: Rancocas State Park, Hainesport Township

Rancocas State Park, with its wonderful nature trails and diverse ecosystems hugs portions of the Rancocas Creek and crosses many township boundaries. The park, often utilized by fisherman, hikers, bikers, and birdwatchers provides several unimproved roadways that facilitate access to the Rancocas Creek and its various recreational offerings. This site, located along the South Branch in Hainesport Township, is adjacent to one of the many unimproved roadways that meander through the park. It is highly visible to park visitors and to boaters on the waterway.

Description of Site and Problem:

The erosion problem at this site is caused primarily from tidal effects of the stream. This action has caused moderate undercutting of the streambank and has compromised the stability of several trees, including a large oak tree that precariously leans over the creek. When this tree collapses into the waterway, it will contribute to a significant amount of soil loss along the



Heavy foot traffic and poor vegetation of the area contributes to enhance the effects of erosion at this site.

streambank, and the tree itself will obstruct the waterway and restrict stream flow. This action could possibly be the catalyst to encourage further downstream erosion and provide a mechanism to facilitate the depositing of sediment.

Overland runoff also is a significant cause of erosion at this site. The nearby roadway provides a channel for stormwater to access the creek, and as a result has resulted in the creation of a small sediment pad along the shoreline. The vegetation in this area is very poor, and may be due to the heavy foot traffic that this area receives as well as the overland runoff. In addition, if a park visitor should improperly negotiate their footing along the shoreline, they may fall and injure themselves. Upon review of the existing conditions at this site, it received a medium priority rating of 68.

The soils located at this priority site belong to the Tinton series soils (TtB). Tinton soils are characterized as loose, fine sand. The TtB phase in particular is droughty and infertile. Due to these factors, these soils are highly susceptible to erosion, especially when vegetation is not present. The soil survey also identifies the presence of Pits series soil (Pt) that indicates that portions of this area were mined at some previous time. The vegetation existing at this location is pines, oaks, and hickories.

Recommended Solutions:

One possible remediation method would be to install coconut fiber logs in conjunction with reed clump plantings and emergent native vegetation. These plantings are then trenched into the soil or placed directly into the coconut fiber roll. This method is highly effective where the water level fluctuates because it is able to protect the shoreline and encourage new vegetation. Once established, this method will promote beneficial and quality wildlife habitats while preventing further streambank erosion.

Rancocas State Park

Looking across the creek from Winzinger's equipment yard, the undercutting of the shoreline can be easily seen.

Site # 9: Rancocas State Park, Hainesport Township

This first site was inventoried while conducting routine investigations on the South Branch just upstream of the split of the North and South Branch. It is located along the north bank within Rancocas State Park and is across the creek from Winzinger's equipment yard.

Description of Site and Problem:

Situated next to unimproved roadways and trails that wind their way through the park, this site is heavily wooded and is often used for recreational purposes such as hiking, fishing, biking, etc. It is also visible to boaters along the creek and to recreational visitors of Rancocas State Park. Like all areas, there are potential safety hazards to the general public by the forming of gullies in the soil and the exposing of tree roots along the shoreline and upland areas. As a result of the overall conditions, this site received a relatively low priority ranking of 49.

The soil type at this location is predominantly of the Tinton soils series, specifically Tinton sand, 5 to 10 percent slopes (TsC). These soils are commonly found in a narrow band alongside west-flowing streams such as the Rancocas Creek. This soil series is characterized as loose, fine sand that is low in organic matter and fertility. The TsC phase of this series is very susceptible to erosion when vegetative cover is removed, as demonstrated at this site.

Tidal effects and the current have contributed to the erosion occurring along shoreline.

The erosion occurring at this site overall is minor as most of the erosion appears to be the result of tidal effects. Some overland runoff from the nearby trails and roadways also contributes to the erosion problems occurring at this site. In the inter-tidal zone a sediment pad is beginning to form. There are some significant undercuts in other areas that are a result of the creek's flow.

Overland runoff also contributes to the erosive conditions.

Recommended Solutions:

One possible solution the District would recommend is the implementation of simple bioengineering methods to reduce the current rate of erosion and to prevent additional erosion in conjunction with a wildlife habitat improvement/educational project. This could be accomplished by installing cylinder shaped coconut fiber rolls consisting of coconut fibers bound together with twine woven from coconut in conjunction with reed clump plantings and emergent native vegetation. These plantings are then trenched into the soil or placed directly into the coconut fiber roll. This method is highly effective where the water level fluctuates because it is able to protect the shoreline and encourage new vegetation. Once established, this method will promote beneficial and quality wildlife habitats while preventing further streambank erosion.

- In addition, improving the roadways leading to the site should also be considered because it would facilitate access for recreational use, while not promoting over-use.

The Bridge at Route 38

Improper installation of outfall pipes has resulted in the undermining of this slope.

Site # 10: Outfall Pipes at Route 38 Bridge, Hainesport Township

Storm drainage systems are designed to collect rainwater from storm events and to direct that flow to areas that are capable of handling the increased volume of water. These areas are typically bodies of water, and the Rancocas Creek is no exception to receiving excess storm drainage from surrounding areas.

Description of Site and Problem:

This next priority site is a privately owned business situated along Route 38 immediately adjacent to a bridge that crosses over the South Branch Rancocas Creek. Drainage improvements have been fairly recently installed on this property and the surrounding area. Several outfall pipes originate from the parking area of the business and discharge into the creek. These outfall pipes, however, discharge at the top of a slope that is poorly vegetated and virtually unprotected from the effects of erosion. It appears that when these discharge pipes were initially installed, riprap was placed along the slope at the discharge point. This riprap, however, has gradually been covered by debris or has washed into the creek.

A multitude of protruding pipes and the failing condition of the slope can be easily seen in this photo.

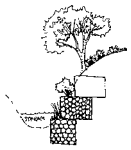
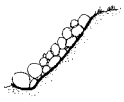
This site can be accessed both by boat and via the parking area of the business. There are several trees located between the parking area and the eroding slope, but they are spaced far enough apart to allow access to the site to implement any remediation efforts. The slope is 1:1 and it is approximately ten (10) feet from the top of the slope to the waters edge. The vegetation that does exist on the slope is woody in nature, but because this site is located at a bend in the creek and the creek is constricted by to the bridge's support structure, the current increases, and therefore contributes to the failure of any vegetation that could exist on the slope.

There also appear to be several pipes that previously conveyed the stormwater to the creek that have since broken and have not been fixed. The lack of maintenance of these outfall structures has exaggerated the erosion problem by forcing the creation of gullies and pushing the existing hard armor into the waterway.

The flow of the stream, the increased current due to the constriction of the creek, and the improper installation and maintenance of the drainage pipes have all contributed to the erosion of the streambanks. There are no drop structures present to take stormwater runoff directly into the creek instead of discharging it at the top of the slope, and the little riprap that did exist at this site now is inadequate to prevent the additional erosion of the slope and adjacent streambanks. It is highly probable that further erosion could cause damage to the property and eventually decrease its property value. The site rating was 63 or a medium priority due to the conditions that were noted during our investigations.

The soil type here appears to be predominantly Alluvial Loamy Land (Ao) and is characterized as consisting of stream deposits adjacent to meandering perennial streams that are subject to stream overflow. The soil survey represents that the Tinton series soil type (TsC) is also present at this location. This soil series is typically well drained and has a thick sandy surface layer over glauconitic fine sandy loam. The color of this soil is usually grayish-brown twelve inches deep and the underlying layers are mostly composed of sand material. This particular class of the Tinton series is highly susceptible to erosion. This factor is especially important when considering the focused concentrated flows present at this site.

Recommended Solutions:


The District would recommend that at least two methods of remediation be combined and implemented at this site. The first solution would be to install a drop structure that would take the overland runoff from the top of the slope directly into the creek. This would prevent any additional erosion of the slope.


The second remediation solution would address the toe erosion and streambank failure issues that exist at this site. Joint plantings or vegetated riprap could be installed. This involves tamping live stakes into joints or open spaces in rocks that have been previously placed on a slope. They can also be tamped into position at the same time that rock is being placed on the slope face. This method is effective where riprap is required or already in place and it dissipates some of the energy along the streambank. The roots improve drainage by removing soil moisture, and over time, joint plantings create a living root mat in the soil base upon which the rock has been placed. These root systems bind or reinforce the soil and prevent washout of fines between and below the rock.

Remediation efforts at this highly visible location would address an array of problems ranging from soil erosion and sediment control to common non-point source pollutants such as oils, grease, metals, and road salt.

Farm on Creek Road

This bench gives us some indication of this private landowners recreational value of Rancocas Creek.

Site # 11: Farm on Creek Road, Lumberton Township

This site is a privately owned agricultural operation located on the South Branch of the Rancocas Creek upstream of the Lumberton Landfill. Situated along the south bank, this site can be identified by a park bench near the shoreline while traveling on the creek. This location is not highly visible to the general public from any land areas although it is easily noticed by watercraft.

Description of Site and Problem:

Adjoining this site is a farm field that was planted with a soybean crop in the summer of 2000 whose landscape turns into a forested area and gently rolls toward the creek. During this transition, there is a trail large enough to accommodate vehicular traffic that also provides a channel for the runoff from the farm field. The site can be accessed by traversing the field or by boat. A bench along the shoreline indicates that this site is often used as a place to relax and to enjoy the scenic views provided by the creek's beautiful environment. It appears that the owner uses this site as a private boat launch. A large marshy area flourishes just downstream and adjacent to this site, which is home to various species of waterfowl, mammals and insects.

Undercutting of the shoreline and very little understory vegetation can be evidenced in this photograph.

At this location, there are sections of the streambank that have severe undercuts due to channel flow. Although the area is adequately forested, there is very little understory vegetation to prevent the gradual erosion of the trail. It does not appear, however, that a significant sediment pad has formed along the streambank at the base of the trail, although this sediment may travel further downstream settling in the marsh that was described above. A prevalent concern at this site is the possible pollution of the creek by agricultural runoff containing as pesticides and fertilizers. There are relatively few safety issues associated with this site. As a result of the conditions existing at this site, it received a low priority rating of 44.

This site lends itself to a variety of private recreational uses, but it is also apparent that this location is subjected to a wide range of erosive forces.

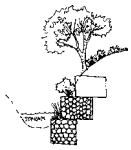
The soil type along the water's edge is characterized as Tidal Marsh (Mt), which are highly organic silt flats near sea level where they are flooded twice daily. It is a brownish material and has an average thickness of about three (3) feet. The native vegetation for those areas that are of the Tidal Marsh classification is salt-tolerant grasses and sedges. Although they do not appear to be present at this particular location due to the overland runoff, this natural vegetation thrives in the immediate areas surrounding this site. The upland area contributing to the erosion at this priority site consists of soils from the Freehold series. These soils, Freehold fine, sandy loam (FfE), 15 to 25 percent slopes, typically have steep, short slopes due to high erosive qualities. A

contributing factor to this problem is the lack of permanent vegetation that would control erosion and sedimentation into downstream areas.

The Wood Duck is one of the many waterfowl species that thrive around the Rancocas Creek.

Freshwater tidal marshes such as this are important feeding areas for migratory birds such as the red-winged blackbird, and waterfowl including the pintail, black duck, mallard and blue-winged teal. Hawks and some owl species hunt the marshes in winter. Many wood ducks were also noticed during our investigations. This ecosystem is also an important spawning and nursery area for anadromous fishes such as the alewife and blue-backed herring. Additionally, freshwater tidal marshes provide endless hours of recreational activities such as bird watching, nature study, hunting, and fishing.

Recommended Solutions:



One possible solution that the District would recommend is installing a series of diversions. These diversions are graded channels with a supporting ridge on the lower side and are constructed horizontally across the slope. At this location, a diversion could be installed at the transition of the farm field to the wooded area. Diversions should be constructed in a way that would not block vehicular access to the stream for the property owner.

 Bioengineering methods could also be implemented at this location such as placing coconut fiber rolls along the streambank to prevent any cutting away of the shoreline, and planting native, shade tolerant vegetation to protect the exposed soils on the trail and to prevent further erosion.

 Implementing a farm conservation plan on this site would also prove beneficial for both the owner/farmer and the Rancocas Creek. The owner/farmer would benefit by keeping his nutrient rich soil on his farm field while decreasing the sediment load into the Rancocas Creek.

Bobby's Run

This discoloration of water is indicative of an upstream erosion problem on Bobby's Run.

Site # 12: Confluence of Bobby's Run and South Branch Rancocas, Lumberton Township

The confluence of Bobby's Run and the South Branch Rancocas Creek is located near the intersection of Main Street and Municipal Drive in downtown Lumberton Township. Just downstream of Bobby's run, an old railroad bridge crosses over the South Branch. Although the problem was first noted during a canoe investigation, it was from this bridge that one can more easily see that sediment is being carried into the Rancocas from Bobby's Run.

Description of Site and Problem:

The shoreline surrounding the convergence of these two (2) appear to be stable and do not show signs of being undercut. In addition, the water typical to Bobby's Run is similar to that of the Rancocas: a fairly clear, but dark brown water.

The meeting of these two bodies of water can be clearly seen.

The only probable cause for the discolored water of Bobby's Run would be from a possible erosion source(s) upstream. There are many agricultural, commercial, and private land uses occurring along Bobby's Run. It is speculated that although a specific source of this sedimentation could not be located, the noted discoloration, however, is the result of many

ongoing land uses. In addition, it is possible that adjoining feeder streams have provided the vehicle in which sediment could travel into the South Branch Rancocas Creek.

Almost the entire length of Bobby's Run is surrounded by the Freehold Series soils. The Freehold soils consist of well-drained, sandy and loamy soils that have a moderately high or high available water capacity. The native vegetation is fast growing forest of red oak, white oak, scarlet oak, yellow-poplar, beech, and hickory. The two (2) varieties of Freehold soils that are located here are Freehold sandy loam, 2 to 5 percent slopes (FfB) and Freehold fine sandy loam, 5 to 10 percent slopes (FfC). Both these series soils are limited by runoff and susceptibility to erosion. Alluvial loamy land (Ao) can also be located within the vicinity of Bobby's Run and is typically characterized as consisting of stream deposits adjacent to meandering perennial streams that are subject to stream overflow.

This site was assigned a low priority rating of 45 as a result of not being able to pinpoint a specific source of erosion and that there are no significant downstream impacts of this siltation.

Recommended Solutions:

As a result of the undetectable nature of the discoloration of the water in Bobby's Run, it is recommended that a more in depth investigation of this tributary be conducted. These investigations may reveal independent sites along Bobby's Run that would benefit from general maintenance projects.

Agricultural Pumping House

This agricultural operation is designed to channel excess water to specific, low-lying areas.

Site # 13: Agricultural Pumping House, Lumberton Township

This agricultural operation is located on the South Branch Rancocas Creek in Lumberton Township. This business takes advantage of its proximity to the creek and pumps water from it to irrigate its nursery stock.

Description of Site and Problem:

During a canoe investigation, team members noted a channel discharging a significant volume of water into the South Branch Rancocas Creek. This water was moving at such a high velocity that it could be heard approximately 50 yards upstream. As a result, there is a significant sediment pad accumulating at the base of the channel and there are numerous other sediment pads further downstream.

Future land investigations revealed that this agricultural operation has graded its site so that the excess water from their irrigation operation drains to several inlets at the back of the site. The outfalls for these inlets are inadequately stabilized and have resulted in the above-mentioned gully as well as one other. The resulting gullies continue to worsen, as there are no stabilization measures in place to take the runoff to a stable outlet on the South Branch. The ensuing

This outlet discharges to an inadequately stabilized area at the top of a slope.

sediment pads are now diverting the flow of water, causing the scouring of the streambank and compromising adjacent trees. This series of events now causes a domino effect further downstream.

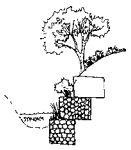
The Freehold Series soils are the predominant soil type at this location and consist of well-drained, sandy and loamy soils that have a moderately high or high available water capacity. The native vegetation is fast growing forest of red oak, white oak, scarlet oak, yellow-poplar, beech, and hickory. The two (2) varieties of Freehold soils that are located here are Freehold sandy loam, 2 to 5 percent slopes (FfB) and Freehold fine sandy loam, 5 to 10 percent slopes (FfC). Both these series soils are limited by runoff and susceptibility to erosion. The possibility of erosion can be reduced, however, by implementing standard Best Management Practices during land use.

This is the end of one of the gullies.

This site received a medium priority rating of 66 as a result of its commercial status and its minimal safety hazard to the members of the general public. However, the erosion is severe

enough to not limit this to a low priority and the property owners can easily implement a variety of best management practices to remedy ongoing erosion problem.

Recommended Solutions:



District staff has notified employees of the Natural Resources Conservation Service (NRCS) as to the erosion problem resulting from the location of the outfalls. It is recommended that the owners of this agricultural operation seek the assistance of NRCS to design a drainage system that will safely take their runoff to a stable outlet along the creek, as well as recommend which Best Management Practices would be best suited for the needs of this operation.



Another recommended solution would be to install gabion baskets or riprap throughout the length of the eroded channels to prevent the additional loss of soil due to runoff. The decision as to which method should be implemented should be based on an Attractive Stress Analysis. This analysis will aid engineers when determining whether installing gabions or riprap would be better suited to withstanding the environmental conditions that the channel is subjected to. Once a solution has been selected, then the chosen method should be installed the entire length of the channel to where it discharges into the creek.

Agricultural Land Near the Flying "W" Airport

This gully has been formed as a result of overland runoff from an adjacent farm field.

Site # 14: Agricultural Land Near the Flying "W" Airport, Lumberton Township

Just north of the runways of the Flying "W" Airport lie privately owned agricultural lands. To the west of these farm fields lies a forested area in which the Southwest Branch Rancocas Creek passes through it.

Description of Site and Problem:

A wooded area is suffering an erosion problem due to overland runoff from an adjacent farm field. The problem begins at the woods line and continues into the forested area for approximately 75 years. Two gullies exist at the border to the farm field and each gully exhibits some understory growth. The gullies eventually merge into one, where the slopes of the gully are steeper and are slightly undercut from the flow of water. To date, the gully has not traveled into the farm field.

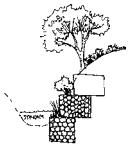
It appears that there is a reasonable amount of sediment being carried into the waterway at the base of the gully but there was not a noticeable sediment buildup in the creek. However, it is important to note that the water elevation on the day that this site was investigated was higher than normal due to a recent rainfall.

The gully as it approaches the Southwest Branch Rancocas Creek.

The Freehold series soils are predominant at this location. They typically consist of well-drained, sandy and loamy soils that have a relatively high available water capacity. They are also nearly level or gently sloping, but they have been known to exhibit steep slopes from time to time. The native vegetation is a fast growing forest of red oak, white oak, scarlet oak, yellow-poplar, beech, and hickory. Freehold sandy loam, 2 to 5 percent slopes (FfB) is present at this location. This soil type is limited by runoff and its susceptibility to erosion. The possibility of erosion can be reduced, however, by implementing standard Best Management Practices during land use. This site also hosts a Freehold fine sandy loam with 10 to 15 percent slopes (FfD). With soils of this type, runoff is rapid and the erosion hazard is severe. Erosion here can usually be controlled through vegetative stabilization measures.

This site was assigned a medium priority rating of 65 as a result of its existing conditions, risk to the public is low since it is privately owned, and that the Southwest Branch Rancocas Creek is not currently exhibiting any downstream problems.

Recommended Solutions:


It is recommended that a farm conservation plan be implemented on the agricultural land. This would provide the owner/farmer some guidance as to the BMP's that should be applied on this property. In addition, maintaining a vegetated buffer between the farm fields and the woods would serve to absorb some of the overland runoff that is directed toward this area.


Installing a drop structure that is designed to take the flow of water to a stable outlet should also be considered at this site. It would be recommended that riprap be placed at


the outfall of the storm drainage structure to dissipate the velocity of the water as well as prevent any additional erosion.


Bio-engineering methods should be installed. As stated previously, the existence of Freehold soils on this site makes it conducive to stabilization efforts as a means to prevent erosion.

Stormwater Outfall at Flying "W" Airport

These badly eroded outfalls receive stormwater from the Flying "W" Airport.

Site # 15: Stormwater Outfall at Flying "W" Airport, Lumberton Township

The Flying "W" Airport is a privately owned operation that provides many local flying enthusiasts with a place to store their planes and pursue their love of aviation.

Description of Site and Problem:

Just offsite of the Flying "W" Airport are two (2) stormwater outfalls that are located within several feet of each other. It is speculated that these storm drainage systems receive water from the runways at the airport where they discharge into a small feeder stream approximately 200 yards away from the Southwest Branch Rancocas Creek.

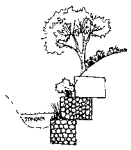
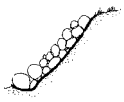
However, it appears that overtime, the velocity of water in conjunction with improper installation and stabilization at the outfall has created conditions where the outfalls have been undermining themselves and are now in a state of severe disrepair. In addition, the feeder stream is also in poor condition as its streambanks exhibit sheer slopes that are approximately one (1) to two (2) feet in height. It is anticipated that as the erosive conditions in the feeder stream worsen that it will negatively impact the forested area surrounding it as well as compound the sedimentation problems in the Southwest Branch Rancocas Creek.

The eroded nature of the feeder stream can be easily seen in this photo.

The Freehold series soils are predominant at this location. They typically consist of well-drained, sandy and loamy soils that have a relatively high available water capacity. They are also nearly level or gently sloping, but they have been known to exhibit steep slopes from time to time. The native vegetation is a fast growing forest of red oak, white oak, scarlet oak, yellow-poplar, beech, and hickory. Specifically, this site possesses a Freehold fine sandy loam with 0 to 2 percent slopes (FfA). In areas where the subsoil had been removed and the topsoil was replaced exhibits a lower available water capacity than what is typical for the series. In addition, it also hosts a Freehold fine sandy loam with 10 to 15 percent slopes (FfD). With soils of this type, runoff is rapid and the erosion hazard is severe. Erosion here can usually be controlled through vegetative stabilization measures.

This site received a medium priority rating of 61 as a result of the following conditions: The proposed project area is heavily wooded making access to the site limited; and since the site is located on private property, the safety risk to the general public is low. However, the long-term effects of this erosion problem increase the immediate need to repair the storm drainage structures and stabilize the outfall and the banks of the feeder stream.

Recommended Solutions:


It would be recommended that a new storm drainage system and outfall be installed at this location that specifically designed to adequately accommodate the volume of drainage that this system currently accepts.

In addition, to ensure the success of the newly installed storm drainage, the outfall and banks of the feeder stream need to be properly stabilized to withstand the discharges of the upland storm runoff. This can be achieved through the installation of a rip rap pad or channel that would dissipate the flow of water upon initial impact into the feeder stream.

It would then be prudent to implement bio-engineering methods throughout the length of the feeder stream that would improve the downstream erosive conditions and the overall health of the water quality. This would also provide a suitable habitat for wildlife and would blend in with the surrounding environment. Live stake plantings should be installed at this site since it would stabilize the banks quickly and it would be a lasting improvement.

Church Road & Fostertown Road

A sediment pad can be easily observed from Church Road in Medford Township.

Site # 16: Church Road & Fostertown Road, Medford Township

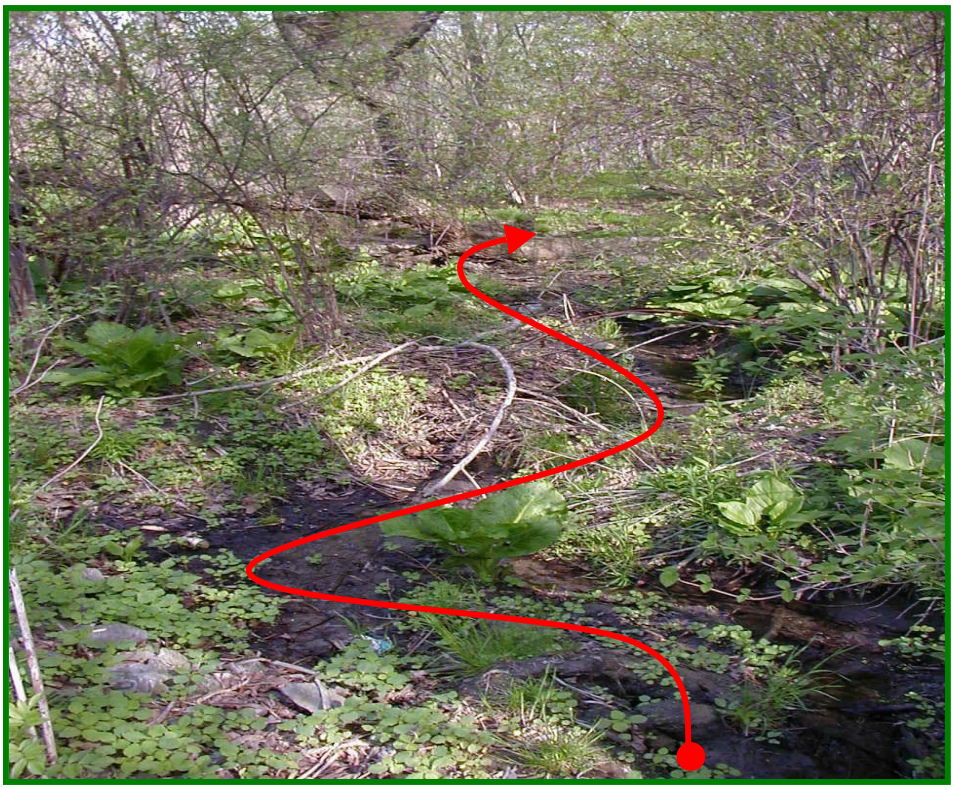
This site is located in the Southwest Branch of the Rancocas Creek upstream of the intersection of Church and Fostertown Roads. This portion of the Southwest Branch passes behind residential homes and near historic buildings as it meanders through Medford Township.

Description of Site and Problem:

Easily noticeable from Church Road, a sediment pad has formed upstream of this location. The sediment pad is very large and is overgrown with some weedy vegetation.

There are several different soil types existing at this location. They include Alluvial Loamy Land (Ao) and is characterized as consisting of stream deposits adjacent to meandering perennial streams that are subject to stream overflow; Pemberton Series (PbA), sand zero to five percent slopes, in which the Pemberton series consists of nearly level or gently sloping soils that have a thick, very sandy surface layer. In addition, they are mostly well drained with some areas of poor drainage, and the surface layer is composed of loose sand and is subject to soil blowing. They are often low in organic matter, and therefore, low in fertility. There also exists at this site the Freehold series, fine sandy loam two to five percent slopes (FhB). The Freehold soils consist of well-drained, sandy and loamy soils that have a moderately high or high available water capacity. The native vegetation is fast growing forest of red oak, white oak, scarlet oak, yellow-poplar, beech, and hickory. The Freehold series soil is limited by runoff and is susceptible to erosion. The possibility of erosion can be reduced, however, by implementing standard Best Management Practices during land use

This site lies downstream of many agricultural and residential lands. It is speculated that the sediment pad was created in part due to erosion during the implementation of other land uses over time. In addition, the curvature of the stream at this location, in conjunction with the widening of the body of the creek and an existing dam, has created ideal conditions for sediment deposition. It is possible that adjoining feeder streams have provided the vehicle in which sediment could travel into the Southwest Branch Rancocas Creek.



A feeder stream such as this can facilitate the transportation of silt to a large water body, as well as cause eroding conditions in other parts of the watershed.

This site received an low priority assessment rating of 46 because the erosion is not severe and access to the site is limited. In addition, the sediment entering the creek does not appear to be causing erosion problems downstream due to the location of the dam, but is likely to be causing problems to the aquatic ecology of the creek and the stream itself.

Recommended Solutions:

It is recommended that routine maintenance of best management practices be encouraged as well as implemented on those agricultural and commercial land disturbing ventures that occur along the Rancocas Creek. It is also suggested that the sediment bar be removed, in part to improve the aesthetics of the environment, but also to prevent further constriction of the waterway in which water may pass into the flood plain.

It is also recommended to implement soil and water education classes for all land developers, both agricultural and commercial in nature. In addition, the general public may also benefit from such education as well as from receiving information about watersheds and watershed health.

Rancocas State Park

This drainage pipe allows concentrated stormwater flows to leave the New Jersey Turnpike and create offsite erosive conditions.

Site # 17: Rancocas State Park Turnpike Drainage Corridor, Westampton Township

This site is located within Rancocas State Park along an unimproved roadway. It may be accessed from a paved roadway that runs perpendicular to the Westampton Township Middle School.

Description of Site and Problem:

Rancocas State Park provides many opportunities for the public to enjoy nature. The varying landscape also allows for owners of all-terrain vehicles to take advantage of the open space that the park possesses.

The Freehold Series soils are the predominant soil type at this location. The Freehold soils consist of well-drained, sandy and loamy soils that have a moderately high or high available water capacity. The native vegetation is fast growing forest of red oak, white oak, scarlet oak, yellow-poplar, beech, and hickory. The two (2) varieties of Freehold soils are Freehold sandy loam, 2 to 5 percent slopes (FfB) and Freehold fine sandy loam, 5 to 10 percent slopes (FfC). Both these series soils are limited by runoff and susceptibility to erosion. The possibility of erosion can be reduced, however, by implementing standard Best Management Practices during land use. There is also the presence of a Holmdel series soils which is Holmdel fine sandy loam, 2 to 5 percent slopes (HdB). This soil type consists of moderately well drained to somewhat poorly drained loamy and sandy soils, and tend to have a reasonably high seasonal water table. Drainage is the main limitation to the use of this soil, but there is also a hazard of erosion.

The severe erosive conditions at this site are due largely in part to the runoff due to concentrated stormwater flows originating from the New Jersey Turnpike right-of-way. In one particular area, a large, cavernous ravine has formed. Over the past five (5) years, sediment deposition has been occurring into Rancocas Creek as a result of ongoing erosion in the ravine. Gas and oil pipelines are also located within and under this ravine.

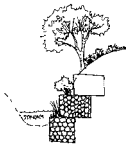
The existence of this ravine has restricted vehicle passage to other areas of Rancocas State Park that offers recreational opportunities to local fishermen. This area also serves as an attraction for

owners of four-wheel drive vehicles, helping to further aggravate erosive conditions that are present. In addition, the site's proximity to the New Jersey Turnpike and accessibility to the public has resulted in a large amount of debris and other waste being thrown into the ravine.

Due to the site's proximity to the Turnpike, this ravine plays host to a great deal of litter and debris such as car tires.

As a result of the overall site conditions, this site received a medium priority ranking of 73. Although erosion is a serious problem at this site, access is not limited and the welfare of the general public is not at high risk. However, there may be high costs associated with repairing the erosive conditions at this site due to the existence of gas and oil pipelines.

Recommended Solutions:



As a result of the concentrated flows, this will require engineering structures and/or armament to safely convey these flows to a stable outlet. A project of this nature may be able to be funded under Federal Transportation funds.

Rancocas State Park Farm Fields

These gullies have been created as a result of overland runoff from the adjacent farm fields.

Site # 18: Rancocas State Park Farm Fields, Westampton Township

This site, located in Rancocas State Park, can be found along an unimproved roadway that runs perpendicular to Westampton Township Middle School. This roadway appears to be moderately traveled as the park provides many recreational opportunities for Burlington County residents. The erosion problems that exist here are located beyond the second field border on the left of this roadway.

Description of Site and Problem:

Rancocas State Park is a popular location for local fishermen to access Rancocas Creek, but it allows for owners of sport utility vehicles to enjoy the vast amount of open space the park possesses. The farm fields, which are the subject of this priority site, also provide a food source for the many deer that thrive in the area.

The Freehold Series soils are the predominant soil type at this location. The Freehold soils consist of well-drained, sandy and loamy soils that have a moderately high or high available water capacity. The native vegetation is fast growing forest of red oak, white oak, scarlet oak,

The beginning of the second gully that also impacts a nearby wetland area.

yellow-poplar, beech, and hickory. The two (2) varieties of Freehold soils that are located here are Freehold sandy loam, 2 to 5 percent slopes (FfB) and Freehold fine sandy loam, 5 to 10 percent slopes (FfC). Both these series soils are limited by runoff and susceptibility to erosion. The possibility of erosion can be reduced, however, by implementing standard Best Management Practices during land use.

The erosion at this site is being created from overland runoff from the farm fields. There are two (2) gullies in question at this location. It appears that the gullies merge together after they travel into the woods, and eventually join a feeder stream of the Rancocas Creek. This feeder stream then joins the North Branch Rancocas Creek, just upstream of the confluence of the North and South Branches.

This is the beginning of the larger gully after the emergence of the two upland gullies.

As a result of the overall conditions existing at this site, it was assigned a medium priority rating of 69. This was due to the potentially serious erosion problem that would occur at this site if the erosion would be allowed to continue, but it can be easily repaired since the site is very accessible.

Recommended Solutions:





The gully should receive hard armor in the form of vegetated gabion structures and riprap. These erosion control measures would provide the most stability for the gully. In order to


safely install the gabion structures, the loose saturated material would need to be removed and replaced with a more compacted material to help provide stability for the structures. The gabions could then be installed along the sides of the gully and live branch cuttings could then be inserted between, in, or around the gabion baskets.


The rock riprap could be placed at the base of the gully to help dissipate the flow of water during storm events. The added vegetation provided by the vegetated gabion structures would not only provide extra stabilization but it would provide an excellent cover for birds and other wildlife.


A farm conservation plan should be sought and implemented at this site. In addition, actively planting this site with a crop in conjunction with agricultural Best Management Practices could also reduce the rate, if not prevent erosion at this site. It would be recommended that the USDA Natural Resources Conservation Service be consulted for the most plausible solutions.

Rancocas State Park

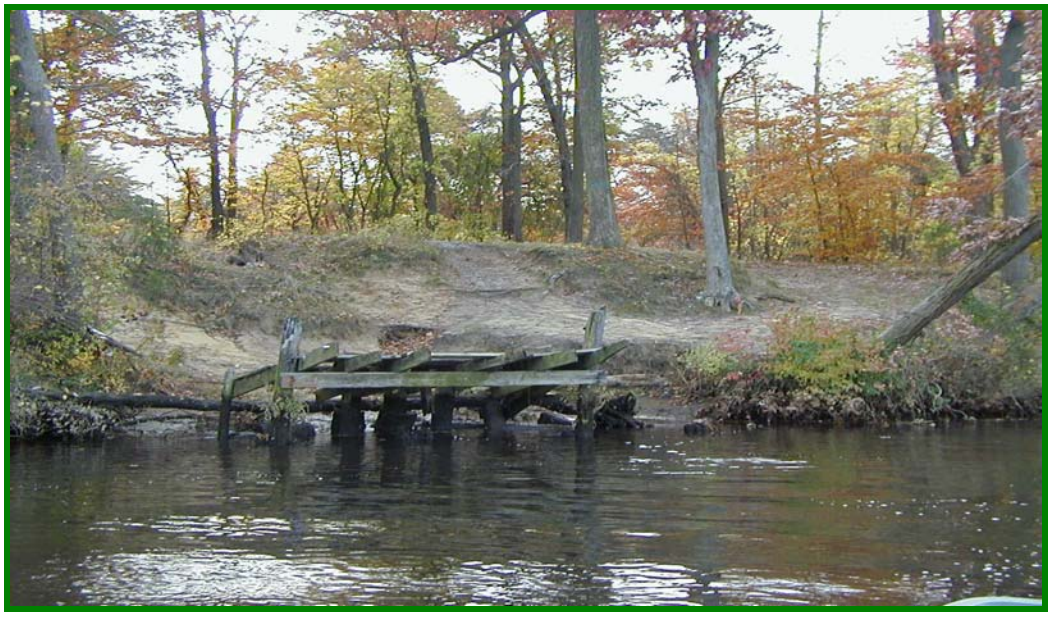
This old, decrepit dock indicates that this site used to be a very popular recreation area.

Site # 19: Rancocas State Park, Hainesport Township

Located along the North Branch on the Rancocas Creek in another section of Rancocas State Park is an area that appears to have once been used as an area to go swimming and fishing. It is easily recognized from the water, as there is an old, severely deteriorated dock present. This site can be accessed by using the many foot trails that are found throughout the park. This area is heavily wooded and located at a sharp bend in the creek.

Description of Site and Problem:

There is extensive erosion occurring along the streambank at this site, and it appears that this erosion is resulting from stormwater runoff from upland areas into the creek. Heavy foot traffic at this site also plays and important role in the erosive conditions that exist here. The landscape has approximately 3:1 slopes that run along the shoreline, and the overland flow has created several significant gullies. In addition, there is no vegetation present on this steeply sloping area to slow the flow of water into the creek or to prevent the erosion of the slope, therefore allowing the lost soil to be deposited as sediment further downstream. The water at this location, however, is approximately five (5) feet deep at any given time. The tide also is a significant contributor to the severely eroded conditions, bare slopes, and falling trees that are present at this



The fluctuating tide, exposed slopes and high usage all contribute to the erosive conditions that exist at this site.

site. The overall site conditions in conjunction with the high usage of the site generated a high priority rating of 78.

The soils present at this location belongs to the Tinton series soils, specifically the sands phase denoted as "TtB". The Tinton sands have a thick surface with 0 to 5 percent slopes. It is well known for being highly erosive due to its fine sand content and droughtiness. These factors are compounded by the bare soil condition of this priority site. Trees that typically thrive in the Tinton series soil type are Virginia Pines, oaks, and hickories.

Recommended Solutions:

One suggested solution for the eroding conditions noted at this site would be to remove the existing dock and install brushmattress. Brushmattress is a combination of live stakes, live fascines, and branch cuttings that is installed to cover and stabilize streambanks. The application of the brushmattress typically starts above stream-forming flow conditions and moves up the slope. It provides an immediate, protective cover over the streambank and is most useful on steep, fast-flowing streams. In addition, brushmattress captures sediment during flood conditions and not only rapidly restores riparian vegetation and streamside habitat, but it enhances conditions for the colonization of native vegetation.

Because this location is appears to be used as an area for residents and park visitors to go fishing and enjoy the scenic views along the Rancocas, it is suggested that the existing wooden dock be replaced with a new dock. This dock should have a railing so it may discourage people from diving into the creek, especially during low tide. The replacement of the dock would provide an excellent location for various recreation activities on the creek.

Rankokus Indian Reservation

Along the shorelines of the Rankokus Indian Reservation eroded slopes can be easily seen.

Site # 20: Rankokus Indian Reservation, Rancocas State Park, Westampton Township

This site is situated along the scenic North Branch of the Rancocas Creek and it is adjacent to one of the many nature trails that meander through the Rankokus Indian Reservation that is part of Rancocas State Park. This location is a favorite spot for many recreation seekers because of the area's beauty and because of the diverse waterfowl and wildlife that inhabit the region.

Description of Site and Problem:

Easily noticed from the waterway in part because it can be found at a 90-degree bend in the creek's channel, this site is easily recognized by sheer cliffs with some sediment base and very little vegetation. The nature trail that leads to this site runs right along the cliffs. The dramatic curvature of the creek's flow pattern contributes, in part, to the gradual erosion of the cliffs because the channel flow is most erosive at the outside of the bend. In addition, this section of the North Branch is tidal, therefore subjecting the streambank to even more erosion due to tidal effects.

The nature trails, as well as, the sheer cliffs and exposed tree roots that are present at this site can be easily seen in this photograph.

As the stream flows continue to erode the toe of the slope, the upper bank becomes compromised and sloughs off into the waterway. Eventually the trees and understory plants begin losing their stability along the streambank, fall into the water, float downstream, and sink, thus becoming hidden obstructions for boaters on the creek. The eroded area extends approximately 50 to 100 feet along the shoreline and the cliffs are approximately eight feet high. Overland runoff from the nature trails have created some gullies that make their way down to the streambank. Due to the volume of visitors to this area of the park, and the proximity of the trail to the cliffs, the potential safety hazard is increased. In evaluating the various issues for this site, it was determined that this site has an overall rating of 78 or high priority.

Installing appropriate stabilization methods at this site would assist in buffering the streambank against the current while continuing to support the wildlife present on this land.

At the waters edge the soil type is characterized as Tidal Marsh (Mt) which are highly organic silt flats near sea level that are flooded twice daily. It consists of a brownish material and has an

average thickness of about three (3) feet. The native vegetation for tidal marsh areas is salt-tolerant grasses and sedges. Found upland from the waters edge is Klej soils. They are gently sloping, sandy soils that tend to be moderately well drained to poorly drained and usually form on terraces. Klej soils consist of an equal amount of clay and sand in the surface layer unlike most other sandy soils. Although they are somewhat acidic, they are subject to wind and water erosion if there is no vegetative cover.

Recommended Solutions:

One possible solution the District recommends is the use of dormant post plantings or live stake plantings. These proposed methods have a high success rate and are self-repairing. The dormant post planting would begin with the selection of the proper species and then cutting live posts between seven and nine feet long and three to five inches in diameter. The basal end should be tapered and then driven into the ground one-half to two-thirds of the length. The posts would be placed in two or more rows along with any other soil bioengineering system to supplement them.

If live staking is implemented, the posts are not required to be as large as the dormant post plantings. The stakes are generally 0.5 to 1.5 inches in diameter and two to three feet long. They also should be tapered at the basal end to facilitate driving them into the ground. All side branches are cleanly removed and the top cut square. These are then driven into the ground with a dead blow hammer, which helps prevent the stake from splintering when hit.

These methods could provide the necessary means to buffer to the stream flow and continue to support the wildlife present on this land. Either of these methods would most likely require additional excavation of the slope. To gain access for the machinery, the removal of some trees in the existing forest would be necessary. This is a drawback, however a replanting effort could sufficiently repair the damage.

Smithville Park Dam

The Smithville Dam is nestled within a diverse and historical environment.

Site # 21: Smithville Park Dam, Eastampton Township

The North Branch of the Rancocas Creek meanders through Burlington County owned Smithville Park. This is a very popular recreational site for Burlington County residents in that tours sponsored of the historical Smithville Mansion, and the vast wooded area nearby provides excellent opportunities for hiking, nature walks, canoeing, and general relaxation. A dam, most commonly called the Smithville Dam, is located on the North Branch, and can be most easily accessed by utilizing unimproved roadways that originate off of Smithville-Jacksonville Road.

Description of Site and Problem:

Slightly downstream from the Smithville Dam, a large sediment bar has formed. This sediment bar appears to originate, in part, from the scouring effects of the turbulence caused by flows over the dam. This sediment bar, although well vegetated with a variety of native plant species, has altered the stream flow on the North Branch, promoting additional erosion and the sedimentation of other areas further downstream. There is evidence of another sediment pad forming along the wall adjacent to the recently improved canoe portage. The main sediment pad, however, is undercutting the streambank farther downstream. Review of the existing conditions resulted in a medium priority rating of 63.

This sediment bar, although well vegetated with a variety of native plant species, has altered the stream flow on the North Branch.

Alluvial Loamy Land (Ao) is the prevalent soil type at this site and is characterized as consisting of stream deposits adjacent to meandering perennial streams that are subject to stream overflow. In addition, it often has a high water table and is subject to flooding. The native vegetation that tends to thrive in Alluvial loamy land are yellow-poplar, red oak, pin oak, white oak, willow oak, sweetgum, red maple, beech, elm, and river birch. Most species of which can be seen while canoeing this heavily wooded stretch of Rancocas Creek.

Sections of shoreline at this location have been undercut as a result of stream flow and the gradually changing course of the creek.

Recommended Solutions:

District recommendations for the remediation of this site at the Smithville Dam is that further investigation and monitoring of this area should be done before any remediation work is considered. The stream dynamics would have to be examined to determine if there are erosion

problems being caused downstream. Monitoring any wildlife that may inhabit the sediment bar or inhabit it in the future would also be necessary. Lastly, an assessment of the overall ecological impact of removing or not removing the sediment bar would be critical.

Smithville Park Ravine & Nature Trail

This ravine is compromising trees and affecting the overall habitat of the area.

Site # 22: Smithville Park Ravine and Nature Trail, Eastampton Township

The village of Smithville is a significant historical, cultural, and recreational asset not only for Burlington County, but for the entire southern New Jersey region. The site encompasses over two hundred acres of land ranging from vast forested areas to rich agricultural lands.

Description of the Site and Problem:

Within the forested area of this site is a nature trial that can be found adjacent to the agricultural fields. However, use of this nature trail has been restricted due to the severe erosion occurring as a result of runoff from the farm fields. Two footbridges had been previously installed to facilitate access to this scenic and diverse nature trail, but they have recently been closed due to safety concerns relating to the worsening erosion problems.

The stability of this footbridge has been compromised as the underlying ravine worsens due to the ongoing erosion.

The wooded area including the ravine consists of Freehold soils, particularly Freehold fine, sandy loam (FfE), 15 to 25 percent slopes, and typically have steep, short slopes due to high erosive qualities. A contributing factor to this soil's erosive qualities is the lack of permanent

vegetation that would control erosion and sedimentation into downstream areas. The upstream adjacent agricultural lands consist of both Adelphia and Collington soils. The Adelphia soils here are fine sandy loam, 0 to 2 percent slopes (AaA). They possess a slow to moderate permeability and contain a moderate organic matter content and reasonably high rate of natural fertility. Crops grown on Adelphia soils include small grains, corn, soybeans, etc. The Collington soils located here are well-drained, loamy soils with 0 to 2 percent slopes (CoA). Its surface layer contains a little more clay and less sand, and is suited to all crops grown in the area.

The erosion problem at this site begins at the woods line and progressively deteriorates as it continues into the forested area. The ravine is so large that is has slopes that are approximately 20 feet in height, and at some points, exceeds 15 feet in width. As the erosion continues to worsen with each new rainfall due to unrestricted runoff from the farm fields, the ravine is

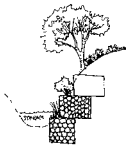
The severity of the ravine can be clearly evidenced in this photograph.

gradually beginning to invade the farm field itself. This ravine gradually feeds into the North Branch Rancocas Creek.

The beginning of the ravine near the border of the farm field.

This site received a high priority rating of 75 due to the high rate of erosion, the impacts that such severe erosion would have on the overall health of the Rancocas Creek, and the increased potential for personal injury to the visitors of the nature trail.

Recommended Solutions:



The Burlington County Soil Conservation District has received a grant from the New Jersey Department of Environmental Protection to develop and implement conservation measures on the agricultural field that will curb the erosive factors that have been impacting the forested area, as well as provide well designed engineered solutions that would take storm runoff to a stable outlet and prevent any additional headward erosion of the ravine. Several solutions have

currently been proposed with the assistance of the USDA Natural Resources Conservation Service.

Several of the proposed remediation items to repair the existing erosion problems at Smithville is to install a diversion berm in the farm field where the runoff will be channeled single drop structure. It is the intention of District, NRCS staff and engineers to direct this runoff to a more stable outlet on the North Branch Rancocas Creek.

A farm conservation plan is also being proposed at this site that would include contour farming and/or crop rotation. Both of these techniques are proven methods to reduce erosion problems. In addition, a buffer strip of at least thirty feet in width is also proposed along the woods line. Implementation of the farm conservation plan has commenced and the best management practices are scheduled to be installed.

Once all the proposed repairs have been completed, this site will offer many historical and recreational opportunities to visitors. In addition, this site will also be an educational center that will be able to adequately highlight a variety of conservation issues such as watershed health, soil and water conservation, wildlife habitats, and the benefits of implementing best management practices on agricultural lands.

Current Land Use Shown Through Aerial Imagery

The following maps have been created using ArcView 3.2 software with the assistance of personnel from the Burlington County Data Processing Office. As stated earlier, a GPS unit was utilized to pinpoint the exact location of each potential priority site. On these maps, each site has been labeled in a color that designates its assigned priority rating. The coding is as follows:

High Priority - Red
Medium Priority - Yellow
Low Priority - Green

In addition, 1995/1997 aerial photographs taken by the State of New Jersey were used as the base to compile these land use maps. In these aerial photos, the 1997 flight information was used to make to corrections to those photos taken in 1995. The overlying data, which included land use/land coverage information and municipal boundaries, was downloaded from the New Jersey Department of Environmental Protection's database.

The legend for the various land uses is as follows:

- Orange - Urban land that includes residential and commercial development
- Yellow – Barren land that is not suitable for vegetative growth
- Green – Deciduous forest whether it is part of a park or open space
- Blue – Tidal Wetlands that are freshwater wetlands found usually within the flood plain of the water body

Townships and their municipal boundaries have been delineated in red.

Overview of Priority Points in the Rancocas Creek Watershed

Legend

Priority Rating
- High
- Medium
- Low

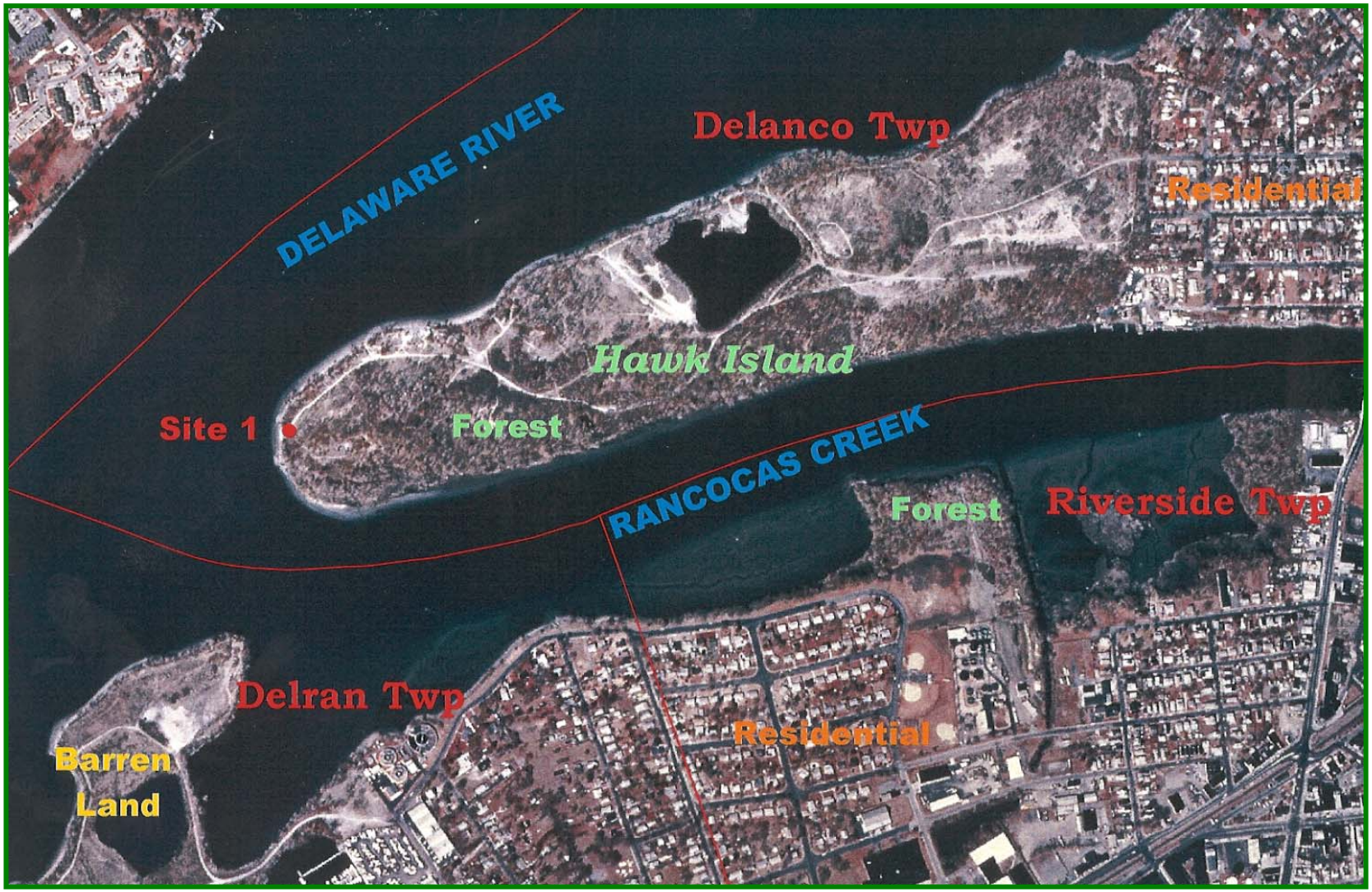
Lake/ River
Stream
Major Road
Township Boundaries
Pinelands Boundary
Watershed Management Area 19

N
W E
S

1 0 1 2 Miles

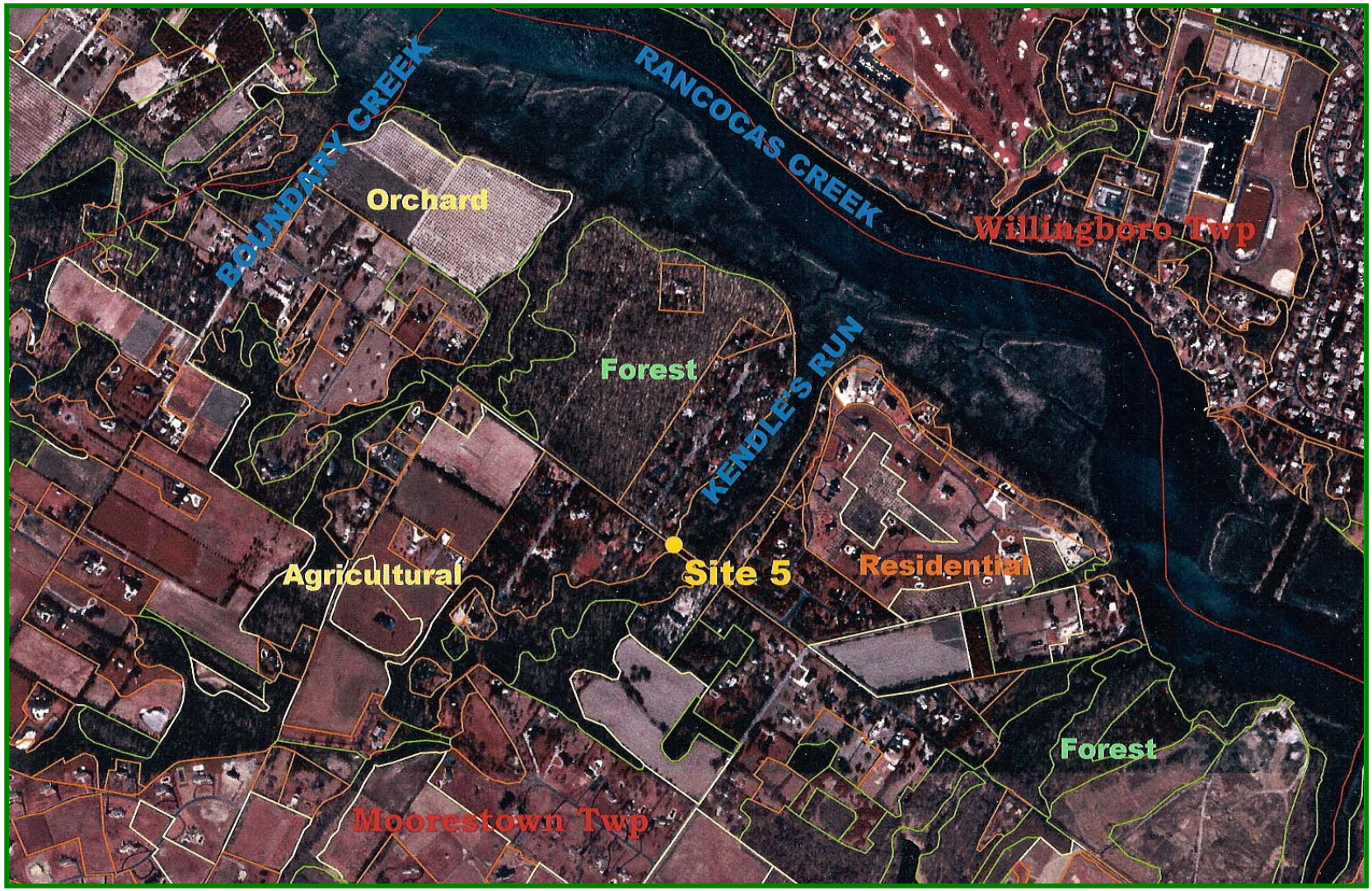
Map created by the Burlington County
Soil Conservation District

Data Sources:
Burlington County Data Processing Office, GIS Division - Roads
NJDEP - WMA Boundary, Stream, River
Burlington County Engineer - Municipal Boundary
Pinelands - Boundary

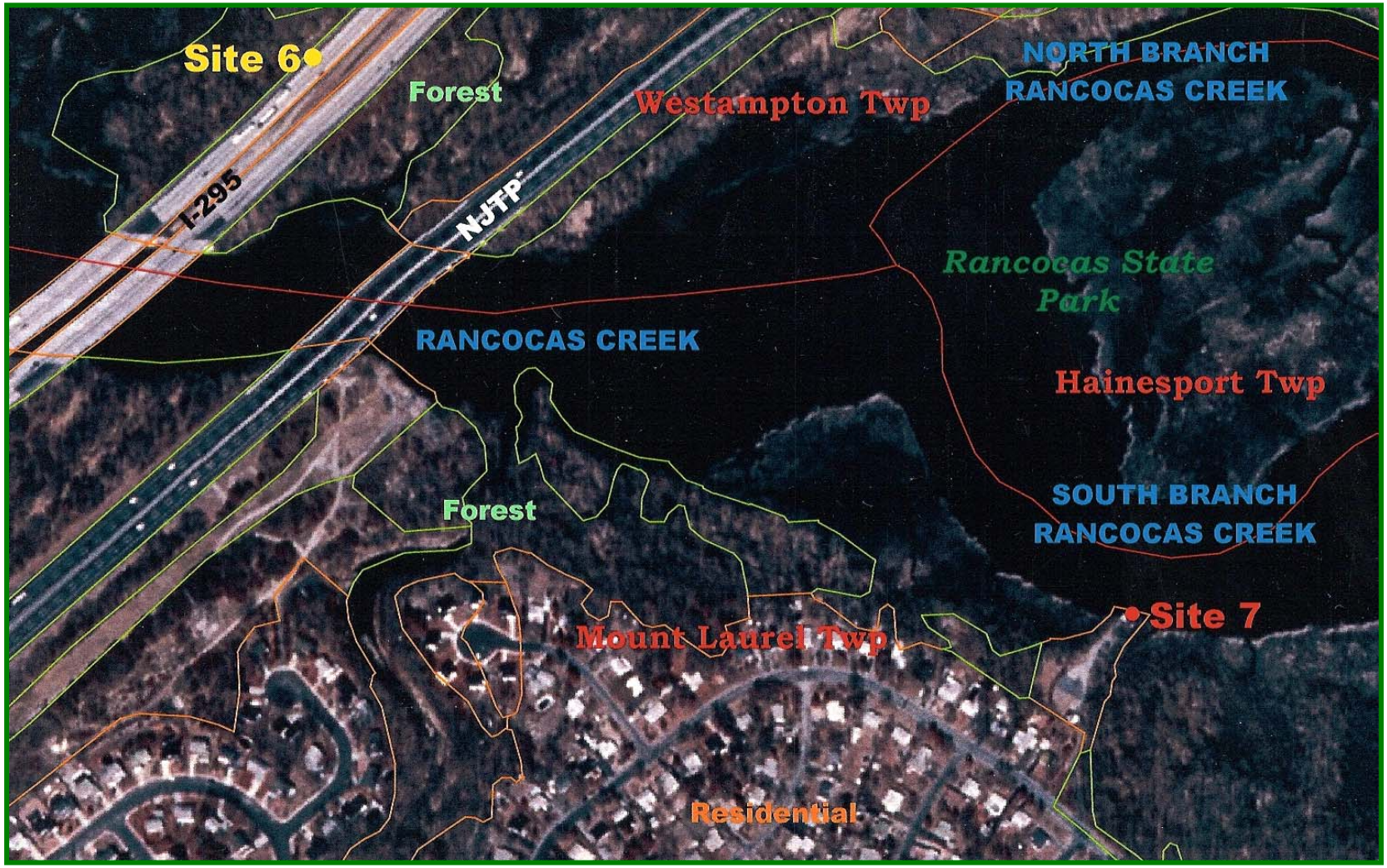


Site # 1: Hawk Island, Delanco Township

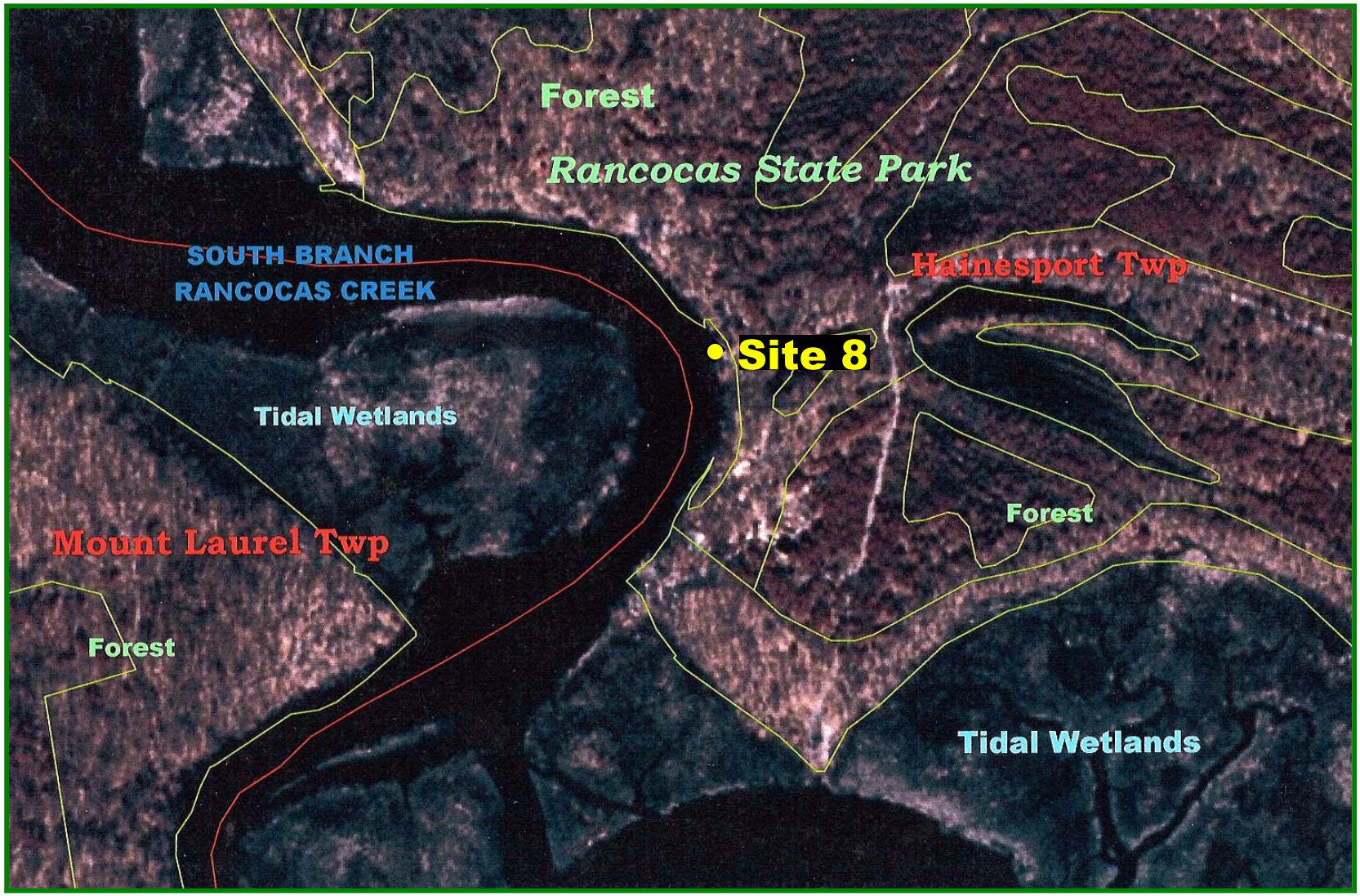
Site # 2: Mill Creek Park, Willingboro Township
Site # 3: Mill Creek Park, Willingboro Township
Site # 4: Upstream of Rancocas Road Bridge, Willingboro Township



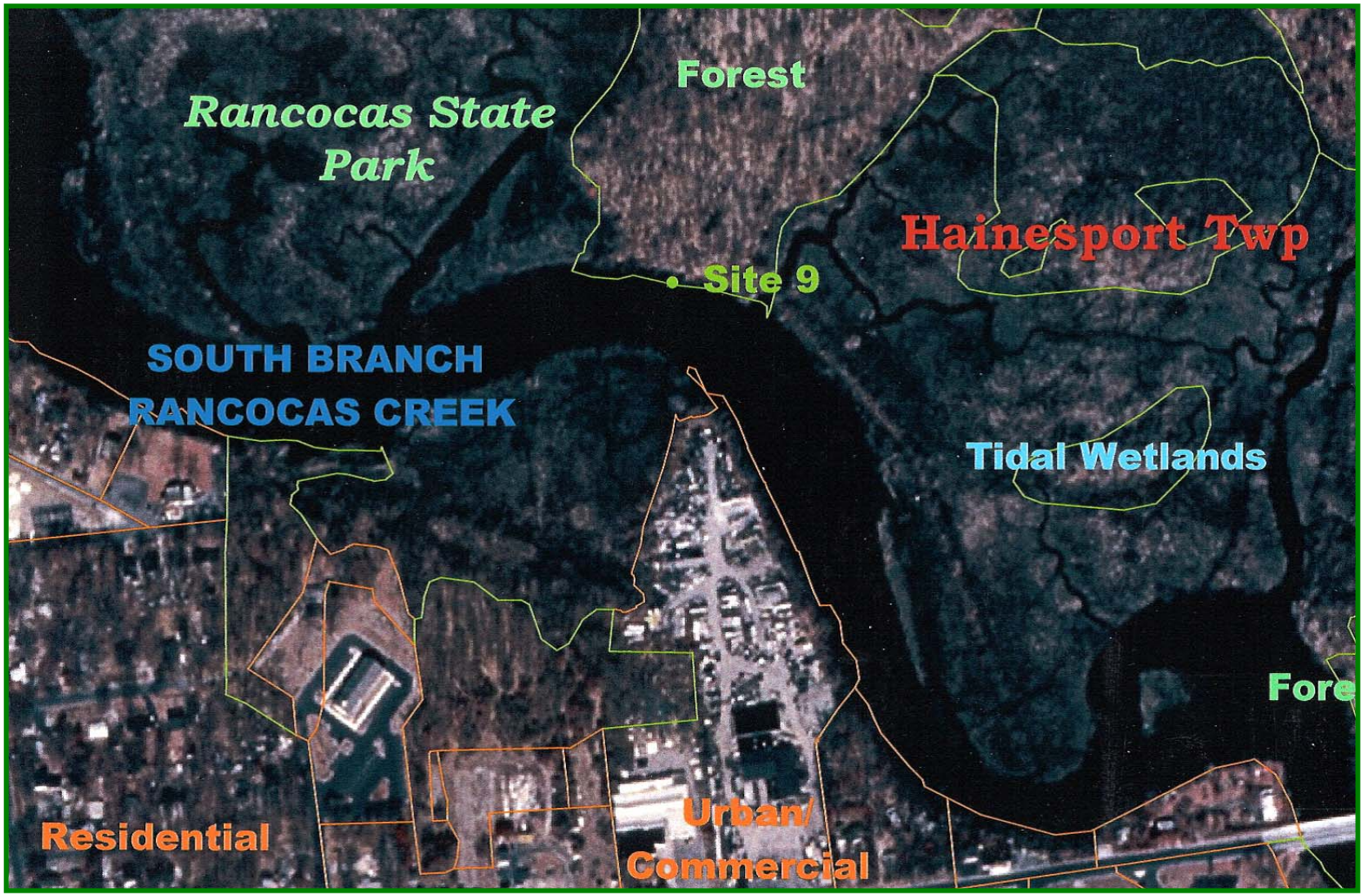
Site # 5: Creek Road at Kendle's Run, Moorestown Township



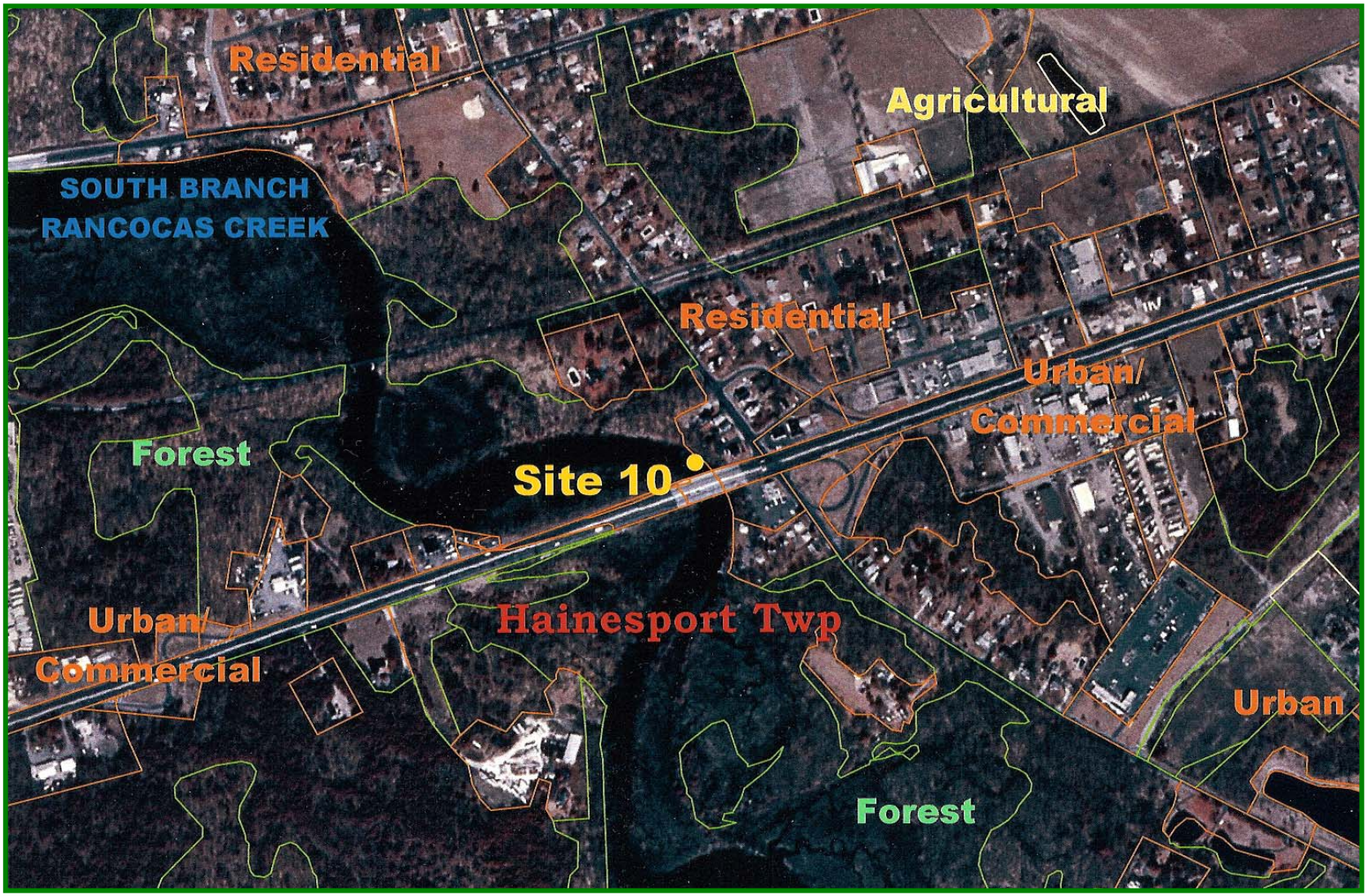
Site # 6: I-295 Stormwater Outfall, Westampton Township
Site # 7: Rancocas Woods Public Boat Launch, Mount Laurel Township



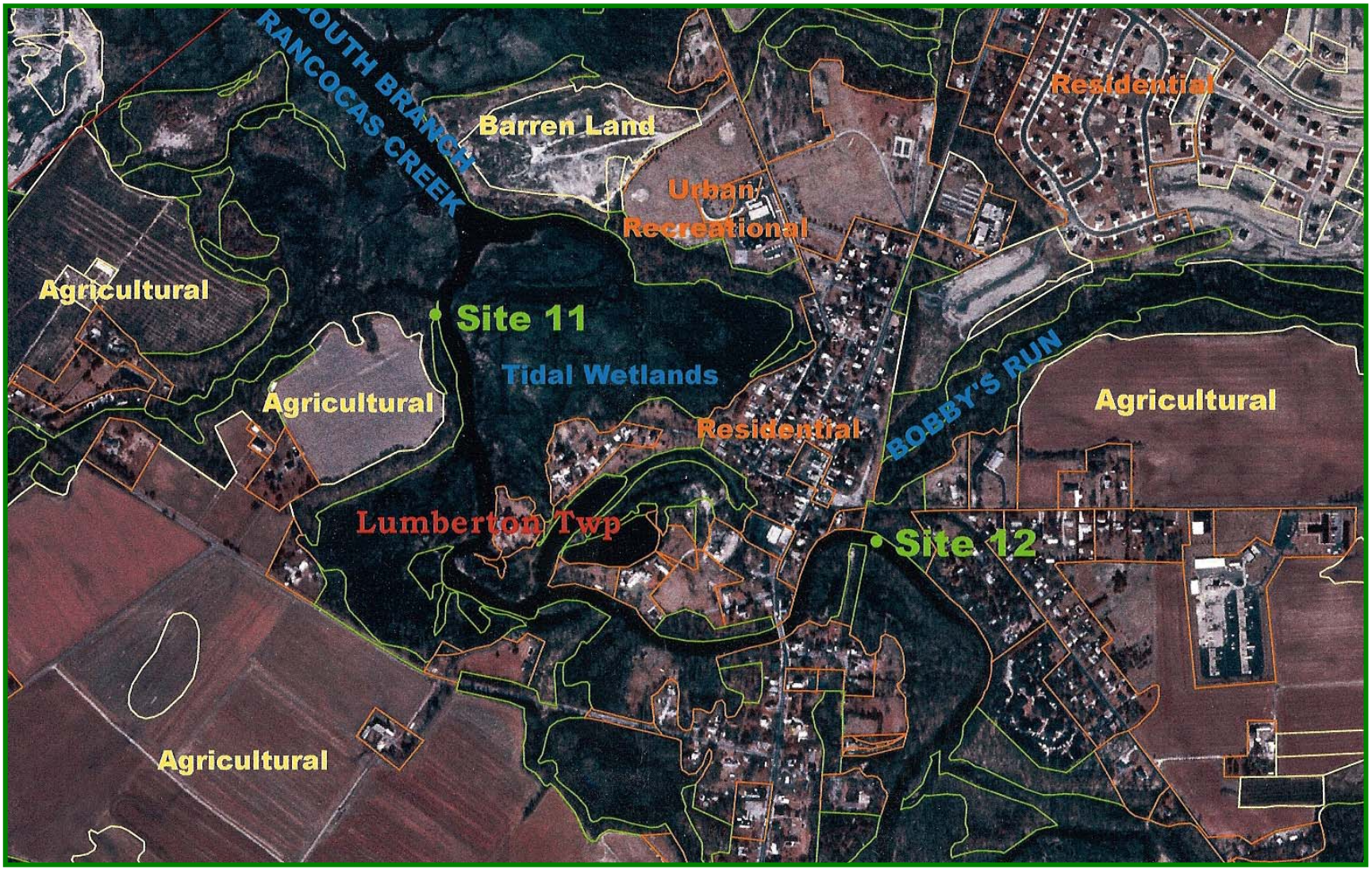
Site # 8: Rancocas State Park, Hainesport Township



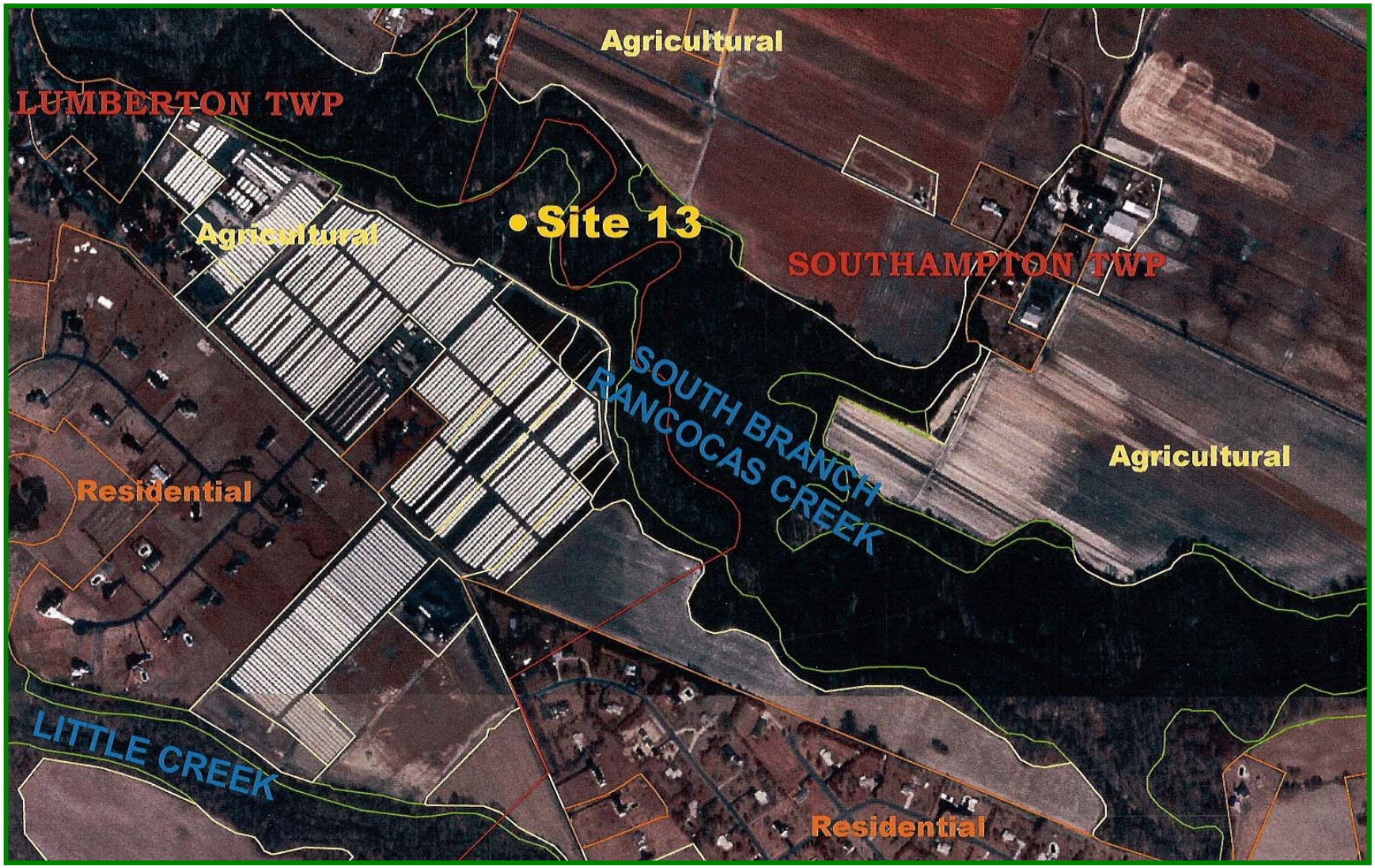
Site # 9: Rancocas State Park, Hainesport Township



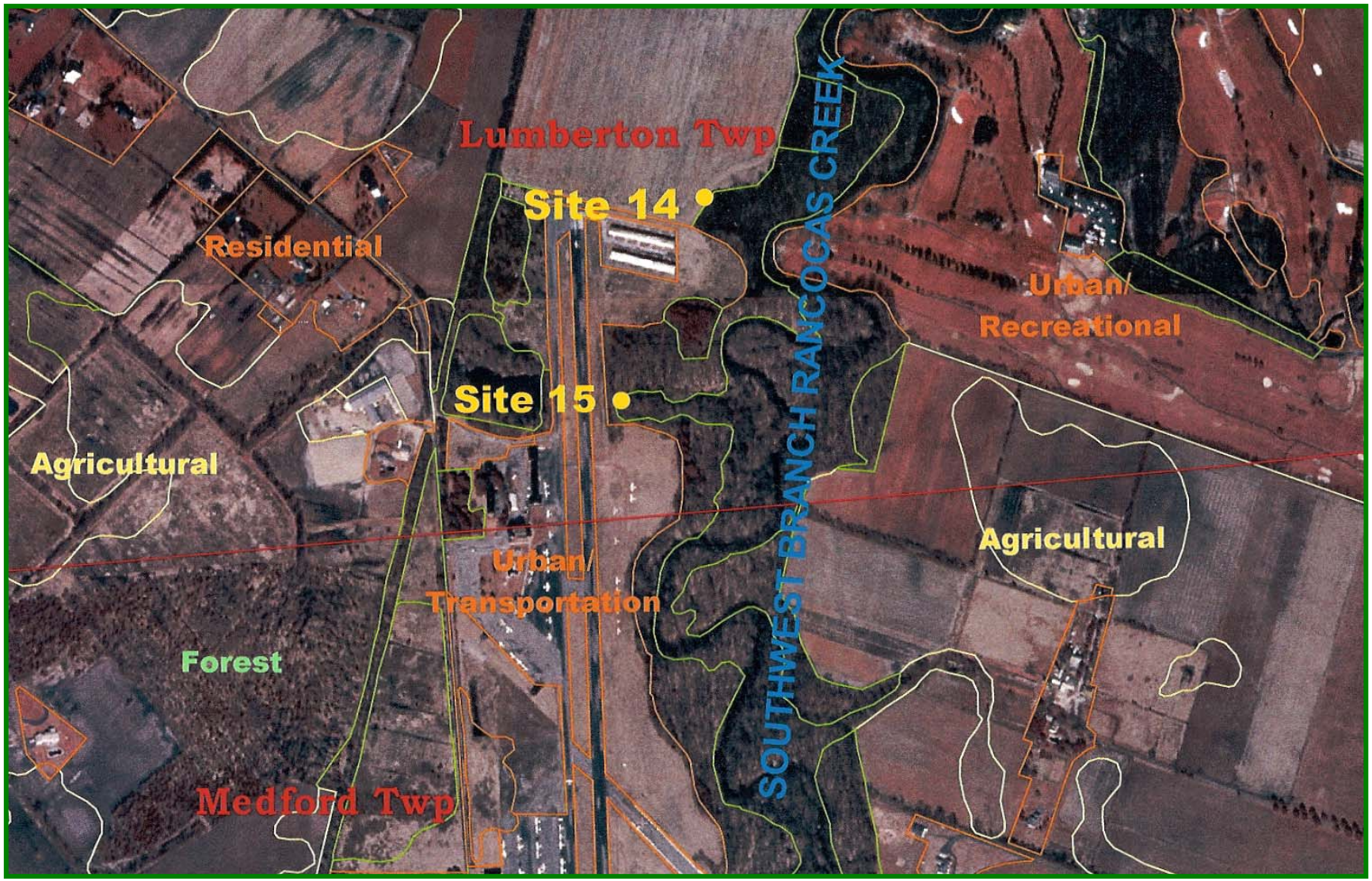
Site # 10: Property at Route 38, Hainesport Township



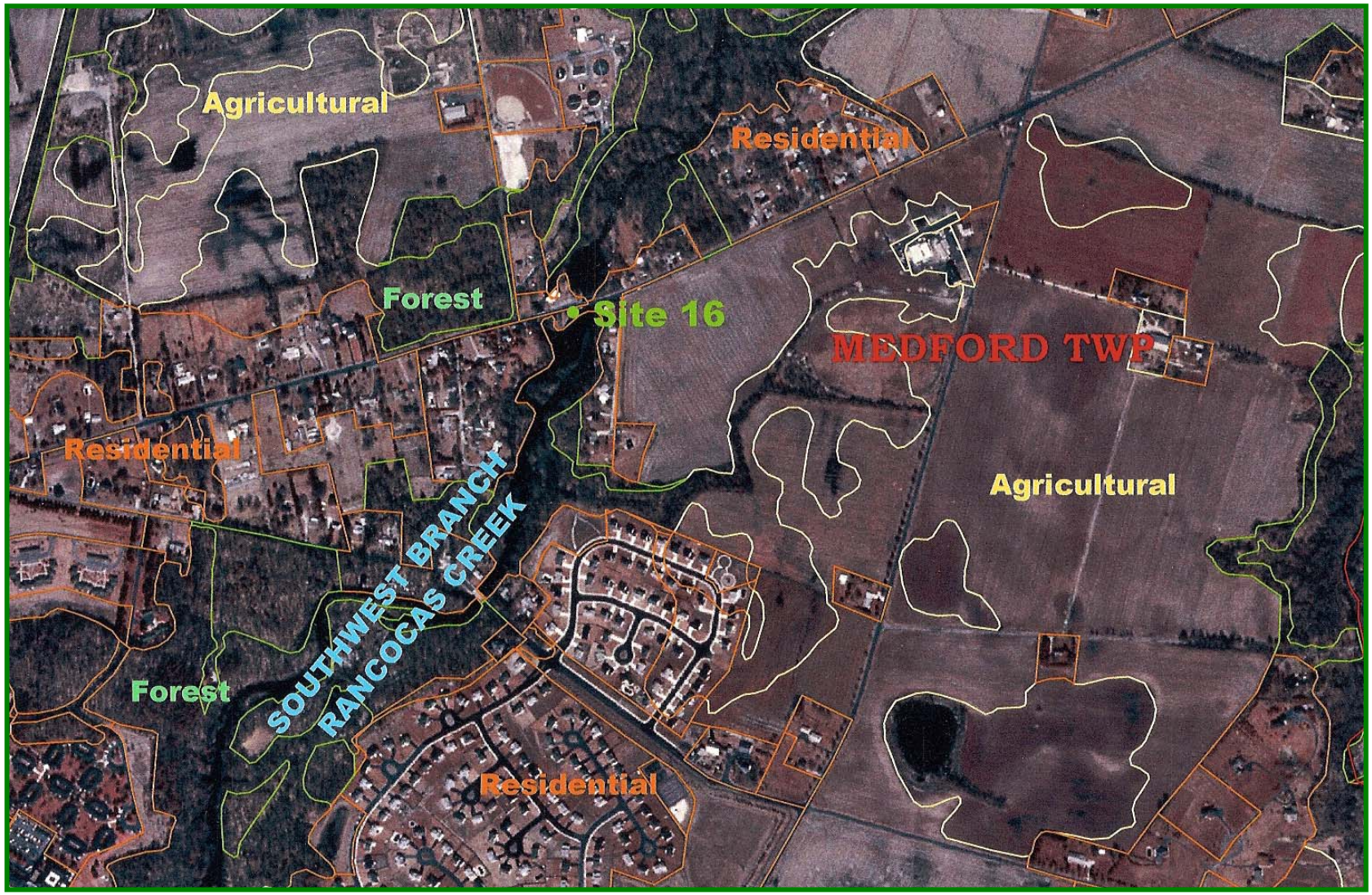
Site # 11: Farm on Creek Road, Lumberton Township
Site # 12: Confluence of Bobby's Run & South Branch Rancocas Creek, Lumberton Twp.



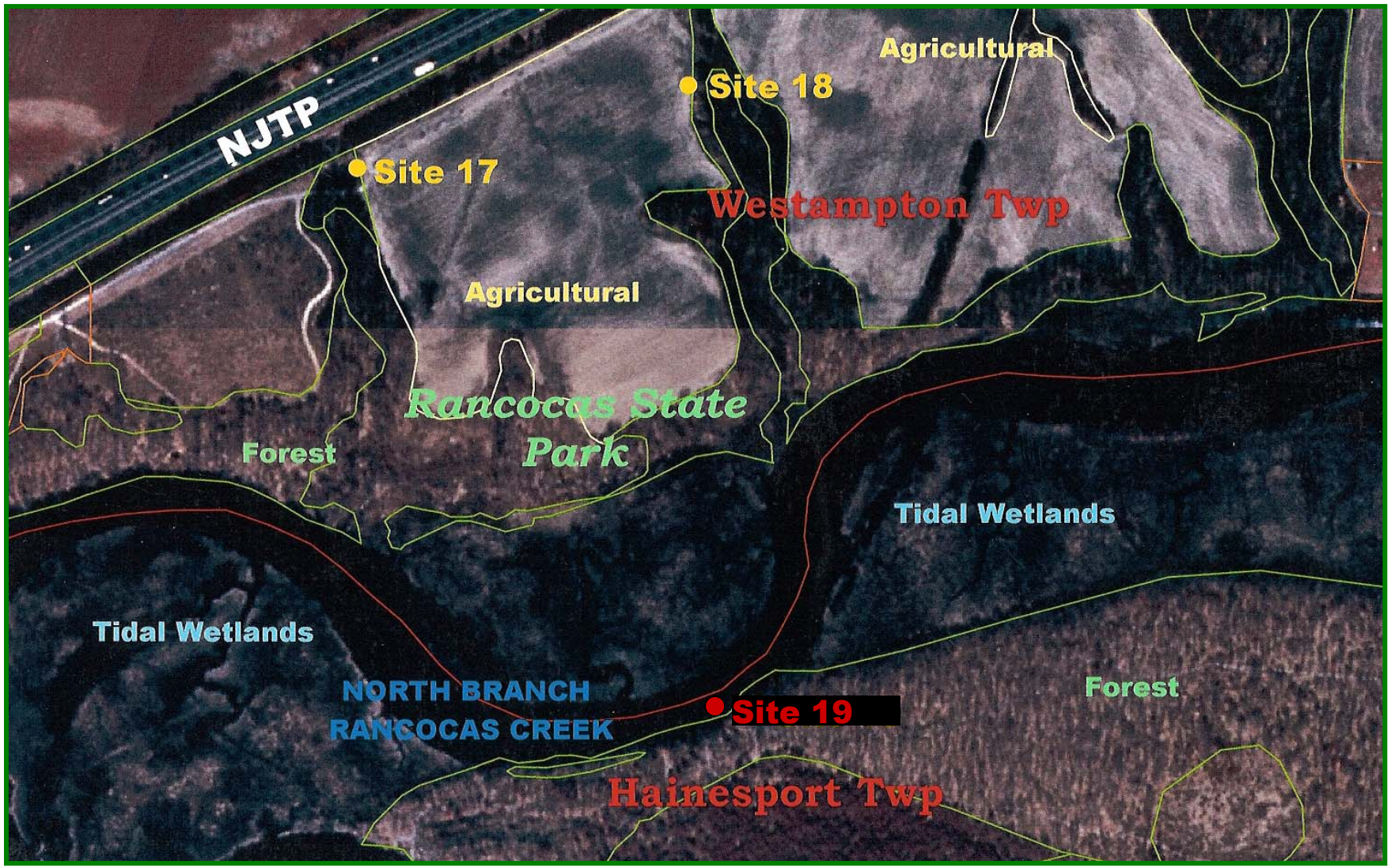
Site # 13: Agricultural Pump House, Lumberton Township



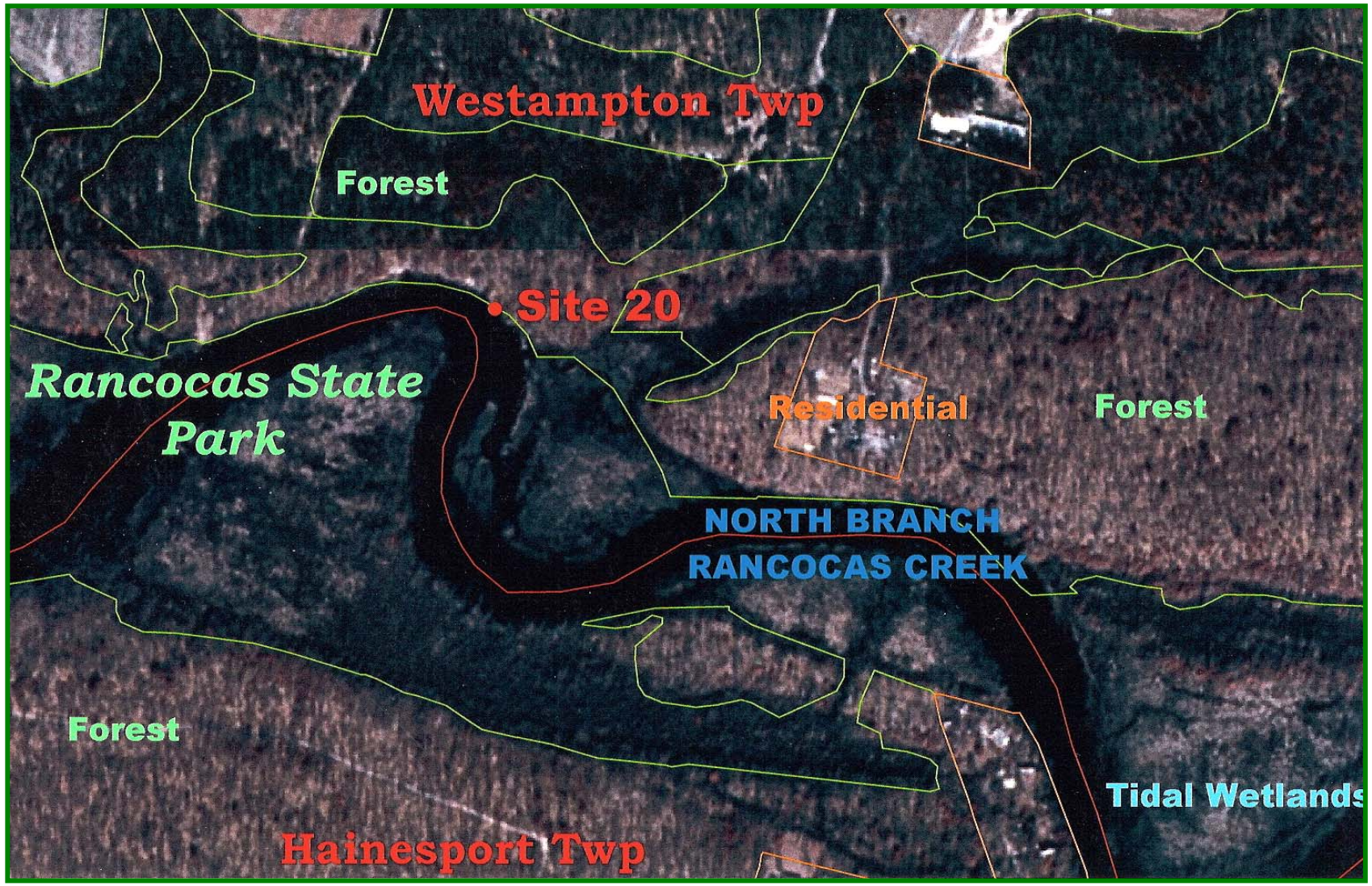
Site # 14: Agricultural Land Near Flying "W" Airport, Lumberton Township
Site # 15: Stormwater Outfall at Flying "W" Airport, Lumberton Township



Site # 16: Church Road and Fostertown Road, Medford Township



Site # 17: Rancocas State Park Turnpike Drainage Corridor, Westampton Twp.
Site # 18: Rancocas State Park Farm Fields, Westampton Township
Site # 19: Rancocas State Park, Hainesport Township

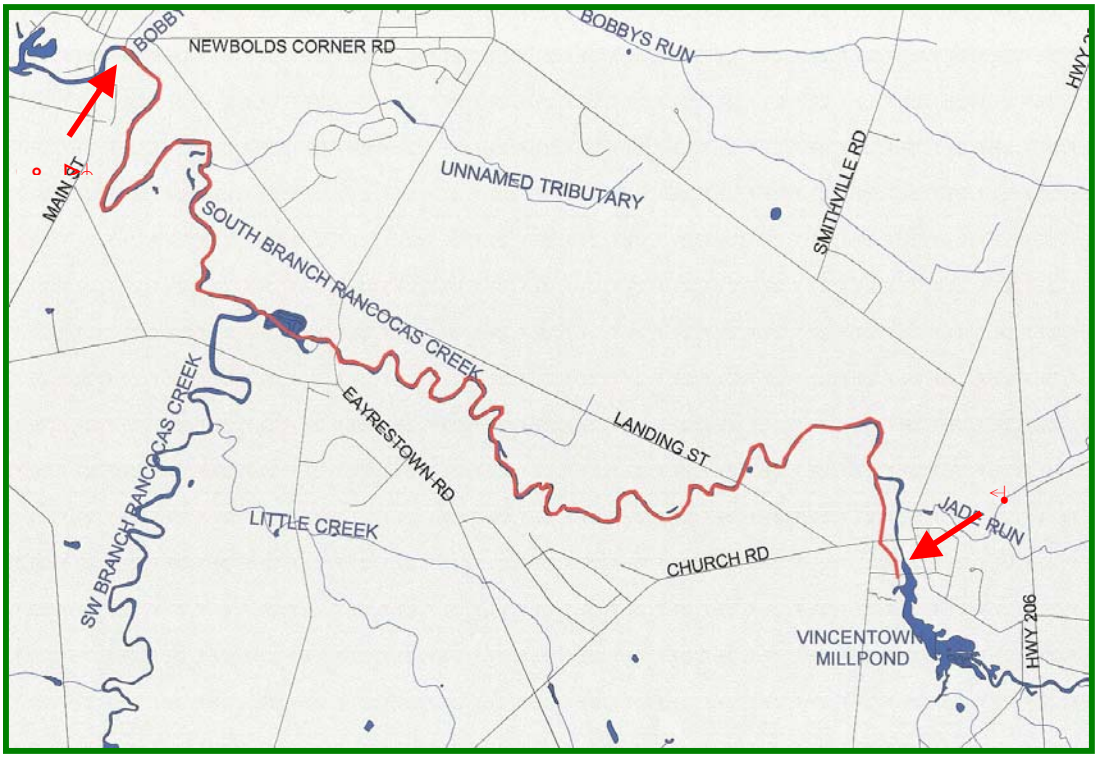


Site # 20: Rankokus Indian Reservation, Rancocas State Park, Westampton Township

Site # 21: Smithville Park Dam, Eastampton Township
Site # 22: Smithville Park Ravine and Nature Trail, Eastampton Township

Synopsis of the Canoe Investigations on the South Branch Rancocas Creek

Investigations on the South Branch Rancocas Creek commenced by canoe near Route 206 in the Vincentown section of Southampton Township. Canoeing the South Branch, however, was not as easily accomplished as it was on the North Branch. Countless times, the team members had to portage the canoes to bypass one or more trees that were obstructing the waterway. These fallen trees slow down the flow of water, allowing sediment to fall out of the water column, resulting in the creation of sediment bars within the creek. These obstructions redirect stream flow, especially during storm events, causing additional erosion of the streambank further downstream.



The banks of the South Branch suffered the same damage from agricultural tile drains that the North Branch had. One agricultural operation in particular was noted as having an outfall that discharged water from the top of a steep, once vegetated slope. The velocity of the water leaving

This photograph depicts only one of the many obstructions that can be found along the South Branch Rancocas Creek.

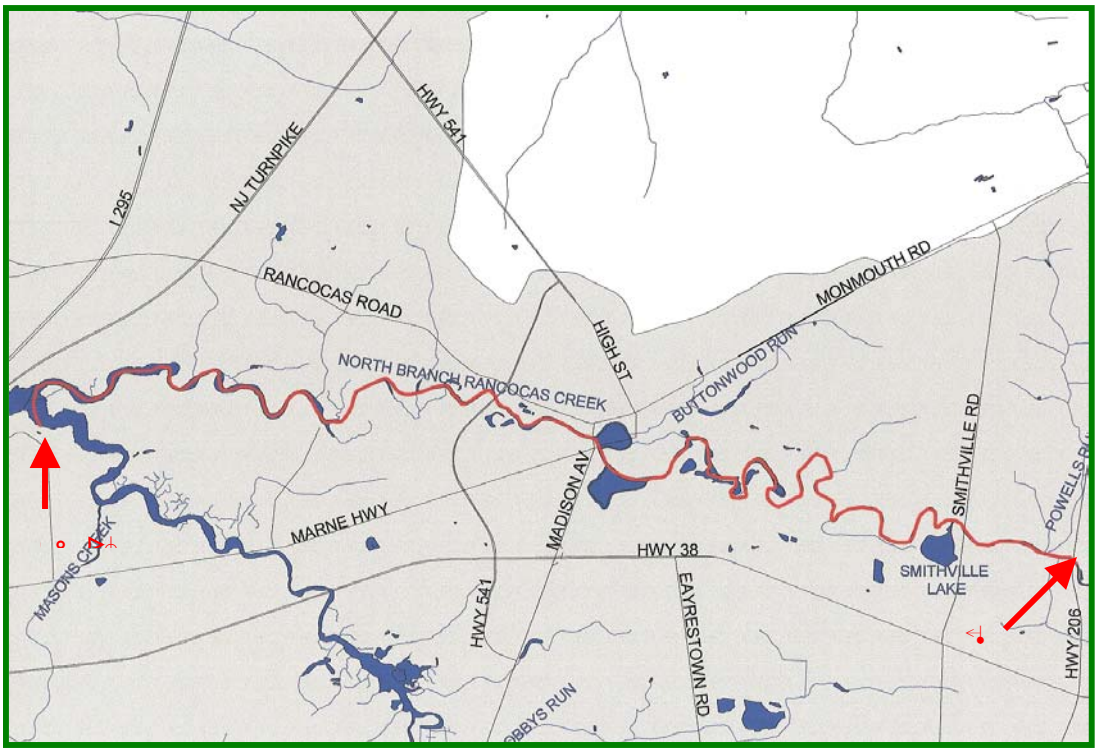
this outfall was so high that it has left a bare soil streambank, a deep gully and a significant sediment pad within the creek. At the time that the canoe investigation was conducted, the direct source of the discharge could not be found. Further investigation revealed that the source of the discharge was from an agricultural operation and is highlighted in this report as Site #13. The District has notified the Natural Resources Conservation Service (NRCS) office regarding the erosion at this site.

This branch of the Rancocas Creek would benefit greatly from routine stream maintenance. The routine removal of obstructions would not only improve the overall condition of the creek, but it would open the creek up to increased recreational use.

The area from Main Street in Lumberton (County Route 541) to Site #11 (Farm on Creek Road) does not show signs of severe erosion. The streambanks in between these two locations are heavily vegetated with spatterdocks and tidal marsh species.

Synopsis of the Canoe Investigations on the North Branch Rancocas Creek

The majority of the meandering channel widths of the Rancocas Creek's North Branch can be easily navigated by canoe. District staff encountered very few segments that were too narrow making passage difficult.



As it winds through Eastampton, there are numerous places that were noted to have erosion problems as a result of improperly installed agricultural drainage. Many outfalls from tile drains discharge at the top of the slope allowing occasional high velocities of water to concentrate over existing vegetation and soil, washing them away and creating gullies and bare slopes. In addition, many other tile drains are in a state of general disrepair that also creates eroded conditions within the watershed. Unfortunately, the District decided that there were too many instances along this section to inventory or GPS and would suggest that these issues be pursued with residents and farmers in an agricultural education outreach effort. Policy changes with

respect to the design of agricultural drainage systems would also aid in curbing erosion from farm field runoff.

Continuing along this section of the North Branch there are also a great number of homes that are located within the floodplain not more than ten to fifteen feet from the banks of the creek. Many of the homes are located in confined and remote locations that do not enable them to utilize local sewer services or septic tanks. Instead, they create cesspools or discharge their sewage waste directly into the waterway.

Further upstream in the town of Mount Holly, the environment surrounding the creek changes. Mount Holly was built around the creek by early settlers and was therefore the primary center for transporting goods and services from the area to Philadelphia. Numerous channels were created and concrete and wood retaining walls were constructed to facilitate and encourage the bustling shipping industry. Over the years, some of these structures have been repaired, but there are many more that remain in a state of disrepair.

In general, the North Branch of the Rancocas Creek, from Route 206 to the boundary of Rancocas State Park, suffers only from small sections that would benefit from restoration projects. The dam at Smithville and the dam at Mount Holly help control the flow of water within the North Branch so that extreme flooding of these areas is minimized. The creek banks are vegetated primarily with native deciduous forests, and do not appear to have significant erosion problems. There are some areas, however, that do not appear to be well protected, but erosion resulting from natural causes is inevitable.

The New Jersey Department of Environmental Protection is aware of the homes located in the floodplain in Eastampton Township mentioned above. The Department has discussed finding ways to purchase this property and either restore it or allow it to revert to a natural condition. The District would agree that this is an optimum solution assuming that the property owners would be fairly compensated. If any of the parcels are purchased by public entities, they would most likely be candidates for restoration projects.

Synopsis of the Stream Walk Investigations

As mentioned in the ***"Procedures"*** portion of this document, District staff conducted stream walk investigations of those tributaries of the Rancocas Creek that were too shallow for boat travel and too obstructed for canoe passage. The purpose of these stream walks was to assess a section of a tributary that would be large enough to be considered a representative sample of the entire tributary. It was not always possible to stream walk entire tributaries on both sides of the streambank out of respect for private property rights. Many areas, however, were accessible to District personnel through public lands or via Chapter 251 projects. These stream walked tributaries did not benefit from Secchi Disk readings because of low water levels. Velocity meter readings were taken at those locations where the portage of the equipment was practical.

Overall, most of the tributaries of the Rancocas Creek that were investigated were very well stabilized from growth of the surrounding woods and with other native woody vegetation. Many discharges from development had outlets into these smaller tributaries with fairly good results.

The following are descriptions of each tributary that was inventoried by District personnel:

Southwest Branch of the Rancocas Creek

The Southwest Branch of the Rancocas Creek has its headwaters in Evesham and Medford Townships. The investigative process commenced at Route 70 near the Medford Leas community, where the Southwest branch flows north past the dam at Kirby's Mill and then runs in between the Flying W Airport and the Golden Pheasant Golf Course. The surrounding landscape of this area between Route 70 and the airport consists of low-lying areas and is dotted with residential developments and farms. Throughout the course of the Southwest Branch, it receives runoff from these developments and agricultural operations, and in addition, it also receives the effluent from the Medford Township Municipal Utilities Authority.

Overall, the District would consider the erosion occurring in this tributary as minimal. However, immediately after the Southwest Branch passes through the airport and the golf course, the streambanks become much higher and steeper, and most of the topsoil has been eroded away by the stream flow in these steep areas leaving behind a clay-like subsoil. A stream flow velocity of 1.286 feet/second was recorded at one of these locations during a storm event. This section of the creek also receives runoff and sediment load from the airport, golf course, and nearby agricultural operations. Several large pre-existing gullies had formed within this area and that outfall pipes had more recently been placed in them. North of this area, the Southwest Branch returns to a stream with low banks and larger floodplains. It joins the South Branch Rancocas Creek inside the boundaries of the Healey farm in Lumberton Township.

Bobby's Run

The tributary known as Bobby's Run is a small stream that flows east to west and empties into the South Branch of the Rancocas Creek near the municipal parking area in Lumberton Township. Due to its accessibility, District staff walked almost the entire length of this tributary and viewed both banks closely.

Bobby's Run begins in Southampton Township where it travels through many farmland areas and newly developed residential areas. In some areas, the banks are very steep with cliffs as high as 40 feet. A common characteristic of these areas having steep cliffs is that the topsoil has been gradually washed away, leaving behind a smooth clay subsoil.

A stream flow velocity of 1.884 feet/second was recorded just upstream of Bobby's Run's confluence with the Southwest Branch of the Rancocas Creek following a storm event.

Kendle's Run

Kendle's Run is a small tributary that runs in a northeast direction from its origin in Moorestown Township to the main stem of the Rancocas Creek. The immediate landscape surrounding the stream consists primarily of forested areas, agricultural fields, and large residential lots. It is important to note that this tributary is affected by the tide. Some erosion of the streambanks is evident, most likely due to increased stream flows following storm events. Clearing of the channel of obstructions would be helpful in preventing further erosion of private property.

Parker's Creek

The headwaters of this tributary are located in Mount Laurel Township where it then proceeds to flow through residential areas, agricultural lands, and finally through a golf course where it then empties into the main stem of the Rancocas Creek. Parker's Creek is increasingly influenced by the tide as it nears the Rancocas. However, due to private property constraints, this tributary was difficult to access, but those areas that were easily approached showed evidence of very little erosion.

Buttonwood Run

Buttonwood Run begins in a residential area of Eastampton Township, where it flows from east to west through Mount Holly Township to its confluence with the North Branch of the Rancocas Creek. This tributary was inventoried from Woolman Lake in Mount Holly Township to the North Branch of the Rancocas Creek. There have been many attempts by residents living along Buttonwood Run to stabilize the nearby streambanks by installing wood, stone, and concrete structures along the shoreline. It was noted during these investigations that a sand parking lot and a small eroded area located behind the Mount Holly Emergency Squad building are possibly contributing sediment to Rancocas Creek during storm events.

Laurel Run

Similar to Kendle's Run, this tributary is a short stream that flows in a northeasterly direction before joining the main stem of the Rancocas Creek. From its origin in Delran Township to where it flows under the bridge at Creek Road, Laurel Run is a freshwater stream that receives runoff from upland forests and residential developments. Laurel Run was investigated from Creek Road to where it joins the Rancocas Creek. It was noted that this section appears to be more tidal in nature as it passes between Anderson's peach farm on the south side and the Green Acres property on the north side. During the assessment of this tributary, it was noted that sediment had accumulated in various areas, but the source of this sedimentation was not evident. The general impression of the Laurel Run tributary is that it is a very healthy ecosystem.

Boundary Creek

Boundary Creek is a small tributary that has its headwaters just south of Creek Road. It is so name because the creek serves as the border between Delran and Moorestown Townships. The general area surrounding Boundary Creek used to be prime agricultural land. Today, large lot residences and smaller farms exist here. Boundary Creek does receive some runoff from the detention basins associated with the newly constructed residential dwellings.

Both banks of Boundary Creek are heavily vegetated and no signs of severe erosion were found during the assessment. It should be noted that access was limited in some sections due to private property constraints.

Mill Creek

Mill Creek is a rather long stream that begins in the farmland of Westampton Township and flows westward into Willingboro Township. Once in the middle of Willingboro, it makes a turn to the south before emptying into the main stem of the Rancocas Creek. The lower portions of

Mill Creek are accessible by boat; however, most of the creek north and east of Beverly-Rancocas Road required stream walking. The upstream areas contained many outfall structures from residential areas, most of which were in poor condition. This upstream portion could be improved with a maintenance program.

Laurel Creek

Laurel Creek is a small tributary that flows from its headwaters in Moorestown Township north to the Rancocas Creek. Much of this sub-watershed is contained within the aptly named Laurel Creek Golf Course. This portion is well maintained and few problems were evident when inventoried. North of Creek Road, this stream flows straight out to the Rancocas with marsh on either side.

Other

Powell's Run receives runoff from farmed areas and also from an elementary school. No significant erosion was discovered during the assessment of this tributary.

Masons Creek and Little Creek were inventoried on a cursory level only. The Burlington County Soil Conservation District is partnering with the Camden, Gloucester, and Cape-Atlantic Soil Conservation Districts to perform a more intense survey in these two tributaries.

Technical Data

Secchi Disk readings were taken at various locations concurrently with velocity readings. In general, the readings taken within the Rancocas Creek Watershed varied between 0.8 meters and 0.875 meters. These readings demonstrated an overall consistency with the depth of visibility within the creek. The visibility was not recorded due to the consistency of the visibility. Immediately following storm events, however, the visibility readings will vary from what was recorded. Storm events will decrease the depth of visibility as a result of increased leaf matter and sediment in the waterway.

The velocity readings that were collected over the course of the investigation process were used to aid in assessing how much erosion along the streambank is the direct result of increased stream flows. It is important to note that these readings do not demonstrate that the erosion occurs from natural stream flow. However, it does indicate that the erosion is more likely caused from increased flows during and after storm events.

For example, the readings taken on August 14, 2000, were taken during a storm event and the flows were slightly greater than readings taken when there was no storm event. Over time, a series of storms may produce the large-scale erosion that has been observed and documented in this report.

The purpose of recording this velocity data in this report was to provide a reference to aid in the designing of plans for remediation efforts. The flows collected by District staff were not significantly high enough to disallow any bioengineering methods for any given site when consulting the NRCS Engineering Field Manual.

Velocity Data

Date	Velocity (ft/sec)	Depth of Reading (ft)	Location	Reported High Tide
5/4	0.875	1.5	Main Stem, downstream of Mill Creek Park, Willingboro	3:18pm
5/4	1.085	3	South Branch, upstream of Flo's Tavern, Rancocas State Park, Hainesport	3:18pm
5/26	.123	4	Main Stem Mill Creek Park, Trail with bench, Willingboro	9:12am
5/26	2.441	4	Main Stem Downstream from train bridge, Delanco Twp.	9:12am
5/26	.606	3	Main Stem Hawk Island, Delran	9:12am
6/1	.455	1	South Branch, Rt. 38 Bridge, Hainesport	2:05pm
6/1	.326	2.5	South Branch, downstream of Main St. Bridge, Lumberton	2:05pm
6/2	--	--	North Branch, Rancocas State Park, Westampton	2:51pm
6/22	.890	1	North Branch, Rancocas State Park, Westampton	6:45am
6/22	1.91	2	Confluence N. and S. Branches, North side, Westampton	6:45am
6/22	.786	1	South branch, Rancocas Woods Pump Station, Mt. Laurel	6:45am
8/14	1.458	.5	South Branch, Main St. Bridge, Lumberton	3:01pm
8/14	1.884	.5	Bobby's Run, upstream of confluence with Rancocas, Lumberton	3:01pm
8/14	1.286	.5	SW Branch, Flying 'W' Airport, Lumberton	3:01pm
8/14	1.937	.5	Little Creek, Sandtown Road Bridge, Medford	3:01pm
8/21	.910	.5	South Branch, park bench below grade of farm field, Lumberton	7:13am
8/21	.934	2.5	South Branch, Rancocas St. Park, Hainesport	7:13am
8/21	1.290	.5	South Branch, Rancocas Woods Pump Station, Mt. Laurel	7:13am
8/25	2.124	1.5	North Branch, downstream of Smithville Dam, Eastampton	N/A

Table Summary of Priority Sites

(including locations in State Plane Coordinates)

Site No.	Assessment Rating		Coordinates NJSPC* (ft.)	Location (General)	Branch	Township	Ownership
1	82	High	E 358,117.78 N 441,111.53	Hawk Island	Main	Delanco	Multiple
2	78	High	E 376,700.53 N 432,922.10	Mill Creek Park	Main	Willingboro	Township of Willingboro
3	77	High	E 376,700.53 N 434,043.12	Mill Creek Park (near Parking Area "A")	Mill Creek	Willingboro	Green Acres
4	65	Medium	E 377,727.77 N 436,491.05	Upstream of Rancocas Road	Mill Creek	Willingboro	Township of Willingboro
5	70	Medium	E 380,211.85 N 426,529.83	Creek Road Culvert	Kendle's Run	Moorestown	County of Burlington
6	68	Medium	E 389,657.82 N 424,355.32	Route 295 Bridge	Main	Westampton	State of New Jersey
7	81	High	E 391,800.06 N 422,908.13	Rancocas Woods Public Boat Launch	South Branch	Mount Laurel	State of New Jersey
8	68	Medium	E 394,572.69 N 422,037.34	Rancocas State Park (Trails from Rancocas Ave.)	South Branch	Hainesport	State of New Jersey
9	49	Low	E 396,852.06 N 419,993.03	Rancocas State Park (across from Winzinger's)	South Branch	Hainesport	State of New Jersey
10	63	Medium	E 401,275.45 N 417,590.80	Route 38 Bridge	South Branch	Hainesport	Private
11	44	Low	E 403,898.50 N 412,884.27	Upstream of Lumberton Landfill (Farm on Creek Road)	South Branch	Lumberton	Private
12	45	Low	E 406,569.23 N 411,511.74	Confluence of Bobby's Run & S. Branch Rancocas	Bobby's Run	Lumberton	State of New Jersey
13	66	Medium	E 413,001.38 N 404,725.78	Near Medford Nursery Pump House	South Branch	Lumberton	Private

Site No.	Assessment Rating		Coordinates NJSPC* (ft.)	Location (General)	Branch	Township	Ownership
14	65	Medium	E 406,517.10 N 402,923.30	Farm adjacent to Flying "W" Airport	SW Branch	Lumberton	Private
15	61	Medium	E 406,120.40 N 401,968.15	Flying "W" Airport	SW Branch	Lumberton	Private
16	46	Low	E 406,466.92 N 394,732.10	Upstream of Church Road	SW Branch	Medford	State of New Jersey
17	73	Medium	E 392,688.36 N 425,375.37	Rancocas State Park (New Jersey Turnpike)	North Branch	Westampton	State of New Jersey
18	69	Medium	E 393,637.62 N 425,612.05	Rancocas State Park (farm fields)	North Branch	Westampton	State of New Jersey
19	78	High	E 393,835.96 N 423,840.46	Rancocas State Park (Deacon Street)	North Branch	Hainesport	State of New Jersey
20	78	High	E 397,686.56 N 424,781.48	Rancocas State Park (within Indian Reservation)	North Branch	Westampton	State of New Jersey
21	63	Medium	E 421,487.48 N 419,845.14	Smithville Park (Downstream of Dam)	North Branch	Eastampton	County of Burlington
22	75	High	E 421,118.52 N 420,964.18	Smithville Mansion Nature Trails	North Branch	Eastampton	County of Burlington

*Coordinates are +/- five (5) feet of data points

The Universal Soil Loss Equation

It is estimated that between 4 and 10 billion tons of sediment is generated in the United States each year. This sediment impacts many land and water ecosystems and contributes to the increased incidents of flooding problems as well as decreased recreational uses of local water bodies.

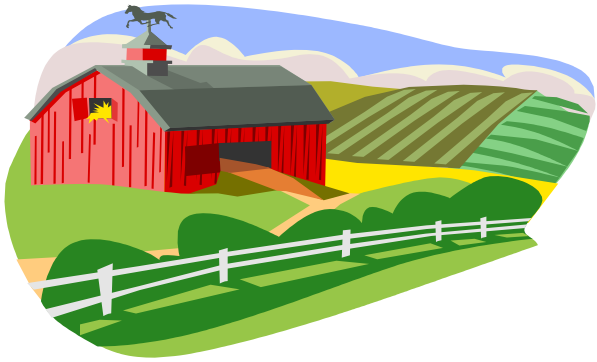
The Universal Soil Loss Equation is a mathematical tool used to determine predictable soil loss estimates. When utilizing this equation, professionals are able to make reasonable recommendations to reduce these erosion rates if they are determined to be excessive. Generally, this equation deals primarily with soil loss resulting from sheet and rill erosion.

The Universal Soil Loss Equation is as follows:

$$E_t = RK(LS)CP$$

Where:

E_t is the estimated soil loss from sheet and rill erosion and is represented in tons
R is the regional rainfall factor
K is the soil erodability factor
L is the slope length
S is the slope gradient
C is a cropping management factor or cover index factor
P is the erosion control practice factor



For demonstration purposes, the District, with the assistance of Natural Resources Conservation Service staff, utilized the Universal Soil Loss Equation on the Farm Fields at Rancocas State Park, which is identified in this report as Site #18.

It was calculated that this site has a soil loss yield of approximately 10 tons per acre. As erosion control professionals, we generally use a maximum tolerable soil loss value of 4 tons per acre.

Therefore, the erosion rates that we calculated for the Farm Fields at Rancocas State Park are 2.5 times higher than the acceptable rate. This is evident to the untrained observer by the significant gully formation that we see throughout this farmed land.

To correct this, a trained technician would look to modify these factors through conservation planning and management practices, and is often provided to many of the farmers in the county through their specially designed farm conservation plan.

In summary, routine use of the Universal Soil Loss Equation would be an effective tool in evaluating and recommending corrective courses of action when addressing a variety of erosion issues at prospective remediation sites.

Recommendations

Sediment is our largest pollutant by volume with its most devastating impact seen in the state's waterways and aquatic systems. With the increased erosion and siltation problems due to wide-scale land clearing and grading during the 1960's and 1970's, New Jersey's State Legislature recognized this problem and the effect it was having on the state's environment.

In 1975, the State Legislature passed the Soil Erosion and Sediment Control Act, Chapter 251, P.L. 1975. This empowered the District's to control sediment pollution by requiring the submission of a soil erosion and sediment control plan for most major soil disturbances over 5,000 square feet.

The Burlington County Soil Conservation District has a highly effective program for minimizing soil erosion and controlling offsite sedimentation from developing sites. Routine inspections are conducted by District staff to ensure that appropriate erosion control measures are being implemented and maintained on these sites.

For almost 30 years, the Burlington County Soil Conservation District has taken great pride in our fine soil erosion and sediment control program. Our goal is to prevent soil erosion and offsite sedimentation, as well as improve water quality. By working side by side with developers, engineers, and landowners, we have been able to improve eroded conditions that would otherwise be detrimental to the environment.

It is based on our many years of experience that we have chosen seven (7) of the priority sites highlighted in this report and made the following recommendations as to why they should be the apex of any remediation project that is being proposed and considered for funding in the future.

Site # 7: Rancocas Woods Public Boat Launch

Due to this site's location near the confluence of the North and South Branches of the Rancocas Creek, District staff often utilized this public boat launch to conduct our routine investigations. It was at these times that we witnessed the high volume of public usage of this site, and determined that because of this usage, this site should be a priority to repair and make a focal point of a future remediation project.

This site would also offer other benefits if it were the subject of a remediation project. For example, since this site is located within Rancocas State Park, any future repair work would improve the public's opinion of the New Jersey State Park System. This in turn, may solicit an increase in public usage of other parks located within the county as well as at the boat launch.

The accessibility of the boat launch in conjunction with high public use would also make the site an ideal platform to promote the awareness of watershed issues. Any remediation work at this site could be highly publicized through invitations to the media and signage erected at the site and in the adjacent neighborhood. As a result of the site's accessibility, it would also easily accommodate any equipment needed to improve the eroding conditions that exist at this location. In addition, when considering the type and severity of the erosion at this site, any funding needed to address the problems here would not be quite as expensive as some of the other problems noted along the Rancocas Creek.

Site # 1: Hawk Island

Hawk Island is an excellent example of man-made influences on our environment. The island is composed of a variety of habitats including areas containing dredged spoils; areas containing previously dredged spoils that are converting to forested land; and areas of mature forest that may include remnants of the original forested island. Recently the ecological value of Hawk Island has become more appreciated.

The Burlington County Office of Land Use Planning identified the island as an environmentally sensitive area, recommending that it be acquired and preserved for passive recreational uses. This site has not been used as a disposal area since 1988, and since that time, Hawk Island has developed a rich and diverse habitat, colonized by a wide variety of plants and animals.

The island's location attracts a great deal of water recreationalists and the implementation of a remediation project at this site would not only encourage increased public usage of the area, but it would provide an excellent platform to address watershed issues to the general public. It is hoped that with this increased awareness of watershed issues by the public that this would foster a feeling of pride in the surrounding environment that would encourage an improvement in the health of the Delaware River, Rancocas Creek, and the sensitive environments of Hawk Island.

Since the erosion problems at this site are severe, it would cost a substantial amount of money to implement a remediation project. Access to the site is facilitated via the unimproved roadways, enhancing the feasibility of executing such a project. However, the long-term benefits to the surrounding environment as well as those benefits that would be derived from re-opening the site to the general public for recreational use are immeasurable.

Site # 3: Mill Creek Park (Mill Creek side)

This site is a popular location for residents to run, ride bikes, study nature, etc. Visible from the water, the erosion occurring at this site is moderate to severe and extends approximately 100 to 150 feet along the shoreline. This site is situated at a bend in the creek, subjecting the shoreline to toe erosion. The toe erosion and overland runoff during storm events is also contributing to the failure of the upper bank. The slopes have very little vegetation, with the exception of some scattered bushes along the shoreline, to stabilize the slope. In addition, obstructions in the waterway have created hazardous boating conditions, and in combination with the constriction of the waterway at the creek's bend, forces a faster current at this location, providing the catalyst for increased erosion at this site.

The work involved in remediating this site would have a positive impact on the surrounding ecosystem. First, removing any obstructions in the stream channel would help deter any additional shoreline erosion problems, and would also prevent any more blockages caused by the undercutting of adjacent trees.

Improving the eroding conditions of the park would encourage usage from the general public. It would also provide an excellent platform to publicize the stabilization work and address watershed issues with the assistance from the local press and signage highlighting the project. Expanding the general public's knowledge of watershed issues would promote pride in one's environment and may provide the catalyst to implement more remediation projects.

Site # 2: Mill Creek Park (Rancocas Creek side)

This site is situated along one of the many foot trails in Mill Creek Park that encourages walkers, bikers, and fishermen to recreate at here due to its high accessibility and aesthetic surroundings. Mill Creek Park's popularity among recreation seekers makes it highly visible to park visitors and to boaters on the creek. However, the proximity of steep slopes next to the trail magnifies the safety hazards at this location.

Benefits to remediating this site are numerous. First, the general public actively uses this site for a variety of recreational activities, making it highly visible from land as well as from the creek. Any proposed improvements would correct any hazardous issues that affect park visitors. This site also is an ideal location for the installation of a fishing pier or observation deck. This may draw in more visitors to the park and it could be worked in nicely if the adjoining nature trails were redesigned to become an eco-trail that would provide general information about the surrounding environment. Educational seminars could be performed to address environmental and watershed issues that would serve to increase the public's awareness of them. These general

improvements could be promoted in the press, giving needed publicity to issues addressed in this remediation project.

Site # 19: Rancocas State Park (old pier)

There is extensive erosion occurring along the streambank at this site, and it appears that this erosion is resulting from stormwater runoff from upland areas into the creek. Heavy foot traffic at this site also plays and important role in the erosive conditions that exist here. The landscape has approximately 3:1 slopes that run along the shoreline, and the overland flow has created several significant gullies. In addition, there is no vegetation present on this steeply sloping area to slow the flow of water into the creek or to prevent the erosion of the slope, therefore allowing the lost soil to be deposited as sediment further downstream.

The implementation of a remediation project at this site would correct the erosion problems along the streambanks and would therefore reduce any sedimentation problems that are affecting upstream areas. In addition, re-building the existing pier would encourage public recreational use of this part of the park and would enhance the aesthetics of the general area. The adjacent unimproved roadways would facilitate access for construction traffic so that they can easily install any desired improvements to this area. This site, in addition to the others, would also be a great public relations item where watershed issues can be addressed and brought to the attention of the general public.

Site # 20: Rancocas State Park (Rankokus Indian Reservation)

This location is a favorite spot for many recreation seekers because of the area's beauty and because of the diverse waterfowl and wildlife that inhabit the region. Easily noticed from the waterway in part because it can be found at a 90-degree bend in the

creek's channel, this site is easily recognized by sheer cliffs with some sediment base and very little vegetation. The nature trail that leads to this site runs right along the cliffs. The dramatic curvature of the creek's flow pattern contributes, in part, to the gradual erosion of the cliffs because the channel flow is most erosive at the outside of the bend.

There are many benefits to making this site the focus of a remediation project. For example, installing measures to stabilize upland areas in conjunction with repairing the eroding slopes would reduce sedimentation levels into the creek. Once the streambank is stabilized, adjacent trees and other vegetation would be encouraged to flourish, instead of becoming the typical obstruction that impacts the downstream health of the creek. The potential hazards to visitors will be reduced if the eroding areas near the trails are repaired.

The greatest difficulty in addressing the erosion issues at this site is that access to the area is limited and it may be difficult to bring in the necessary equipment to repair the existing problems.

Site # 18: Rancocas State Park Farm Fields

Rancocas State Park is a popular location for local fishermen to access Rancocas Creek, but it allows for owners of sport utility vehicles to enjoy the vast amount of open space the park possesses. The farm fields, which are the subject of this priority site, also provide a food source for the many deer that thrive in the area.

The erosion at this site is being created from overland runoff from the farm fields. There are two (2) gullies in question at this location. It appears that the gullies merge together after they travel into the woods, and eventually join a feeder stream of the Rancocas Creek. This feeder stream then joins the North Branch Rancocas Creek, just upstream of the confluence of the North and South Branches.

The remediation efforts at this site could address agriculturally related best management practices. By installing measures that would stabilize upland areas this site could be shown as a demonstration farm in which the BMP's could be educational tools for other farmers and county residents. Watershed issues and other conservation issues could be tied in to the educational topics addressed at the demonstration farm that may, in turn, encourage usage of the park by the general public. The project could be publicized in the local papers and informational signs could be erected to highlight interesting aspects about the site. The combination of the above would promote pride in one's environment and may provide the catalyst to implement more remediation projects.

In addition, by improving upon the upland conditions, the adjacent eroding slopes would also receive erosion control measures. These measures would reduce sedimentation levels into the creek and encourage the re-establishment of native vegetation.

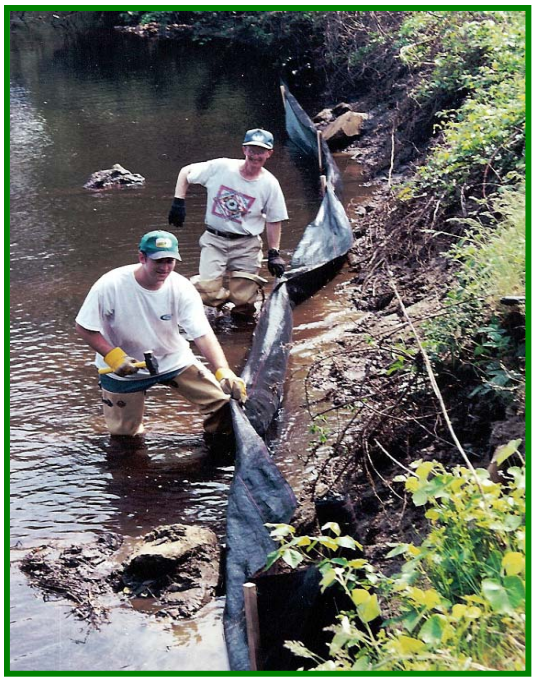
Successful Remediation Projects

Mill Dam/Iron Works Park Project

The Battle of Iron Works Hill took place in Mount Holly during the War for Independence. This battle enabled General Washington's troops to capture Trenton after the historic crossing of the Delaware River. In addition, early settlers in Mount Holly relied heavily on the Rancocas Creek to earn a living. Some of their strongest assets at the time were the mills that utilized the Creek's water for power.

Today, however, the Rancocas Creek is heavily impacted by various water quality impairments for pH, fecal coliform, lead, mercury, total phosphorus, sediment and other non-point source pollutants.

Funded through a grant provided by the New Jersey Department of Environmental Protection, the Mill Dam/Iron Works Park Project was designed to enhance the quality of the water contained within the watershed by preventing non-point source pollutants from entering



Craig Fisher (front) of the Burlington County Soil Conservation District and Ken Taaffe (rear) of NRCS install silt fence along a severely eroded section of Rancocas Creek located within Mill Dam/Iron Works Park.

Rancocas Creek. This was achieved by implementing the proven best management practices of riparian forest buffer systems and streambank stabilization.

The designs for this project were developed by staff from the Burlington County Soil Conservation District and the Natural Resources Conservation Service (NRCS), and targeted a 100-foot segment of eroding streambank. In May, staff from the District, NRCS, and Rutgers Cooperative Extension in coordination with a private contractor, worked together to remove approximately 65 cubic yards of soil and replace it with clean fill material, re-shape and re-grade the slope of the streambank. Native plant species were then installed to resemble nearby areas that had the same species population. Biologs and erosion control fabric were also installed as needed along the streambank.

The excavation and re-shaping of the shoreline begins.

As stated previously, Mount Holly thrived on various types of industries early in its history. This site was once used as a dumping ground for trash and other debris. During the excavation process, bottles, tires, rubber shoe sole templates were removed from the shoreline.

The bioengineering methods have been installed, the site has been stabilized, and all native vegetation has been planted.

After the initial installation of all the best management practices, the site was closely monitored to gauge the viability of the plantings. It was noted that there was a high level of foot traffic coming through the area. In an effort to deter fishermen and other passers by from walking through the project area, fencing was installed to protect the new plantings. It soon became evident that although some vegetation would have to be replaced and routine maintenance would be an important factor, the project was an overall success.

As time progressed, however, new issues that would affect the success of the project arose. Beaver had invaded areas within the site and were gnawing at the roots of several of the tree species planted there. District and NRCS staff took measures to protect the existing vegetation against this pesky predator.

Although this project addresses the best management practices available to prevent the sedimentation of the stream by stabilizing the streambank and by creating a buffer to prevent the

washing of non-point source pollutants into the waterway, it is evident that there are many other factors that contribute to the overall health of our watershed.

The project area can now be seen as a flourishing, well -vegetated area.

This project also is an excellent example of what can be accomplished when federal, state, and local agencies work together with private citizens to improve conditions that can adversely affect our watershed.

Conclusion

In summary, of the 22 sites that were identified, seven (7) were classified as a high priority, eleven (11) as a medium priority and four (4) as low priorities. All but one of the high priority sites is located within in parks and recreational areas. These parks are frequented by the general public and have a greater risk factor for public safety. These sites would be ideal for educational outreach programs due to the high public usage of the park areas and the ease of installing proven soil bioengineering methods to improve the site conditions and habitat. The Hawk Island site is the lone privately owned property on the high priority list. This site would also be ideal for educational programs due to its high visibility to recreational boaters and to fishermen that travel on the Rancocas Creek and the Delaware River. However, the private ownership here is an issue that may hinder expediting remediation of the eroding conditions and the enhancement of wildlife habitat.

Of the four medium priority sites, one rests in the Rancocas State Park, one at Smithville Park, and two are outfalls, one from road drainage and the other from parking drainage. The outfalls are just two of many agricultural, residential, or roadway discharges that require the attention of the owners, whether they are publicly or privately owned. Willingboro Township owns one site and township engineers have notified the District office that they are aware of the poor conditions of the drainage structures and the resulting problems. A private businessman who may not be aware of the erosion problem owns property adjacent to the other outfall site. The remaining two sites that belong either to Burlington County (Smithville Park) or New Jersey State Department of Forestry (Rancocas State Park) could also be used as educational sites because of high public visibility and the ease of installing soil bioengineering methods.

The low priority sites would not require as many materials or manpower as the medium and high priority sites. This is because the erosion is less extensive and the habitat value is not as significant. There is overland runoff and some undercutting which would easily be remediated with proper maintenance and the installation of minor bioengineering methods.

Overall, the tributaries and the majority of the Rancocas Creek were very well stabilized from the growth of the natural vegetation. Some portions of the tributaries had very extensive growth so access along the streambank to the water body was limited. Many discharges from development had outlets into these smaller tributaries with fairly good results. Recent revisions to the Standards for Soil Erosion and Sediment Control in New Jersey will further help curb erosion from future development.

Some of the erosion problems in these smaller tributaries can be traced to older developments with direct stormwater discharges or basins designed only to reduce stormwater runoff peaks from the 100-year storm. It is the smaller, more frequent storms that typically cause erosion. Basins that predated the current regulations were not designed to address post-development runoff from the two and ten year storms. Detention for water quality after a storm (one-year storm) had not yet been considered when these older sites were developed. Other non point source pollutants often generated from residential, commercial, and industrial land uses such as oil, grease, pesticides, fertilizers and road salts may be impacting these tributaries due to poor stormwater management.

It is apparent that the general public is in need of education. The health of the watershed is in their hands, not just that of environmental agencies and public authorities. This was evident as one investigative team member noticed a private citizen that resides on the Rancocas Creek disposing of their pet's waste in the creek. There are also numerous discharge pipes from homes along the North Branch of the Rancocas in Eastampton Township. These are speculated to be for septic tank or sump pumps. Raising the awareness of residents concerning the impact that direct discharges and runoff from residential areas have on the creek is also critical. Promoting concepts such as backyard habitat improvement and xeriscaping serves to draw the public into watershed issues by furnishing them with fun activities that will provide many hours of enjoyment and can increase their property value.

Opportunities to educate the general public as well as public authorities, such as mayors, township officials, etc., abound just on the 22 sites as described in this report. There are a vast number of methods, some not included in this report, which could be used in effectively

preventing further erosion and improving the habitat for wildlife. The general public seems to want to do more to help the environment, but usually do not know where to begin. Seminars on the overall health of the creek, how to improve the health or reduce pollutant loading, and how to implement soil bioengineering methods have proven to effectively involve the community in similar situations. When the general public gets involved with these projects it includes a sense of responsibility and helps to impress on them to do what they can to reduce problems. These programs would also improve the image of the Rancocas Creek and enhance water quality.

In addition, facilitating public access to these waterways is important because it will instill a sense of ownership and, in turn, a sense of stewardship among citizens. These attitudes help generate support for necessary policies and plans, and help to change consumptive behaviors that can have detrimental impacts on the watershed. Conversely, lack of public access limits the public's exposure to or use of the waterway, reducing interest in and the willingness to take action in the fostering and care of the watershed.

References

Anderson, Karl, September 1977. "New Jersey Audubon's Newest Facility: Rancocas Nature Center," NJ Audubon, Vol. III, No. 9, p. 138-141.

Bernstein, Herbert, August 1978. "No Free Rides," South Jersey Magazine, p. 19-21.

Citizens United to Protect Hawk Island, November 1996. Natural Resource Inventory for Hawk Island, Delanco Township, Burlington County, New Jersey.

DeCou, George, 1949. "The Historic Rancocas," The News Chronicle, Moorestown, New Jersey, p. 1-6, 173-194, 205-211.

Eisenstat, Ben, October 1962. "Rancocas New Jersey: A calm red brick oasis out of the past," *Today Magazine*, The Philadelphia Inquirer, Philadelphia, Pennsylvania.

Federal Emergency Management Agency, 1983. Flood Insurance Study, Township of Medford, Burlington County, New Jersey, p. 2-20.

New Jersey Department of Environmental Protection, Office of Environmental Planning, February 1995. New Jersey 1994 State Water Quality Inventory Report, p. III-13 – III-18.

Sokolic, William, H., June 19, 1988. "Many Along Muddy Rancocas Went Dredging," Philadelphia, Inquirer, Philadelphia, Pennsylvania.

Times Advertiser, Burlington County Times, June 1964. "Logs Once Floated Down Rancocas Creek from Pines to Mills," Willingboro, New Jersey.

USDA Natural Resources Conservation Service, October 1971. Burlington County Soil Survey.

USDA Natural Resources Conservation Service, December 1996. Engineering Field Handbook, Chapter 16.

Acknowledgements

The Burlington County Soil Conservation District would like to thank the following individuals for their guidance and assistance in completing this grant project:

Department of Environmental Protection

Sue Halsey

Burlington County Soil Conservation District

Board of Supervisors
Donald P. Yarus, District Director
Cindy Smarra, Bookkeeper
Janel Decker Jurkiewicz, Natural Resource Assistant
Robert C. Reitmeyer, Natural Resource Specialist
Craig Fisher, Project Inspector

Burlington County Data Processing Office

John Pavek
Merrilee Torres
Kathleen Meyers

Natural Resources Conservation Service

Janice Reid, District Conservationist
Leon Brooks, Resource Conservationist
Kenneth Taaffe, Resource Conservationist Douglas Kaufmann, Soil Conservationist
Tami Kelly, Soil Conservationist Technician