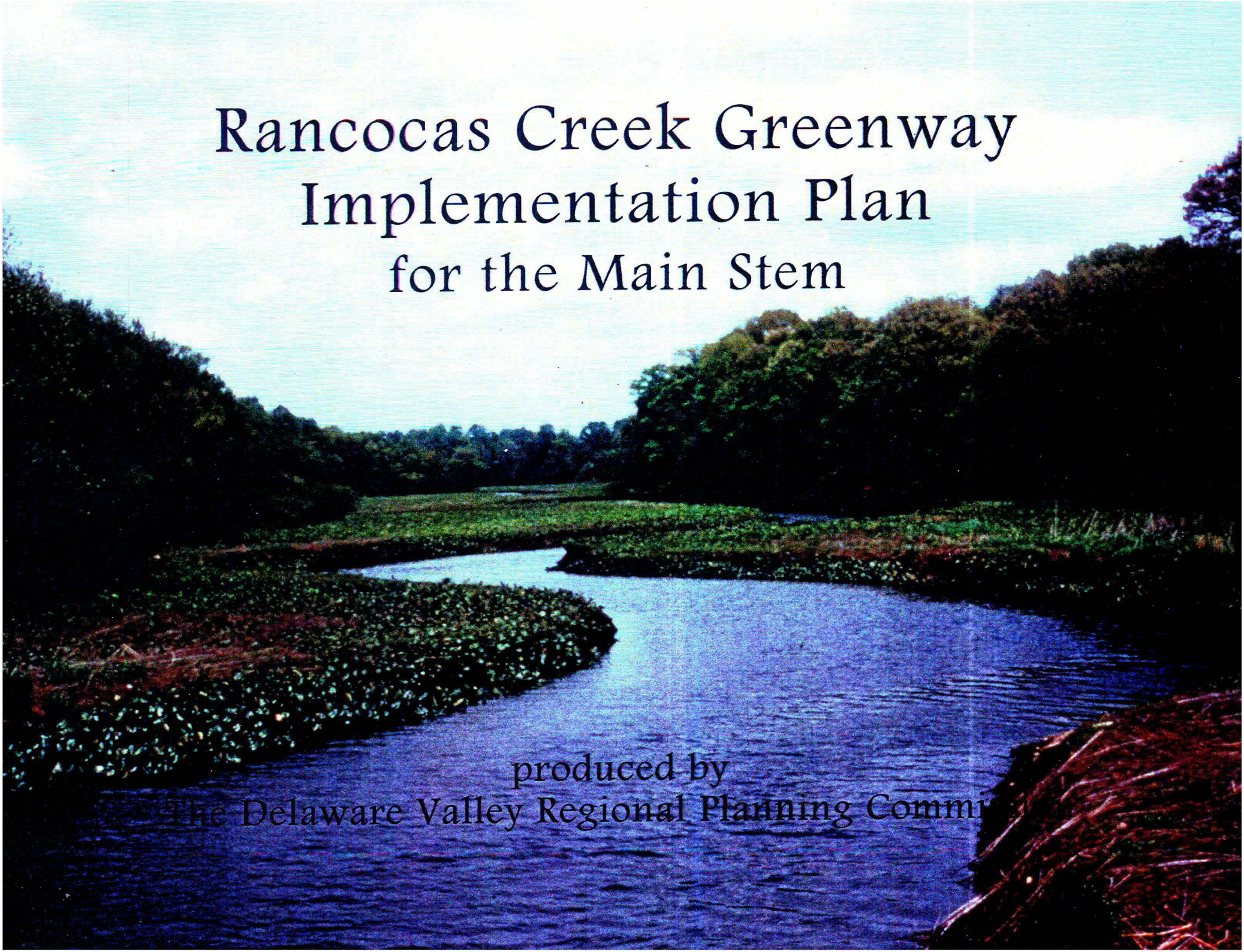

Rancocas Creek Greenway Implementation Plan for the Main Stem

produced by
The Delaware Valley Regional Planning Commi

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December 1996

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Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty and intercity agency which provides continuing, comprehensive and coordinated planning for the orderly growth and development of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties as well as the City of Philadelphia in Pennsylvania and Burlington, Camden, Gloucester, and Mercer counties in New Jersey. The Commission is an advisory agency which divides its planning and service functions between the Office of the Executive Director, the Office of Public Affairs, and three line Divisions: Transportation Planning, Regional Planning, and Administration. DVRPC's mission for the 1990s is to emphasize technical assistance and services and to conduct high priority studies for member state and local governments, while determining and meeting the needs of the private sector.

The DVRPC logo is adapted from the official seal of the Commission and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River flowing through it. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey. The logo combines these elements to depict the areas served by DVRPC.

DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Publication Abstract

TITLE	DATE PUBLISHED: DECEMBER 1996
RANCOCAS CREEK GREENWAY IMPLEMENTATION PLAN FOR THE MAIN STEM	**PUBLICATION NO. 96021**

Geographic Area Covered: Streamside properties along the Main Stem of the Rancocas Creek in Burlington County, New Jersey. Municipalities covered include Westampton, Mt. Laurel, Moorestown, Willingboro, Delran, Delanco and Riverside Townships.

Key Words: Greenway, riparian corridor, open space preservation, floodplains, wetlands, wildlife habitat, non-point source pollution, recreation, sense of place.

ABSTRACT

This report is a "how-to" guide for municipalities, the county and state, the Rancocas Conservancy and residents interested in protecting the creek environment and people's enjoyment of it. Through research, analysis, and public meetings, the plan identifies the major environmental, recreational and sense of place issues facing the Rancocas Main Stem. The plan provides a rationale for why these issues are important, and proposes recommended actions to address them.

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Executive Summary

The Rancocas Creek Greenway Implementation Plan has been developed as a "how-to" guide for municipalities, the county and state, the Rancocas Conservancy and residents interested in protecting the creek environment and people's enjoyment of it. The greenway plan covers the streamside properties along the Main Stem of the Rancocas, starting at the Rancocas Creek State Park where the North and South Branches meet and traveling 8 miles downstream to the creek's confluence with the Delaware River. This area passes through a variety of residential neighborhoods and agricultural settings which provide cherished views to local landowners and recreational users. However, the remaining open space lands are being quickly converted to new subdivisions and other uses.

Through research, analysis and public meetings, three main greenway issues have come forth. In addition to identifying these issues, the plan attempts to provide a rationale for why they are important, and it proposes recommended actions that, if implemented, will serve to address them:

Issue #1 - The Rancocas ecosystem is bounded by fragile environmental features including floodplains, wetlands and wooded uplands. These areas serve important functions in absorbing flood waters and stormwater runoff, filtering out non-point source pollution before it reaches the creek and groundwater reserves, and providing habitat for wildlife. Inappropriate development, uncontrolled stormwater, and non-point source pollution all threaten the health of the Rancocas ecosystem.

Major Recommended Actions

1. Municipalities in the study area should consider adopting an overlay Riparian Corridor Conservation Ordinance.

2. Municipalities should consider adopting mandatory cluster development districts along the creek's edge.

3. The NJDEP should develop and make public a detailed long-term plan for the re-use of Hawk Island, including any continued dredge material disposal.

4. NJDEP and the Burlington County Soil Conservation District should work together to produce a watershed based stormwater management plan for the Rancocas Creek Watershed.

5. The Rancocas Conservancy should develop and distribute brochures on good landowner stewardship to property owners in the Rancocas watershed.

6. The Rancocas Conservancy should contact landowners about acquiring voluntary conservation easements to environmentally sensitive and scenic portions of their property.

Issue #2 - Burlington County needs to develop additional public open space to meet current and future recreation needs. The Rancocas Greenway area is a population center surrounding a unique regional resource. These two factors make the area ideal for additional county owned open space. However, the popularity of the creek for recreational use has sometimes resulted in increased pollution, erosion and trespassing on private property.

Major Recommended Actions

1. The Burlington County Office of Land Use Planning should focus immediate preservation efforts on properties labeled Development Proposed in the Prioritized Resource Protection Map.

2. Burlington County and the New Jersey Department of Environmental Protection should examine the possibility of acquiring Hawk Island for passive recreational use and a nature center focusing on wildlife habitat restoration;

3. Marina operators and concerned boaters should form a Rancocas Patrol, a volunteer boatwatch program based on the premise that watchful eyes will deter reckless and illegal boating behavior.

Issue #3 - The neo-traditional town planning movement is promoting the mix of uses and walkability that Riverside and Delanco already naturally possess. By together capitalizing on their small town design, vernacular architecture and their unique location at the confluence of the Delaware and Rancocas Rivers, these two towns have the potential to not only enhance community pride but to spur economic development as well.

Major Recommended Action

1. Riverside and Delanco Townships should join efforts to build on and market their unique location at the confluence of the Delaware and Rancocas Rivers to boost community pride and economic development.

It is hoped that *the greenway planning process*, which involved numerous meetings with the public and conversations with public officials, as well as the plan itself, will not only raise awareness and concern for the environmental, recreational and changing community issues facing the Rancocas, but will also encourage residents and local officials to seek creative and cooperative solutions to creek related issues, as they arise.

Chapter 1

INTRODUCTION

Chapter 1
INTRODUCTION

Background

The main stem of the Rancocas Creek is a special place. Its beauty and bounty have attracted people to its banks since prehistoric times. In 1772, the Quakers established the first permanent agricultural settlement and called it Rancocas, after the name the Indians had given to the creek. By the mid 19th century the Rancocas Creek environment became a popular tourist destination for Philadelphians seeking to escape the city. Excursions along the Rancocas peaked in the 1860s and then quickly declined after the opening of railroad lines going from Philadelphia to the Jersey shore. The urban cores in Delanco and Riverside formed in the late 19th century. Up until World War II, most of the Rancocas main stem outside the concentrated urbanized area remained undeveloped as farmland and woodlands.

It was after World War II, when the federal promotion of road building and inexpensive mortgages encouraged suburbanization, that the character of the main stem changed again. Willingboro was originally developed as a Levittown, transforming the township into a large subdivision over a short period of time. Other waterfront properties in Mt. Laurel and Moorestown are currently being developed into new residential areas. A number of existing farms are currently up for sale and likely to become new developments. By the turn of the century, most of the waterfront property along the main stem of the Rancocas is likely to be developed for residential or other uses.

People continue to be attracted to the main stem area of the Rancocas because of its natural beauty, recreational opportunities, and excellent highway access to job centers. Recognizing that the Rancocas Main Stem is undergoing change, the intent of this plan is to identify measures that will serve to protect the resources that have made the Rancocas Creek environment so attractive and appealing in the first place. If implemented, these efforts will result in a greenway that protects the natural environment, scenic vistas and recreational opportunities so valued by all the people who live along and know the Ranocas.

Why a Greenway

But why a greenway along the Rancocas? A greenway is like a ribbon of open space linking natural, cultural, and recreational resources together. Due to its linear nature, a greenway corridor passes through a variety of communities, connecting people to open space. It is the perfect response to preserve what is special about the Rancocas. A greenway established along the Rancocas can provide many benefits. It can preserve the environmental

features in the area, and thereby provide natural protection from flooding, improve water quality and provide a hospitable corridor for wildlife migration. It can offer scenic relief from the urban landscape, preserve the integrity of historic sites and nostalgic places, and enhance people's enjoyment of the creek. As the common thread tying municipalities together, it can also improve intermunicipal communication and cooperation. In addition to these benefits, a greenway can raise individual property values as well.

Although it may sound like a tall order, a greenway implemented with community support really can provide all the benefits mentioned above. Realization of some of the benefits may be subtle, such as improved water quality over time. Other benefits are intrinsic, such as the return of certain rare or endangered species. Still others may be taken for granted, such as a lack of flooding. Yet all these benefits can be generated from implementing the primary intent of the greenway; to create and maintain a clean, green open space buffer along both sides of the Rancocas Creek.

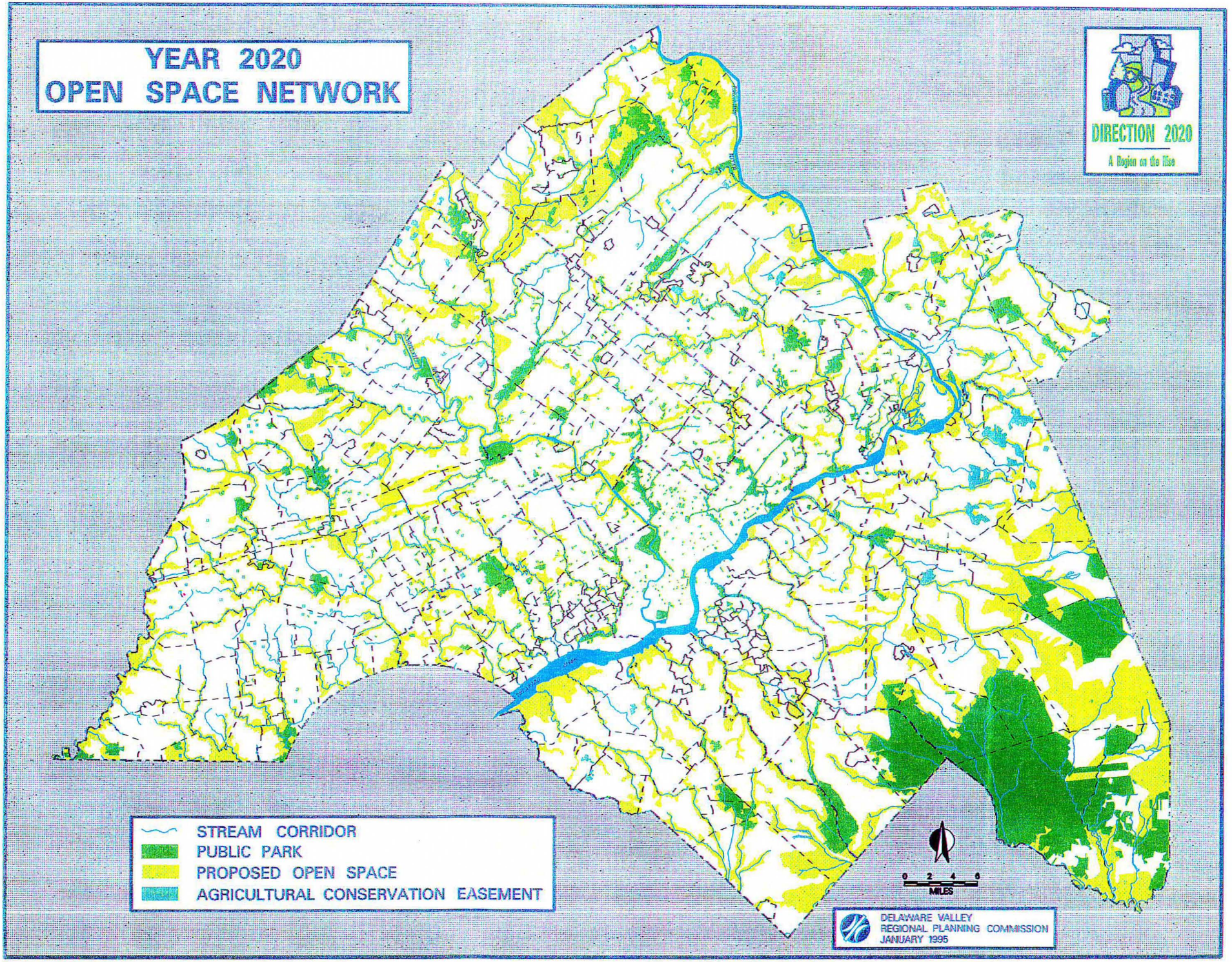
Rancocas Creek Main Stem Study Area Defined

The Rancocas Creek Greenway Study Area extends along the Rancocas Creek Main Stem from the Delaware River about 8 miles upstream to the creek's split at Rancocas Creek State Park, and then another two miles east through the park on both the North and South Branches. The study area focuses primarily on the properties between the creek and the first parallel street in the seven municipalities along the Main Stem; Riverside, Delanco, Delran, Willingboro, Moorestown, Mt. Laurel, and Westampton. However, the Main Stem drains an area of almost 50 square miles, and many of the issues and recommendations are pertinent throughout the watershed.

The Rancocas Main Stem was selected for two main reasons. Firstly, it was known that some of the creek's large, remaining adjacent farmland was under development pressure and therefore required prompt preservation planning. Secondly, due to the development potential on the farm parcels, the Burlington County Office of Land Use Planning had begun studying the area for greenway implementation, but was unable to progress due to staffing shortages. The DVRPC project allowed work to continue on establishing a Rancocas greenway.

Study Purpose in Regional Context

The Rancocas Creek Greenway Implementation Plan is a follow-up study to the Open Space Element of DVRPC's Year 2020 Comprehensive Plan, DIRECTION 2020. The open space element within the plan identified areas throughout the region, such as the Rancocas Creek and other environmentally sensitive stream corridors, proposed for open space preservation to provide both natural resource protection and recreational opportunities. Although the nine-county region covered in the DVRPC plan contains more than 1.5 million acres of open space, only about 250,000 acres are currently protected as public parks. The year 2020 Proposed Open Space Network (see map on following page)


YEAR 2020
OPEN SPACE NETWORK
DIRECTION 2020
A Region on the Rise
STREAM CORRIDOR
PUBLIC PARK
PROPOSED OPEN SPACE
AGRICULTURAL CONSERVATION EASEMENT
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JANUARY 1995

presents a proposed open space network sufficient in area to meet the region's recreational needs through the year 2020 and beyond. It also designates for protection woodlands and upland habitat areas that provide an environment for plants and animals, and the river and stream corridors and wetlands that supply clean water for drinking, habitat for fish, plants and other wildlife. This and other DVRPC greenway implementation plans are intended to be "how-to" guides, containing the necessary data base of information, analysis, community input, recommendations, and responsible parties to translate the broad goal of preserving open space into concrete implementation strategies.

Other DVRPC Greenway Studies

In addition to the Rancocas Main Stem Greenway Study, DVRPC has conducted several other greenway projects in the region. In Pennsylvania, DVRPC compiled the parcel specific inventory and created a series of maps for the Ridley Creek through Chester and Delaware Counties. This information served as the basis for more detailed analysis and recommendations prepared by the Natural Lands Trust of Media, Pennsylvania. In New Jersey, DVRPC has also inventoried and mapped the Mantua Creek from its headwaters in Glassboro to Bethel Mill Park, and one of its tributaries, Duffield Run in Washington Township. DVRPC will continue working on the Mantua Greenway project in coordination with the Gloucester County Federation of Watersheds and the Gloucester County Planning Department. DVRPC is also lending technical assistance to the Camden Greenway Working Group for continuation of the Cooper River greenway through Camden to the Delaware River.

In addition, through a grant from the New Jersey Local Coastal Planning Grant Program, DVRPC acted as the consultant to the Rancocas Conservancy to produce parcel based maps for the North, South and Southwest Branches of the Rancocas Creek outside the Pineland Border. These maps will assist the Conservancy in their greenway planning efforts. DVRPC will continue to conduct greenway implementation planning work along other areas identified in the open space plan in fiscal year 1997.

Relationship to State and County Open Space Planning

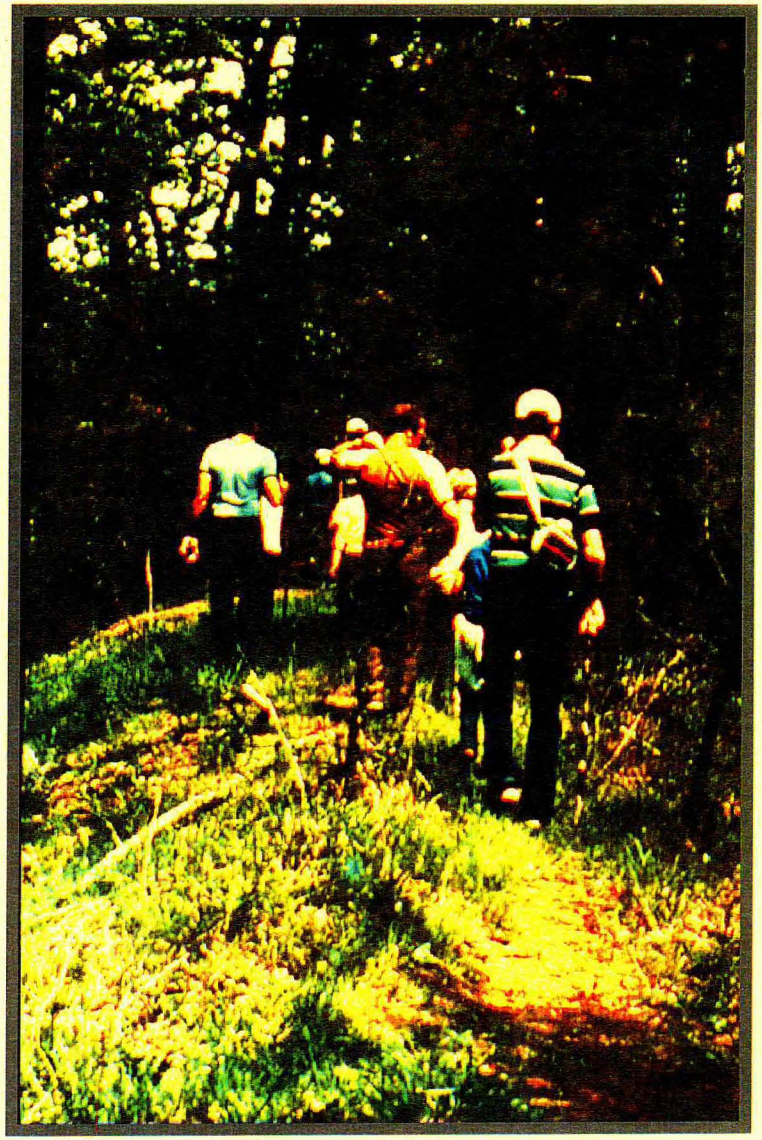
The intent of the Rancocas Greenway Implementation Plan is consistent with and supported by the 1992 New Jersey State Development and Redevelopment Plan (SDRP), the 1994 New Jersey Open Space and Outdoor Recreation Plan, and the 1996 Burlington County Open Space Preservation Program. In the SDRP, one of the eight planning goals and strategies is to "Preserve and enhance historic, cultural, open space and recreational lands and structures by identifying these resources and using preservation, conservation and other programs and techniques to guide growth in locations and patterns that protect them." (SDRP, p. 11) In the State Open Space and Outdoor Recreation Plan, one of the primary objectives is to preserve sufficient open space for current and future public use and to utilize the environmental protection amenities of open space to

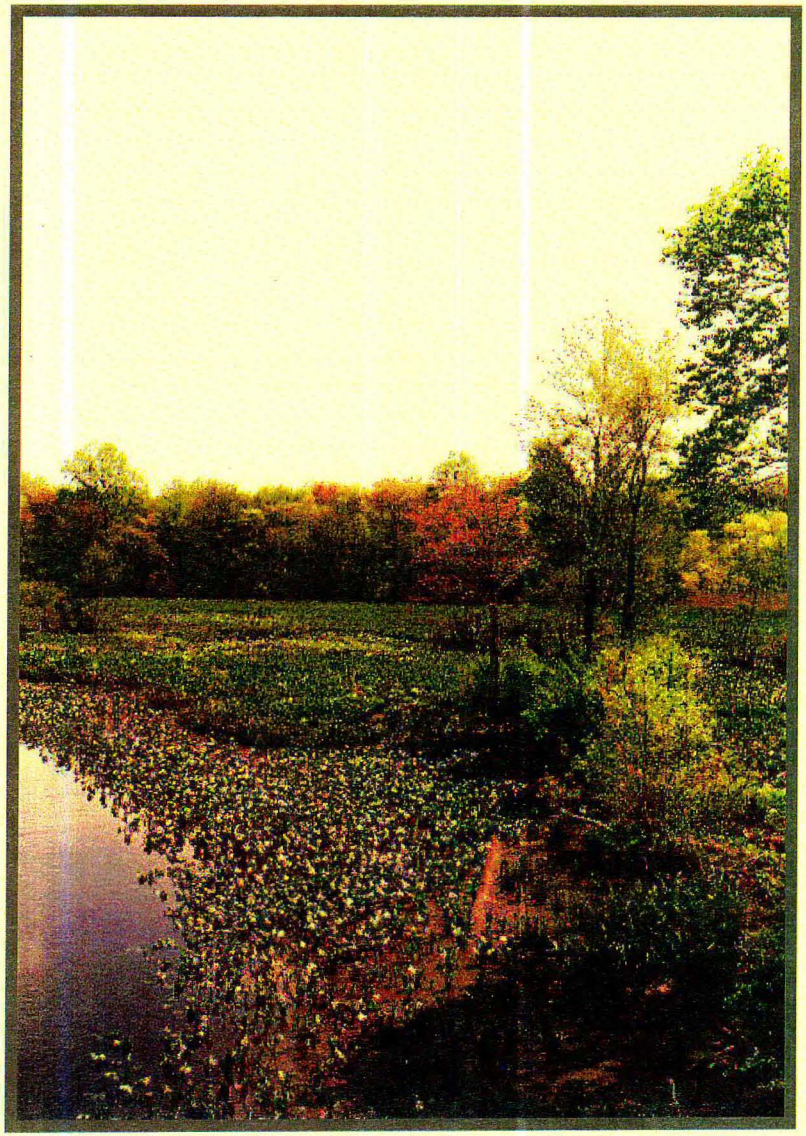
protect important natural and historic resources for the maintenance and enhancement of the quality of life in New Jersey. It is also the specific policy of the State of New Jersey to establish a greenway network through cooperative regional initiatives with local governments and nonprofit land trusts and by legislative, planning and financial efforts.

The county is currently in the process of developing a program to permanently protect open space and farmland before it is swallowed by encroaching suburban sprawl. The county's goals are to protect critical environmental resources, provide a mix of recreational experiences, serve major population concentrations of the county, establish buffers around areas not compatible with development, and to maintain the rural character of portions of the county. (Burlington County Open Space Preservation Program Strategic Plan, page 15) The county plans to achieve these goals through a two-tiered strategy. Firstly, the County Office of Land Use Planning will work with municipalities to develop land use planning techniques such as municipal master plans and ordinances that provide for open space. Secondly, in recognition that acquisition is sometimes the only alternative in preserving certain lands, the county will be establishing a dedicated funding source through a two cent increase in the county's tax rate. This has been estimated to raise $3.8 million annually. Half of this will be used to preserve farmland exclusively, and half will be for combined farmland and open space preservation purposes. This tax will provide a steady and reliable funding source dedicated to preserving the county's disappearing farmland and open space.

Involving the Public

Recognizing that community interest and support is imperative to the greenway's success, public involvement has been and will continue to be an essential component to the greenway effort. As the study began in the winter of 1995, introductory letters were sent and presentations were made to each of the townships in the study area to both inform them of the study and to elicit their support and assistance as needed. The municipalities continued to be contacted throughout the process both to seek information and to offer updates as to the study's progress. Two public meetings were held, the first in June of 1995, to present the initial findings on existing conditions and possible futures, and to listen to community issues and concerns. The second meeting was held in June of 1996, to present the preliminary recommendations and hear the public's reaction. Both meetings were lively and well attended, and the feedback was incorporated into the plan. Throughout the process, DVRPC worked closely with the Burlington County Office of Land Use Planning and the Rancocas Conservancy, who will both work with municipalities and landowners to begin implementing the recommendations of the plan, making the Rancocas Greenway a reality.





Chapter 2 EXISTING CONDITIONS and IMPLICATIONS for the GREENWAY

Chapter 2
EXISTING CONDITIONS and IMPLICATIONS for the GREENWAY

To examine existing conditions along the Rancocas, DVRPC compiled data on land use, ownership, environmental features, historic resources, and zoning for each parcel in the study area. The methodology and sources of information used are described in Appendix C. Related data on topics such as water quality, endangered species and recreational facilities was also researched. In addition, federal, state, and local plans and regulations affecting the environment and development along the Rancocas were reviewed and assessed. This information, along with issues and concerns elicited at the public meetings, was integrated to conclude the best measures for implementing a greenway along the Rancocas.

Environmental Features and the Rancocas Ecosystem

The stream and its associated floodplains, wetlands, woodlands and wildlife are intricately interconnected making up the Rancocas ecosystem. Disturbances to any of the ecosystem's components threaten to unbalance the system. The following section assesses the conditions contributing to and dependent on the Rancocas ecosystem.

Water Quality

Covering 75% of the earth's surface, water is not only the most abundant resource on earth but possibly the planet's most valuable resource. Water makes up two thirds of the human body and is the main substance of all other living things as well. Water is used to produce our food, paper, furniture, clothes, homes and almost everything else around us. We are also dependent on clean water for recreational and leisure activities such as swimming, boating, fishing and hiking along a stream. Although water is plentiful, only 3% of the planet's water is fresh water, most of which is locked in polar ice caps and glaciers. The remaining fresh water must be "recycled" over and over again to meet the needs of people and all other forms of life. (PA Department of Environmental Protection Water Pollution Control in PA Fact Sheet, 1996)

The water quality of a creek such as the Rancocas is affected by two forms of pollution, point and nonpoint. Examples of point sources are sewage treatment plants or industries that discharge directly into a stream. Less obvious are the nonpoint sources, pollution that does not come from any one specific place but enters the stream after flowing over or under land within the watershed. A watershed is all the land that water flows across or under on its way to a particular stream. On its way, water travels

over the surface of parking lots, streets, suburban lawns and farm fields, or it seeps into the soil and travels as ground water. Either way, water picks up pollutants such as sediments from construction projects, toxins from pesticides, and pathogens from human or animal fecal matter, and delivers them to the stream. The entire Rancocas Creek watershed is 360 square miles and is the largest in south-central New Jersey. About half the watershed is forested, including an area that drains the Pinelands Protection Area. The remaining area is divided between urban/suburban development patterns and agriculture, although many of the agricultural areas are under significant development pressure. Of this, almost 50 square miles drain directly into the Main Stem. (NJ Water Quality Inventory Report, 1992)

The Rancocas Creek's water quality is regarded by the New Jersey Department of Environmental Protection as threatened, as are all waterways in the state, due to the level of development, the population density, the economic pressures for development, the intensity of land use and the ubiquitous nature of non-point source pollution. The most common water quality problems affecting the Rancocas Creek include total and fecal coliform bacteria, nutrients, depressed dissolved oxygen levels, pH fluctuations, siltation, road salts, and oil and grease. Nonpoint sources of pollution are a major factor in the degradation of the creek. Nonpoint sources include stormwater outfalls, construction, urban and agricultural runoff, land disposal practices, and marinas. (NJ Water Quality Inventory Report, 1992 and 1994)

New Jersey Department of Environmental Protection monitors and assesses water quality for aquatic life use support and for primary contact use support (swimming). The most recent assessments were conducted in 1992 and indicated excellent water quality (no or minimal pollution, water quality uses met throughout the year) at sampling stations located at Brown Mills and Pemberton; good water quality (generally low amounts of pollution, certain water uses periodically not met) at Mt. Holly and Vincetown; and fair water quality (pollution amounts vary from moderate to high levels, certain water uses prohibited) at Hainsport. It seems, apparently, that water quality diminishes as it flows downstream through increasingly developed areas. However, no stations along the Rancocas Main Stem were actually sampled, and the NJDEP recommends that data not be extrapolated beyond the immediate station location. Nevertheless, a NJDEP water quality modeling study found excessive nutrients, elevated algae production, and highly fluctuating diurnal dissolved oxygen concentrations, and the overall Rancocas Creek is identified as having "Some Aquatic Life Support Impairment". (NJ Water Quality Inventory Report, 1992 and 1994)

The creek's water quality has been improving, though, according to Hugh Carberry, Senior Fisheries Biologist at the Fish and Game field office of DEP. He said this is evidenced by shad coming back and spawning, and the Blueback herring, Alewife herring and striped bass all coming back after nearly going extinct 50 to 75 years ago. At least 15 species of fish were identified by electrofishing along the Rancocas between Riverside and Delanco in 1975, the most recent date such sampling has been conducted. (phone conversation 2/20/96)

Through the Citizen Monitoring Program of the Delaware Riverkeeper Network, water quality samples were taken by a volunteer at a marina location on the Main Stem from May 1991 to September 1993. This data showed neutral pH, mildly high levels of nitrates probably due to seasonal fertilizing, low levels of phosphates, and very good levels of dissolved oxygen. These measures show water quality able to support aquatic life, but other measures, such as biomonitoring of macroinvertibrates and visual monitoring of turbidity would further determine the quality of water along the Main Stem. A site in Mt. Holly was also monitored through the Riverkeeper Network by a group of girl scouts, but this effort has also lapsed.

Both the main stem and main branches of the Rancocas Creek outside the Pinelands are classified as FW2-NT, meaning fresh water non-trout surface water that has not been designated to be maintained in its natural state of quality for posterity. Sections of the Rancocas in the Pinelands and in Lebanon State Forest are classified PL and FW1, respectively, and are afforded greater protections.

While the water quality in the main stem of the Rancocas seems to be improving, the area is also anticipated to undergo a growth spurt by the turn of the century. ***New development increases stormwater runoff, sedimentation and other nonpoint source pollution in the watershed, which eventually reaches the river. New development may also threaten and stress the floodplains and fresh water wetlands, whose function in filtering out pollutants before they reach the stream becomes even more paramount. Protecting these features from encroachment and limiting nonpoint source pollution is therefore imperative to improving water quality in the creek.***

Since NJDEP has not had sampling stations along the Main Stem, and the previous citizen monitoring efforts have discontinued, stakeholders in this part of the Rancocas should reactivate the effort. A group of interested volunteers can form a task force and receive technical assistance from the Riverkeeper Network on conducting and interpreting water quality sampling. Usually, groups need to raise money to buy the water analysis kits (they are not provided by the Riverkeeper Network), but it may be possible to acquire them from the former girl scout monitors. The group should complement their water quality monitoring with proactive public outreach to municipal officials. Water quality data can be used to influence land planning decision making and can provide impetus for land stewardship educational outreach.

In addition, local schools can play a role in monitoring the water quality of the Rancocas and teaching about water issues at the same time. Environmental educational programs are offered by the New Jersey Audubon Society, which has a nature center located inside the Rancocas Creek State Park. Last year about 6,000 students came to the nature center on school sponsored field trips. Audubon naturalists also go out to about 50 schools in the area to present special environmental classes. Plus, the Audubon Society has developed an elementary school level environmental curriculum called "Bridges to the Natural World" that is currently used by teachers in about 150 school districts statewide. Furthermore, the Society has recently created a high school program called New Jersey Waters which fosters communication between neighboring schools who each monitor

surface water quality in their area of the watershed. (telephone conversation with Brian Vernachio, Audubon Society Teacher/Naturalist, September 20, 1996) Adopting this program along the Rancocas would provide another opportunity to monitor the creek's water quality and simultaneously provide a lesson in civics by having students present data to public officials. Although many schools are participating in these and other environmental programs, many still are not. Students and their parents should urge their school systems to incorporate environmental education, for their own enrichment and for the earth's.

Flooding and Floodplain Management

Practically all riverfront properties along the main stem of the Rancocas are floodprone, as shown on Map 1 - Natural Resource Areas, which shows the 100 year flood delineations of the Federal Emergency Management Agency (FEMA). Left in their natural state, floodplains perform many important functions. Floodplains drain floodwaters, preventing serious on-site and downstream flooding and erosion which destroys property and endangers human life. Floodplains also naturally enhance water quality by filtering nonpoint source pollution, especially sedimentation and stormwater runoff, before they reach the stream. Moreover, floodplains provide ground area and passageway for wildlife to nest and migrate.

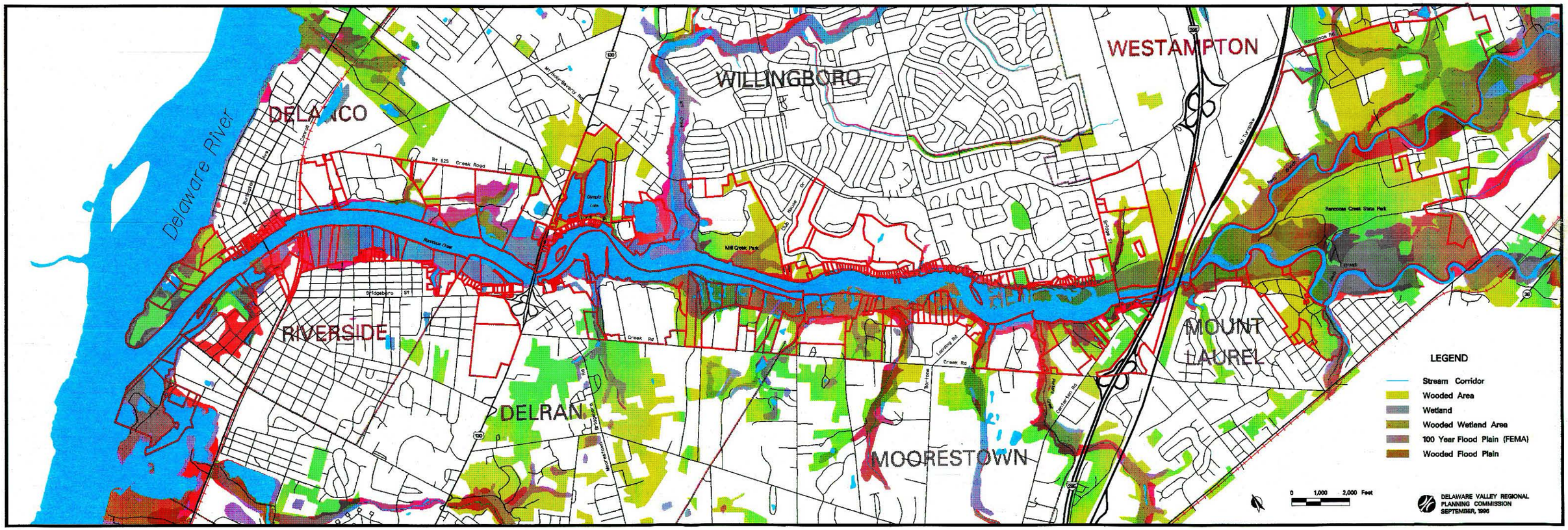
To assess the flooding situation along the main stem of the Rancocas, the Rancocas Conservancy conducted a telephone survey of municipal managers in February of 1996. The Conservancy found that only a few of the municipalities had even minor flooding problems in the vicinity of the Rancocas, but where they did occur the floodplain had been encroached upon, such as near the bridge between Delanco and Riverside. ***Because the floodplains along the main stem have been largely undeveloped, they have been able to perform their natural function in absorbing floodwaters. This function, however, is at risk, since an assessment of local floodplain regulations revealed them to allow more development than has occurred.***

Development in flood hazard areas (defined as 25% greater than 100 year flood delineations) along the Rancocas is subject to review and permitting by the state DEP and by the municipality where there are local floodplain ordinances in effect. The state issues waterfront development permits for stream encroachments provided that the proposed development meets specific criteria, such as not obstructing stream flow and adequately complying with stormwater runoff and water quality regulations. Moorestown, Mt. Laurel, Willingboro and Riverside each have adopted floodplain ordinances, which allow development in the flood hazard area provided it meets the requirements of the state regulations. Communities with their own ordinances have advantages over localities that rely solely on state review in that they can more closely control the type of development they will accept in the fragile flood hazard areas, and they can guide development plans to match local environmental protection goals during the site plan review process.

Although these floodplain regulations are certainly more effective in protecting the fragile floodplain areas than no floodplain regulations, even these types of restrictions on development could be improved, thereby better protecting the entire stream system. Allowing development in flood hazard areas, albeit with a permit,

Map 1 – NATURAL RESOURCE AREAS

RANCOCAS CREEK GREENWAY STUDY



disturbs the natural ability of floodplains to provide sufficient storage for floodwaters, and will undoubtedly have a cumulatively detrimental effect on downstream properties. In addition, although permitted construction in flood hazard areas is supposed to meet certain standards that would minimize damaging effects, there is the possibility that, under certain circumstances, these standards could potentially be relaxed to meet other municipal goals. For example, in nearby Cinnaminson Township, there was a recent development proposal to build a 117 townhouse unit subdivision entirely within the 100 year floodplain along the Delaware River and Dredge Harbor. Because the developer was promoting a portion of the subdivision as affordable to help the township meet its fair share housing requirement, the development proposal apparently was given more consideration, despite its location in the floodplain. The proposal was rejected by the Township Planning Board in April of 1996 for environmental concerns, but the developer is still actively pursuing his proposal. (Telephone conversations with Suzanne Day, Chair of Cinnaminson Township Environmental Advisory Committee, September 1996)

Freshwater Wetlands

For many years, marshes and other wetlands were thought of as dismal, mosquito-ridden places with little economic or other value. Now, as wetlands have been further studied, their value is better understood and accepted. ***In their natural state, wetlands help control floods, reduce erosion, improve water quality, contribute to wildlife habitat, and provide open spaces that increase property values and enhance quality of life.*** Many of these benefits were not known or appreciated until the 1970's and 1980's. By then, more than half the nations marshes, swamps, and bogs had been filled, and the need to halt wetland loss was considered critical. Against this background, local, state and federal agencies responded by creating a series of regulatory programs.

Since wetlands are considered a critical natural resource, they are protected under a number of state laws and regulations, including the Freshwater Wetlands Protection Act of 1987, The Wetlands Act of 1970, Waterfront Development Act, Coastal Area Facility Review Act (CAFRA), Flood Hazard Area Control Act (Stream Encroachment) and Water Quality Criteria. Federal acts regulating development in wetlands include the Clean Water Act, Rivers and Harbors Act, National Environmental Policy Act and Coastal Zone Management Act. The U.S. Army Corps of Engineers issues federal permits, in cooperation with the USEPA.

In addition to regulating wetlands themselves, NJDEP also regulates Transition Areas or buffers around freshwater wetlands. Buffers are considered important to reduce developments' impact on wetlands. A permit is required for practically any activity proposed in a wetland. Permits allow limited types of activities in wetlands, provided specific permit conditions relating to their impact on the environment are met.

At the local level, municipalities can choose to set performance zoning standards for wetland areas. A common approach is to set aside a certain percentage of an area that must be left undisturbed. Performance zoning can be very effective and equitable because it allows a portion of a tract to be developed while limiting the impact on the sensitive part. In addition, effective floodplain, erosion and sedimentation control, and stormwater management

plans can be used to protect wetland resources at the municipal level.

Erosion and Sedimentation Control

Controlling erosion and sedimentation along the Rancocas is important to the overall health of the Rancocas. Sedimentation entering the creek reduces its width, decreasing the surface area of the stream bottom where most biological activity occurs. Eroded soil initially suspended in the water decreases the amount of sunlight reaching aquatic plants, inhibiting their growth and reproduction, as well as harming fish life by clogging gills. Erosion and sedimentation entering the stream also increases the amount of phosphorus in the stream, leading to the proliferation of algae, at the expense of submerged aquatic life. Moreover, eroded soil and sedimentation in the stream reduce the stream's carrying capacity during floods. (Montgomery County Model Riparian Corridor Overlay District Ordinance, 1996)

All developments involving over 5,000 square feet of soil disturbance or more than one single family dwelling must be reviewed by the Burlington County Soil Conservation District for compliance with their standards. Townships may only issue permits for occupancy after the Soil Conservation District has issued a certificate of compliance to the developer. If a construction site is inspected and found in violation, the soil conservation district works with the developer to resolve the problem. Significant fines of up to $3,000/day and stop work orders may be issued for repeated violations. Since Burlington County's four inspectors are unable to check every construction site every day, it is important for township officials and residents to keep watch over construction sites, especially large projects where the soil may be disturbed over a long period of time and would be subject to numerous rainfalls. Township officials and neighbors should notify the Soil Conservation District if they suspect a problem.

When erosion and sedimentation problems on development sites do occur it is often due to lack of knowledge of proper control measures by construction crews. Both the States of Delaware and Maryland require classes and certification for state-of-the-art sediment and stormwater control measures geared toward foremen responsible for on-site clearing and land disturbing activities during construction. The states also require that at least one supervisory person with certification to be on location at each construction site. State staff report little resistance to the program, and positive feedback from both communities and the regulated contractors and developers.

Stormwater Management

Effective stormwater management is important to prevent flooding and to decrease the amount of runoff pollutants reaching the waterway. Stormwater drainage systems are generally designed to limit the rate of runoff from any new development to not exceed the rate of runoff that occurred before development. They do this by detaining rainwater on-site in basins or underground holding tanks and releasing the stormwater at a controlled rate equal to the predevelopment rate. Although the release rate is designed to be same as before development, the quantity of stormwater is increased. This is because the impervious coverage associated with the development results in

less water being absorbed directly into the ground with more water draining as surface runoff. The cumulative effect of many basins within a watershed releasing increased amounts of water over time can be damaging to the creek's banks (although it is obviously preferable to sudden flash floods that might occur without stormwater management facilities). In addition, the increase in runoff quantity can also have a detrimental impact on the creek's water quality.

To comprehensively address these issues, NJDEP has recently drafted amendments to the Stormwater Management Rules that specify new technical standards for stormwater runoff water quality and quantity, and that establish criteria for watershed control of stormwater runoff from new and existing development. The basic premise behind the proposed amendments is that watershed based planning and program implementation for stormwater runoff control, that moves beyond site-by-site calculations after land development projects are proposed and implemented, can more effectively manage runoff quantity and water quality at lower total cost. (NJDEP Watershed Focus, Winter 1996, and telephone conversation with NJDEP's Liz Rosenblatt, September 1996)

In addition to the new rules, NJDEP also recently prepared a Nonpoint Source Pollution Best Management Practices Manual to serve as a guide for nonpoint source pollution and stormwater management. The manual demonstrates how to integrate nonpoint source pollution and stormwater management control practices into the development planning process. For example, it shows how to apply pollution prevention techniques during the site design stage of a development. The manual primarily presents guidance directed toward new development and redevelopment, but some of the procedures can also be applied to existing developments. Best management practice guidelines for road construction and maintenance are also included.

Currently, only Delran, Mt. Laurel, and Delanco have a plan and stormwater management regulations in place. With the issuance of the new watershed based Stormwater Management Rules and the new Best Management Practices Manual, the stage is set to develop a watershed based stormwater management plan for the Rancocas. The County Soil Conservation District has compiled runoff and release calculations from all the projects they have reviewed since 1976 which can be used to help develop the watershed based plan. After it is developed and adopted, municipal plans and ordinances are expected to comply with the new standards.

Wastewater Management

Improperly treated wastewater discharged into a stream can be a major source of pollution. The NJDEP administers the New Jersey Pollutant Discharge Elimination system (NJPDES permit program), which regulates facilities and activities discharging or releasing pollutants into the surface and ground waters in the State. According to NJDEP Bureau of Permit Management, Division of Water Quality, there are 18 facilities with permits to discharge into the Rancocas Creek. Three of these facilities, the Willingboro MUA, the Mt. Laurel MUA, and Moorestown Township discharge into the main stem of the Rancocas or one of its tributaries; the remaining 15 discharge into the north, south or

southwest branches. Information on whether dischargers are meeting their permit standards was not readily available.

Within the study area, Willingboro, Riverside, portions of Mt. Laurel and the developed parts of Delran and Delanco are served by public sewage treatment plants. Westampton, portions of Mt. Laurel, Moorestown and the agricultural areas in Delanco and Delran are served by on-lot systems. The Burlington County Health Department has recorded known discharges of sewage and malfunctioning septic systems in each of the townships, but most of the complaints have been abated.

NJDEP is currently undertaking a major initiative to update and improve the NJPDES program. In concurrence with the stormwater management watershed approach, the main focus of the NJPDES program improvement is a move to a watershed cycle for the issuance of discharge-to-surface-water permits. The watershed approach is intended to be a comprehensive program of planning, monitoring, modeling, total maximum daily load development and permitting, integrating both point and nonpoint source pollution controls, and public outreach. (NJ Water Quality Inventory, 1994)

Toxic Discharges

Up until 1991, the NJDEP maintained a program assessing waters where toxic discharges from point sources were suspected. Neither the Rancocas Creek nor any of the lakes in the study area were identified in the program as having experienced violations, and the fish in the creek were not cited as containing PCBs. (NJ Water Quality Inventory, 1994)

The "Toxic Fish Alert for the Delaware Estuary and Nearby Waters" prepared by the Delaware Riverkeeper Network, also did not specifically list the Rancocas as containing toxic fish. It did, however, list species including American Eel, White perch, Catfish, Largemouth Bass, Chain Pickerel, and Bluefish in the Main Stem of the Delaware River that should not be eaten or should be limited to no more than one meal a week, due to high concentrations of mercury, PCBs, chlordane and/or dioxin. Due to the tides, these fish may also possibly be found in the Rancocas Main Stem, and the same advisories would apply.

Nonpoint Source Pollution

Nonpoint source pollution is a major cause of water quality problems in all the state's rivers and streams, including the Rancocas, and is a major concern for groundwater quality as well. Rainwater flowing over land or through stormwater sewer systems conveys most of the nonpoint source pollution affecting waterways. Since the Rancocas Main Stem landscape is becoming increasingly developed, the greenway plan will focus on urban and suburban nonpoint source categories rather than agricultural sources.

As mentioned above, NJDEP recently prepared a nonpoint source pollution Best Management Practice Manual that will serve as a guide for nonpoint source pollution as well as stormwater management. In addition, there are many actions that residential and commercial landowners can take to reduce nonpoint source pollution. For example, property owners should limit the amount of pesticides and fertilizers used in their yards, they should not improperly dispose of hazardous household wastes, and they should plant native species whenever possible, which tend to be

less invasive and provide habitat for wildlife. The Rancocas Conservancy can help spread this information by producing and distributing good stewardship brochures throughout the watershed. Examples of stewardship outreach materials are shown in Appendix D.

Endangered Wildlife and Habitat

Data from the Natural Heritage Program at the NJDEP indicates there are several rare species and natural communities inhabiting the area. Three animal species - the bog turtle, cooper's hawk and red shouldered hawk - are listed as endangered within New Jersey, in immediate danger of extinction. At least five plants are also endangered, and several invertebrates are considered critically imperiled. In fact, the entire freshwater tidal marsh complex along the Rancocas is considered rare in New Jersey and in need of protection.

Interestingly, a territorial pair of bald eagles have also been recently sited constructing a partial nest in the Rancocas Main Stem area. According to the Endangered Nongame Species Program of the Division of Fish, Game and Wildlife within NJDEP, it is unusual for bald eagles to nest in such an area; when spotted, it is much more likely to be in the less developed southern reaches of the Delaware Bay area. Bald eagles have been recently "downgraded" from endangered to threatened in the United States, but are still considered endangered within New Jersey. Many factors can contribute to species' endangered or threatened status, such as predation and disease, but loss of habitat is the most significant cause in the Rancocas environment.

The Willingboro Country Club, a 130 acre golf course located near Mill Creek Park and the Rancocas Creek, may soon have the ability to become a more hospitable environment for wildlife thanks to a new environmental program established by the U.S. Golf Association (USGA). Called "Wildlife Links," this program will fund research, management and educational projects needed to provide the game of golf with state-of-the-art information on protecting and enhancing the wildlife, fish and plant resources typically found on golf courses. The fragmentation of open space and its effect on wildlife, especially birds, will be a major focus of the research project. Educating golf course developers, managers, golfers, and the general public about how golf courses can be maintained as biologically productive sites for wildlife is another goal of the program.

The program will be administered by the National Fish and Wildlife Foundation (NFWF), a non-profit organization dedicated to the conservation of natural resources. The NFWF began issuing requests for proposals in the spring of 1996 for research projects. Currently, $100,000 per year for the next three years is available. Findings from the program can help incorporate the golf course as part of the wildlife corridor along the Rancocas. The Rancocas Conservancy should follow up on information generated from this program and present it to the Willingboro Country Club.

Land Use and Ownership Patterns along the Main Stem

Map 2 - Land Use on the following page was created by interpreting aerial photography taken in 1990 into twelve land use

categories. For the Rancocas, it shows that the predominant land uses along the main stem are single family residential, farmland and woodlands. Mixed use, urban development patterns are found in Riverside and the core of Delanco. Medium to high density residential development is found in Willingboro, and low density, large lot singles are found in Moorestown. The remaining agricultural lands are mostly found in Westampton, Delanco and Delran. The major woodlands in the area are part of the two major parks, Rancocas Creek State Park and Mill Creek Park, and are on Hawk Island, a peninsula jutting into the Delaware River from Delanco Township. The fact that the area contains a mix of neighborhoods and open spaces lends itself nicely to the greenway concept of connecting people with open space.

About half the acreage making up riverfront properties is in private ownership, and half in public ownership (a negligible amount is in quasi-public ownership), as shown on Map 3 - Type of Ownership. Although the type of ownership split is fairly even with respect to acres owned, the number of properties involved varies greatly. There are about 25 properties in public ownership owned by the State of New Jersey or one of the townships, but there are about 375 parcels in private ownership, owned by about 350 landowners.

The predominance of privately owned parcels does not have to be a deterrent to creating the greenway. Residents have an important role to play in being good stewards of the land, in offering scenic and conservation easements, and in supporting municipal adoption of open space preservation land use techniques. In addition, developers of large tracts can support the greenway by designing neighborhoods that leave a wide buffer along the creek as common open space for both natural resource protection and the potential recreational enjoyment of neighborhood residents or the public.

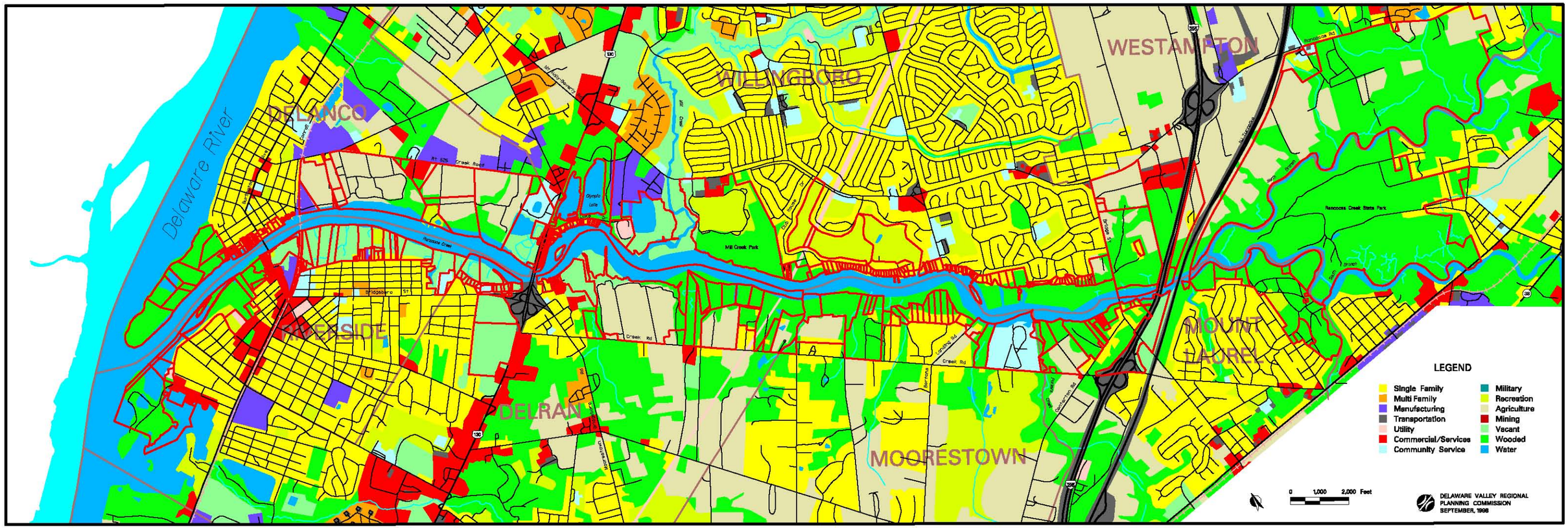
At the same time, the presence of large publicly owned lands ensures that significant open spaces will remain in an otherwise suburbanizing environment. Areas like the Rancocas Creek State Park, Mill Creek Park and Olympia Lakes not only provide natural area protection and recreational opportunities on their own, but as part of the greenway they are like anchors. These parks, and any other large remaining open spaces become the resources that the rest of the greenway serves to link. For example, with respect to providing a hospitable corridor for wildlife, the greenway open space buffer along the creek provides the migratory corridor and the anchors provide the stopping grounds. Other publicly owned parcels such as the Moorestown Landfill and the state owned parcels on Hawk Island, under the right circumstances could also potentially become anchors along the greenway, providing natural resource protection, habitat for wildlife, and passive recreational opportunities.

Master Plans and Zoning

Municipal master plans examine a community's existing conditions, define what the community wants to look like in the future, and develop a set of policies and goals to reach that vision. These policies and goals are then primarily implemented through the community's zoning ordinance, which dictates the municipality's pattern of land use and development.

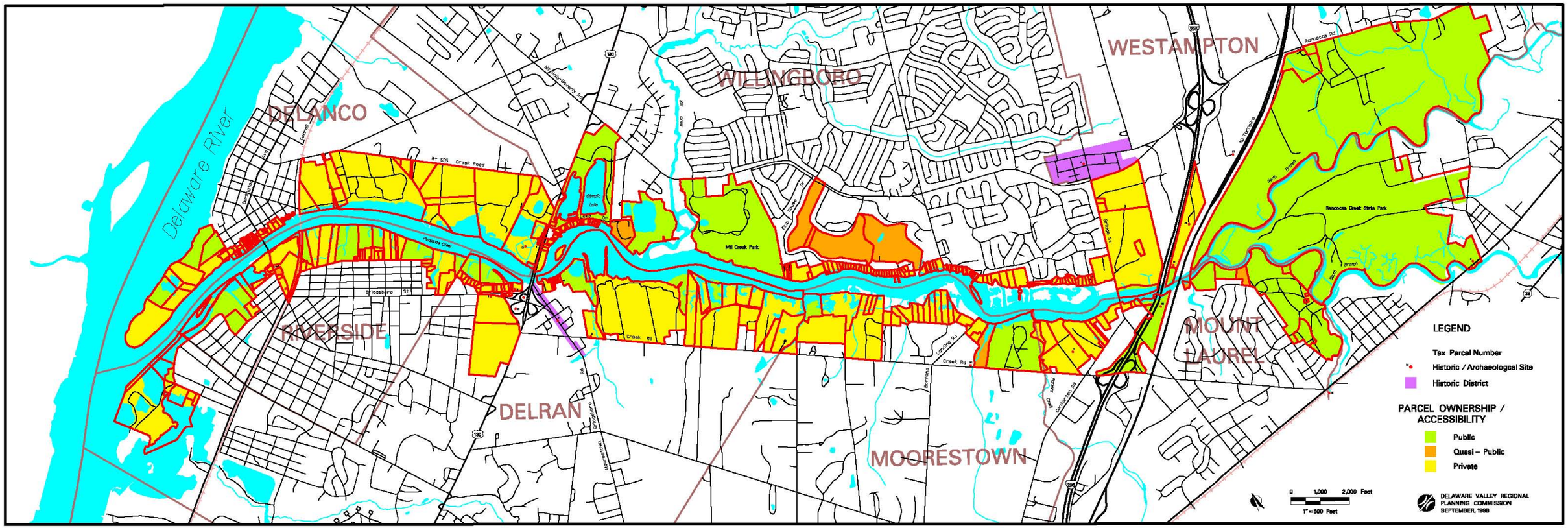
Map 2 – LAND USE

RANCOCAS CREEK GREENWAY STUDY



Map 3 – TYPE OF OWNERSHIP

RANCOCAS CREEK GREENWAY STUDY



Municipalities wishing to preserve their natural features and provide for open space and recreation should therefore first incorporate these goals into their master plan, and then follow up with appropriate and effective zoning.

Main Stem Municipalities Open Space Goals and Implementation through Zoning

Most of the Main Stem municipalities' master plans support open space, public access and recreational improvements for the Rancocas area, but few of them specifically implement their riverfront open space goals through municipal ordinances. Delanco Township probably has the best linkage between its master plan and ordinances. Delanco's Master Plan goals are to seek opportunities for preserving and upgrading accessible open spaces, to provide for the recreational needs of township residents through the preservation of open space within new developments, and to promote quality waterfront land use and encourage public access, both visual and physical, to the waterfront. The township's riverfront zoning districts are written to implement these goals by requiring a minimum 50 foot wide public access strip along the waterfront.

Delran's Master Plan Update proposes open space acquisition in the northeast corner of the township through developer cash contributions or subdivision set asides. The Master Plan recommends that this area be excluded from the public sewer service area to remove the incentive for residential development, and that any development that does take place be required to cluster, leaving open space that could remain farmed. However, this area is proposed for sewer service and the township's zoning does not require mandatory cluster.

Riverside's Master Plan designates the 243 acres of floodplain/marshland around its riparian borders Conservation, and recommends that passive recreational activities consistent with conservation objectives be developed. However, the township has zoned this area industrial. In any case, development proposals would have to follow numerous state and federal environmental protection rules to gain approval.

Willingboro Township's Master Plan recognizes that the health of the township's streams has been compromised through point and nonpoint source pollution, and recommends zoning protection for the township's designated environmentally sensitive areas. While Mill Creek Park and the area along the Rancocas are designated for recreation and conservation in the master plan, the zoning for these areas is industrial and residential, respectively, without any specific performance standards requiring protection of natural features.

Moorestown Township has an excellent Conservation Plan element that was adopted for reference to its Master Plan. The strategies for conservation proposed in the plan address the protection of wetlands, floodplains, coastal areas, aquifer recharge, threatened and endangered species, stream corridors and view sheds. However, specific policies or ordinances implementing these strategies have not yet been developed by the township.

Mt. Laurel's Master Plan shows all riverfront property along the Rancocas as desirable for open space. In fact, almost all the land to the east of Route 295 is part of the Rancocas Creek State Park. The land west of the highway, however, is zoned residential, without any open space set aside requirements.

Westampton Township's Master Plan did not propose a clear vision of land use for the township, nor any specific open space, public access or recreation goals. The Rancocas Creek State Park occupies a large portion of the township on the Rancocas North Branch, and the township has zoned the area industrial and residential. Cluster development is an option in the R-6 Residential district located along the creek, but there are no regulations addressing where open space should be located or how it should be used.

Zoning along the Main Stem

Residential uses are the predominant zoning classification, followed by industrial, along the main stem of the Rancocas. See Map 4 - Type of Zoning, a composite zoning map showing permitted uses, and density categories based on the maximum by-right density permitted in the district. The residentially zoned districts range from high density in Willingboro (minimum lot size < 10,000 sf) to medium density in Moorestown, Mt. Laurel and Westampton (minimum lot size between 10,000 sf and 1 acre) to low density in Delanco and Delran (minimum lot size > one acre). When development goes directly to the creek's edge, as it does, for example, in parts of Willingboro, the impervious coverage associated with the development and residents' care of their yards can result in seriously aggravating non-point source pollution seeping into the Ranocas.

Cluster development with open space set asides placed in the environmentally sensitive areas has been an option for development in almost all of the residential districts, but in developed areas and sites with recently approved plans, cluster has not been utilized. Consequently, ***opportunities to preserve and protect larger, unfragmented open spaces along the creek have been lost. Only the waterfront residential districts in Delanco Township mandate that development be clustered and open space along the waterfront be set aside.***

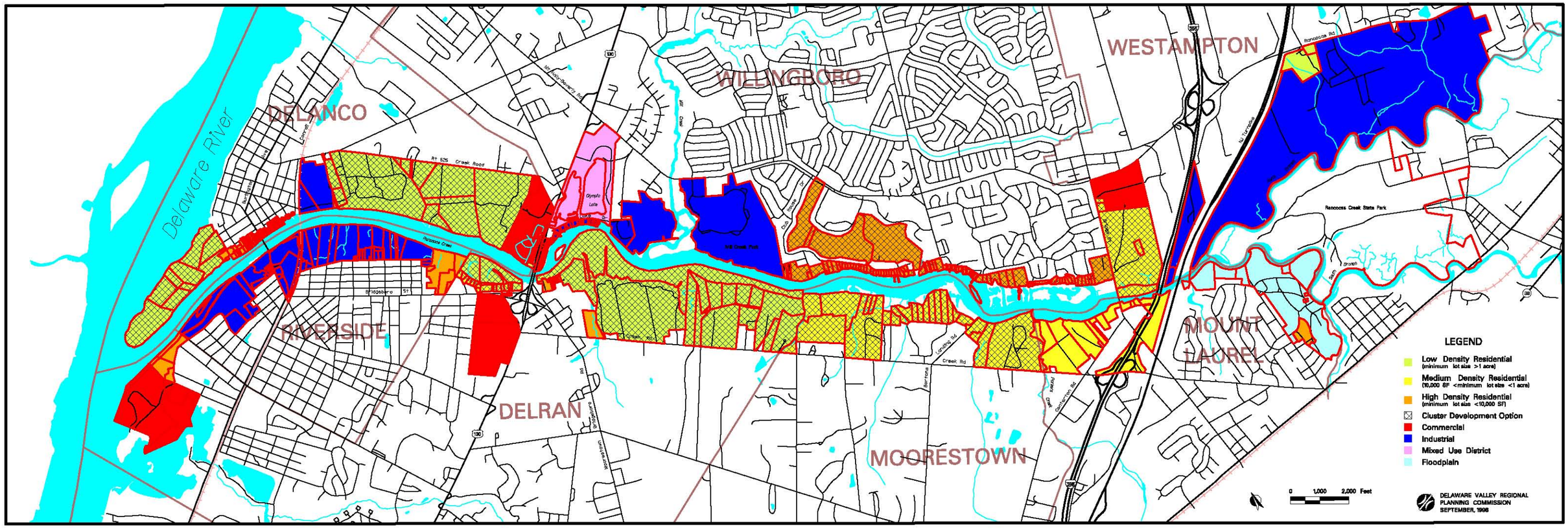
At the first greenway public meeting, some residents said that, if the remaining open spaces along the Rancocas had to be developed, large lot singles were the preferred pattern. However, ***it was apparent from the ensuing discussion that these residents were not familiar with the benefits of quality cluster designs that maintain unfragmented open spaces, and they may not have realized how their current bucolic views would be permanently changed under conventional lot layouts. Educational outreach on the benefits of quality cluster design to both residents and area developers is clearly needed.***

Need for Conservation Zoning

In addition to cluster development ordinances, ***a Stream Corridor Protection and Management Overlay Ordinance can function to protect the sensitive riparian area.*** This type of ordinance would be overlaid on top of the existing zoning district regulations that might currently allow residential, commercial or

Map 4 – TYPE OF ZONING

RANCOCAS CREEK GREENWAY STUDY



industrial uses. The stream corridor ordinance would ensure that vegetated riparian buffers are maintained by requiring development to be set back from sensitive floodplain and wetland areas and by limiting the use and intensity of activities within the corridor. Buffer widths can vary, depending on intended function and slopes, but should be, at a minimum, equal to the 100 year floodplain. For example, according to Watershed Management Strategies for New Jersey (Cook College, 1989), the following buffer widths are suggested:

Function	Buffer from Water's Edge (feet)
Sediment Control	50 - 200
Streambank Erosion Control	25 - 213
Nutrient Pollutant Removal	150 - 200
Reservoir Protection	75 - 300
Stream Temperature Control	25 - 200
Aquatic Species	25 - 50
Wildlife Habitat	200 - 300

Even though there are various state and federal regulations already governing riparian areas, a stream corridor protection ordinance can assist in the identification and satisfaction of these requirements without necessarily adding additional restrictions. The Delaware Estuary Comprehensive Conservation Management Plan (CCMP), a cooperative initiative undertaken by the States of New Jersey, Pennsylvania, and Delaware, also recommends the establishment of riparian corridor protection programs, such as adoption of ordinances, in the Estuary region. Model Stream Corridor Protection Ordinances are available from the Association of New Jersey Environmental Commissions (ANJEC).

Conservation zoning is also recommended, ironically, for the established parks in the area. Mill Creek Park, Olympia Lakes and the Rancocas State Park are currently respectively zoned industrial, mixed use, and industrial and residential, even though they obviously are being used, presumably indefinitely, as open space. Likewise, the marsh area along the creek in Riverside Township is zoned industrial, although it would be difficult to develop as such under existing environmental regulations. Furthermore, much of the woods that are part of the state park in Mt. Laurel are zoned floodplain, which would limit, but not prohibit development opportunities if the park were ever to revert to private uses. However unlikely as it may seem, if the state or Willingboro Township were to eventually give up the parks, or if wetlands laws were severely repealed, these open space lands could, by right, be developed under their industrial, mixed use and residential zoning. Rezoning the areas to Conservation, with appropriately limited uses, would better guarantee their futures as permanent open space.

Public Access and Recreation

According to a DVRPC analysis of open space needs using the Adjusted New Jersey Balanced Land Use Guidelines, Burlington County has an open space deficit of almost 9,000 acres, or 7% of the remaining developable land in the county (DIRECTION 2020 - Open Space Element). Since the Rancocas Creek main stem is at the crossroads of the county's two population concentrations - the Delaware River/Route 130 communities and the south/central developed and developing communities - and since it is an

important natural resource in itself, it is an ideal location for expanding the county's open space network and for the provision of outdoor recreational opportunities.

Creek access and recreation is currently provided by a mix of public and private entities along the Rancocas. Mill Creek Park in Willingboro Township is about 200 acres and provides a network of trails, picnic areas, playgrounds and tennis courts. The trail network is partly paved, for bicyclists, and partly unpaved, for walkers. Unpaved trails extend down to the creek's edge for views of the water. The Rancocas Creek State Park covers over 1,200 acres in Mt. Laurel, Westampton and Hainsport Townships. The park currently leases land in Westampton Township to the Powhatan Indians of the Delaware Valley, the New Jersey Audubon Nature Society, and Sunnyside Dairy Farms, and in Mt. Laurel Township to the Township for active recreation ballfields and trails. The Audubon Society maintains a nature trail walk and runs educational programs. The Powhatan Indians run occasional festivals open to the public. Mt. Laurel Township runs recreational programs at the ballfields, but the access through the Rancocas Woods subdivision is problematic. Other than the above programs, there are no state sponsored recreational activities at the state park.

Riverside Township has a pleasant linear park area along the Rancocas near its confluence with the Delaware River. Hawk Island also has a trail network that is not supposed to be open to the public, but locals apparently use the trails anyway. There is an easement on an 11 acre parcel known as "Little Woods" located next to the Moorestown Land Fill, but it has not been developed yet for public access. Plans to develop a perimeter park around the Moorestown Land Fill were proposed in the township's Conservation Plan, but no work has begun on this effort either.

A new addition to the public network of open space along the Rancocas will be the Olympia Lakes site. With Green Acres funding and a developer donation, the 100+ acre parcel is being turned into a passive recreation township park. The site's proximity to the Rancocas Creek, its uniquely large lakes and its environmental value as home to at least 28 varieties of plants and trees and as the nesting and breeding ground for at least 75 types of birds (inventories by the Willingboro Township Environmental Commission) make it a very significant addition to the open space network in the area.

Boat launches are mostly available through private marinas in Delran and Delanco or private residential docks. Due to the strength of the tides, most boating along the main stem is on motor boats and jet skis. Canoeing is more popular and common on the main branches of the Rancocas. There is a public boat launch suitable for canoes and small boats on the South Branch in the Rancocas Creek State Park. There are no official public fishing piers, but people have been seen fishing in many areas, including under the bridge at Route 130.

Due to its linear nature along a stream, the Rancocas Greenway could provide additional opportunities for developing trails, and public fishing and boat piers along the creek. It seems that such additional facilities would be desired and needed, considering their popularity. In fact, walking, jogging, biking, and fishing were ranked in the top ten most popular outdoor recreational

activities in the New Jersey Open Space and Outdoor Recreation Plan.

Fortunately, there are still numerous opportunities to preserve open space, provide additional recreational opportunities, and increase public access along the Rancocas. Map 5 - Type of Open Space, on the following page shows that land in the large majority of streamside parcels, about 90%, is still in open space. About 43% of this open space is already public parkland, 24% is farmland, 16% is vacant, 14% is tidal marsh, and 3% is golf course. At the public meetings residents said that they wanted to continue to see the open areas along the creek that they now enjoy. ***That so much of the streamside is still undeveloped should therefore not be taken for granted, but should instead present a stronger case for implementing greenway measures to keep it open.***

When asked about expanding the trail network in the area, residents at the public meetings reported that they were in favor of more trails so long as they were on public property. The amount and location of existing public lands and still undeveloped open spaces make this a stronger possibility. For example, the recent acquisition of Olympia Lakes as a township park located adjacent to Crystal Lake and Mill Creek Park provides a splendid opportunity for expanding the trail network beyond Mill Creek Park. Similarly, since it is required by ordinance, pathways will be incorporated into any development proposals for the open parcels in Delanco along the creek and on Hawk Island. ***By creating the trails as part of the development, only new homeowners who want to live near such a facility will buy into the development; trails will not be imposed on any unwilling landowner.***

In any case, the experience of other communities across the country have consistently shown that most trail users live nearby, well-used trails are self-policing, homeowners next to trails do not experience higher rates of vandalism or burglary, and homes located next to protected open space are worth more than identical homes across the street. For example, the trail along Pompeston Creek in Moorestown Township is well used and is considered a positive addition to the community's landscape, despite the initially fearful and negative attitudes of neighbors. To allay fears and encourage the feeling of safety for trail users, proposed trails should have a logical beginning and end that actually provides a desired route for pedestrians, and they should not have dead ends.

When asked about boat access at the public meetings, residents were unanimous in their response against increasing boat access to the creek. Residents reported that there were already too many boaters on the creek, and that many boaters, especially jet skiers, were endangering others as well as the environment. Residents claimed boaters acted recklessly in not obeying speed limits, littering, hunting wildlife, and otherwise polluting the creek. Residents also said that many boaters trespass by stopping at people's backyards and disembarking for a picnic. Furthermore, residents said that the situation is exacerbated by a lack of a marine police presence on the creek.

The marine police stationed in Burlington City responded that they have only three to four officers to patrol the waterways from

Burlington County to Salem County, and from the Delaware River to Route 206. Although they respond to calls as quickly as they can, they cannot obviously have a permanent presence at any particular spot. The marine police said most problems occur with drunk boaters who most blatantly disregard rules and cause accidents. Depending on the intent (ignorance, maliciousness or drunkness) marine police can issue tickets from $200 to $6,000 for speeding and other violations. (Telephone conversation with Marine Police Sergeant Barry Ballurio, 5/30/96)

The ideal solution would be to have a dependent marine police presence on the Rancocas during times of highest use, presumably weekends. In the absence of that possibility, a partial solution may be for marina operators and law abiding boaters to form a Rancocas Patrol, a volunteer boatwatch program similar to Neighborhood Watch efforts. Based on the premise that watchful eyes will deter crime, and, in the river context, deter unlawful boating behavior, the Rancocas Patrol could significantly reduce reckless behavior. The Delaware Riverkeeper Network is initiating such a program, called Riverkeeper Patrol, that is primarily intended for the Delaware Bay, but may also venture into Delaware River tributaries such as the Rancocas. Interested citizens and mariners may contact the Riverkeeper Network for information on their boatwatch program (contact information in Appendix A). The Rancocas Conservancy could aid the effort by producing a brochure distributed at marinas explaining why it is important to obey marine rules, and to not pollute, hunt wildlife nor trespass. The brochure could identify public areas where disembarking and picnicking is encouraged, and reinforce the penalties for violations. If a group of residents feel very strongly about prohibiting jet skiing on the Rancocas, they could lobby their legislators for a state law, as was done for the Cape May Canal.

Historic Resources in the Rancocas Vicinity

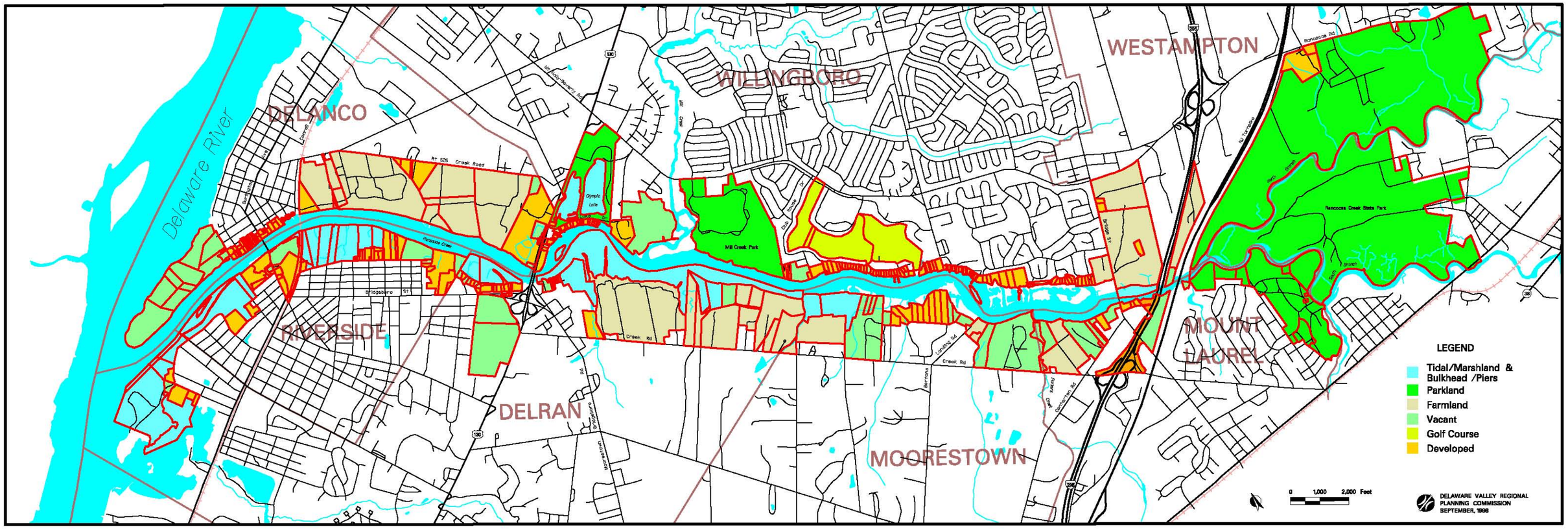
The Type of Ownership Map (Map 3 on page 21), also shows about twenty historic and archaeological sites, and two historic districts located within the greenway area that have been documented by the Office of New Jersey Heritage. The two districts are Rancocas Historic Village, a mid-19th century Quaker Village on the National Register of Historic Places, and Bridgeboro, a mid-to-late 19th century village issued a Determination of Eligibility for the National Register. The Philadelphia Watch Case Company Building, an important visual landmark in Riverside ever since it was constructed in 1852, is also on the National Register. There are several historic houses and farmsteads which also add to the character of the area. The remainder of the state-documented historic resources in the greenway study area are archaeological sites, which can give glimpses into the area's very early history. The following list describes the sites as they are shown on Map 3. The numbers correspond to site locations marked on the Office of New Jersey Heritage's quad maps:

Historic and Archaeological Sites

1 **Philadelphia Watch Case Company Building**, 1852, Pavilion and Lafayette Aves, Riverside, listed on National Register of Historic Places in 1978

Map 5 – TYPE OF OPEN SPACE

RANCOCAS CREEK GREENWAY STUDY



6 **Bridgeboro Historic District**, mid-19th century, Bridgeboro Road, Delran, issued Determination of Eligibility for National Register, 1981

7 **Fortnum Motors**, early remnants of automobile age, circa 1913. Formerly located within what is now the cloverleaf at Route 130 in Delran.

8 **Sabino Site**, prehistoric artifacts, Delran, issued Determination of Eligibility for National Register, 1981

9 **Dahmer/Beier Site**, prehistoric artifacts, Delanco, issued Determination of Eligibility for National Register, 1981

10 **Siris Site**, prehistoric artifacts found in Route 130 cloverleaf, Delran, issued Determination of Eligibility for National Register, 1981

11 **West Bridgeboro Street Site**, prehistoric artifacts found, Delran, issued Determination of Eligibility for National Register, 1981

12 **Victorian House**, 1870, NE side of Creek Road, SE of Bridgeboro Street, Delran, SHPO Opinion 1980

13 **Holiday Lake Site**, prehistoric artifacts, Delanco

14 **Rancocas Historic Village**, mid-19th century Quaker village surrounding an 18th century Friends Meeting House, Westampton, listed on National Register of Historic Places in 1975

15 **Prehistoric Site**, Mt. Laurel, Hainsport, no SHPO opinion

20 **Prehistoric Site**, Mt. Laurel, SHPO opinion 1992

21 **Prehistoric Site**, Westampton, SHPO opinion 1992

25 **S. Little House**, circa 1800, Creek Road, Moorestown, SHPO opinion, 1980

26 **Historic Farmstead**, Westampton, listed on the Historic Sites Inventory of Burlington County. Prehistoric artifacts and historic artifacts and structures were found.

27 **Historic Farmstead**, Westampton

71 **Prehistoric Site**, Mt. Laurel.

1 **J.D. Johnson Foundry**, Hainsport. Foundry supported development of Hainsport. Presently in ruins.

2 **W. Davis Tavern,** Hainsport. Listed in Historic Sites Inventory of Burlington County. Its importance was as a pioneer tavern/hotel when Hainsport served as an important transportation center.

In addition to the state documented historic resources, there are several other areas within the greenway study area that are worthy of mention and protection. First, is the vernacular architecture and town center design of Riverside and Delanco, both of which are reminiscent of the type of traditional town living for which many people are nostalgic. In fact, the neo-traditional town planning movement is attempting to recreate the walkability and mix of uses that these towns already naturally possess. The other noteworthy area is Rancocas Woods, a subdivision of log cabin style homes evoking a rustic, woodsy, atmosphere.

Protecting the documented historic sites as well as the vernacular architecture in the old towns and Rancocas Woods can offer the greenway communities both cultural and economic benefits by enhancing community identity and pride, attracting visitors, and promoting investment. However, without the help of certain protections, the uniqueness of these places may be jeopardized or lost through neglect, demolition and/or surrounding inappropriate development. Listing on the National Register provides some

protections against federally and state funded, assisted or licensed projects, but ***local preservation controls can offer more protection by regulating the private use, maintenance, alteration and demolitions of targeted special places.*** Moreover, building on the unique and special quality of these places, in conjunction with their location adjacent to the Rancocas Creek and all that it offers, can serve as a stimulant to economic revitalization.

Prioritizing Resource Protection

The future of the Rancocas Main Stem study area under current zoning and other regulations and following current development trends is of ***continued conventional subdivisions up to the creek's edge, with little or no open space set asides. In addition, without effective municipal regulations in place in many of the communities, the Rancocas is vulnerable to increased runoff and non-point source pollution and potential flooding problems. Both these trends go against the preferred vision residents have for the Rancocas; that of continued bucolic views where they currently exist and a healthy river ecosystem.***

In recognition that preservation efforts, whether in the form of money for acquistion or staff offering technical assistance, are limited, and must therefore be efficiently focused, DVRPC produced Map 6 - Prioritized Resource Protection, shown on the following page. The Geographic Information System was first employed to determine which undeveloped parcels in private ownership had natural features (floodplains or wetlands) or scenic resources (farmland) and could be further subdivided according to their zoning. Municipal managers were then asked the development status of parcels meeting these criteria. Development status was categorized as one of the following:

1. Development Approved - Preliminary or final site plan approval was issued by the township. *These parcels are considered beyond intervention.*

2. Development Proposed - Development has been proposed to some degree on these parcels. Some proposals were as preliminary as a discussion of development possibilities with the township planning board, and other proposals were as formal as an official submission of site plans or request for rezoning. These are the parcels that are most likely to be developed in the very near future. *Immediate strategies for resource protection are required.*

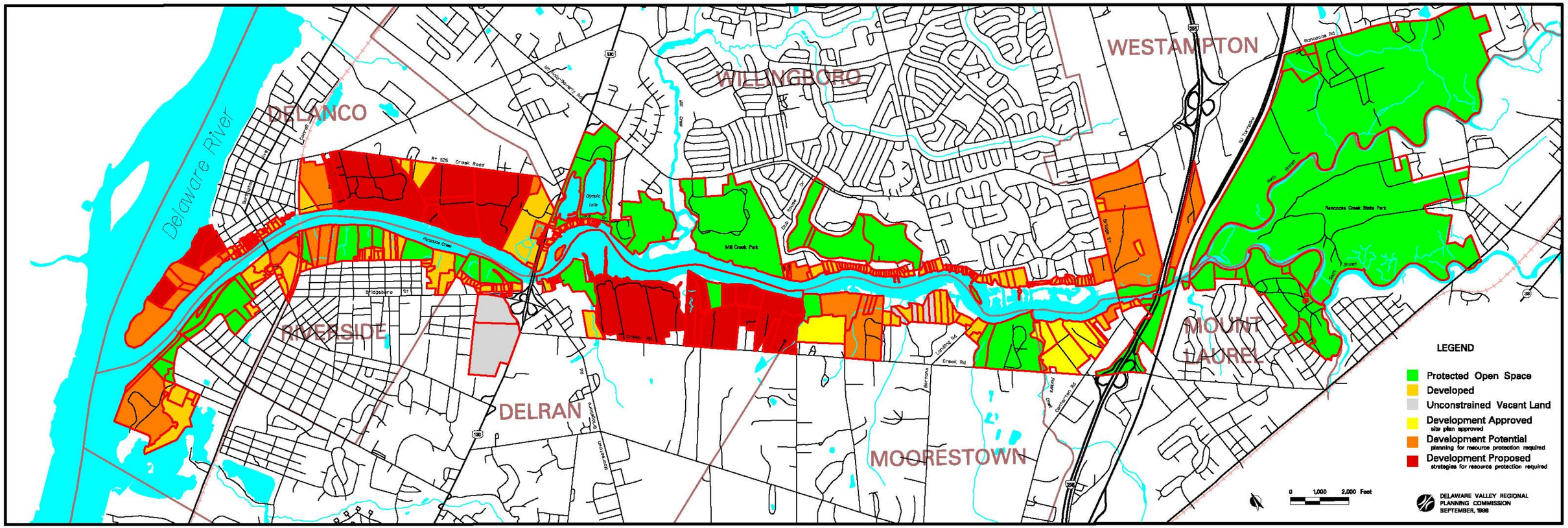
3. Development Potential - There are no known proposals for developing these parcels, but *planning for resource protection is required* to preserve the natural and scenic features on these sites.

<u>Development Approved Parcels</u>

In Mt. Laurel Township, the Hovpro Investment Group tract shown in yellow on Map 6, along with another parcel across Creek Road have been given preliminary approval for 84 single family dwellings and 319 multi-family units. According to the

Map 6 – PRIORITIZED RESOURCE PROTECTION

RANCOCAS CREEK GREENWAY STUDY



township planning board secretary, the plan does not provide for common open space along the Rancocas Creek. No action has been taken recently on this proposal, and its preliminary approval status expires in December, 1996. Should it expire, this tract should be moved to Development Proposed status.

In Moorestown Township, the Moriuchi tract (partially shown on Map 6) was granted final approval for 20 single family lots. According to the Planning Board Secretary, this plan also did not include any common open space. No action has been taken on the proposal, and its preliminary approval status also expires in December, 1996. Should it expire, this tract should also be moved to Development Proposed status.

Development Proposed Parcels

In Delanco Township, two separate developers have formally proposed a change in zoning that would permit them to build almost 1,000 senior citizen housing units on the Russ and Pennington Farms. Considering the township's 1990 population was 3,316, such a development would drastically change the community's character and tax municipal resources. Not surprisingly, 200 protesters showed up at a recent town meeting. The county had initially attempted to acquire the Pennington Farm with Green Acres funding, but the landowner considered the county's appraisal too low. Residents at the town meeting urged the county to be given another chance to negotiate.

Given the sites' location along the Rancocas and next to the concentration of Delaware River/Route 130 communities, the former farms are well suited and situated to become part of the county open space system. The county should, therefore, promptly attempt to renegotiate acquisition. Another option the county, township and developers could explore is to incorporate the most environmentally sensitive and scenic portion of the farms as part of the county open space system, and to develop the remainder of the parcels. If full acquisition or a compromise solution such as that suggested above does not work out and the entire site is to be developed, Delanco Township should remain true to its Master Plan goals and zoning ordinance in requiring an open space buffer with public access along the waterfront.

Hawk Island, also in Delanco Township, is a 118 acre penisula whose ecologically significant habitat is under a two-fold threat; first from the disposal of dredge materials, and second, should the disposal site be closed, from the potential subsequent development (discussed in next section; Development Potential Parcels). As a riparian habitat, Hawk Island supports a variety of wildlife, and because it is located in an urbanized area of the Delaware River, it functions as a wildlife refuge. Almost the entire perimeter of Hawk Island is bounded by riverine tidal flats, there are more than eight acres of forested wetlands along the southern edge of the site, there are additional wetlands on other privately held parcels, and there is an approximately 6 acre pond in the center of the penisula. Due to its location and the type of habitats contained on Hawk Island, the site would be used by a variety of birds, including declining species of warblers, vireos and thrushes, during nesting and migration. (1993 letter to Debbie Rietzen, Chair of Citizens United to Protect Hawk Island, from Christine Hafner, U.S. Fish and Wildlife Service Biologist) In addition, five wetlands species of plants and invertebrates believed to be imperiled in New Jersey because of their rarity

have been observed on Hawk Island in the 1990's. (Hawk Island Natural Resource Inventory, 1996).

Currently, the State of New Jersey owns about 44 acres of Hawk Island and considers this land an active dredge disposal site. Within the State Department of Environmental Protection, the Bureau of Tidelands owns the land and the Division of Coastal Engineering manages the site. The Division of Coastal Engineering works directly with the Army Corp of Engineers, who conduct the dredging operations.

Past disposals of dredge material on Hawk Island have had detrimental effects on the site's habitat. In the 1930's, before environmental laws were enacted, about 40 acres of shallow water habitat were converted to uplands that now have little value to wildlife. More recently, in 1988, despite strict environmental protection laws, a large pond of about 5 acres was filled with dredge material, completely destroying the wetland habitat and wildlife that had developed there.

From a strictly environmental protection perspective, the disposal of dredge material on Hawk Island has had a detrimental impact on the island's habitat. However, periodic dredging of the Delaware River and its ports and harbors is essential for the economic health of the region, there are dwindling numbers of disposal sites for dredge material along the Delaware, and Hawk Island has been identified by the Army Corp of Engineers as one of the key remaining dredge disposal sites. (Telephone conversation with Charlie Meyers, Project Manager for Delaware River Philadelphia to Trenton Project, Army Corp of Engineers, November 15, 1996) Establishing a compatible relationship between the disposal of dredge material and the protection of wildlife habitat is clearly needed for Hawk Island.

Proposed dredge operations are currently subject to review by the New Jersey Land Use Regulation Program. To minimize adverse impacts, the DEP has identified a menu of best management practices which are selected and incorporated as conditions into permits issued by the DEP for dredge operations. Appropriate BMPs are selected based on site specific conditions including compatibility with adjacent and nearby land uses, characteristics of the dredge material, design and construction of the containment facility, operation of the facility, and plans for final closure and use of the facility. For example, DEP may prohibit dredge operations during seasonal migratory periods to minimize adverse impacts to anadromous fish (fish migrating from salt to fresh waters) and nesting shorebirds. In addition to following the conditions of the permit, the NJDEP requires the owner/operator of a site to submit an annual report summarizing the disposal operation, maintenance activities, the final use/destination of the dredged material, an analysis of the remaining disposal capacity, and, when a site remains unused for more than five years, the Department may also require formal plans addressing its final closure, post-closure maintenance and monitoring, and subsequent site development or use.

Given that dredge material disposed on Hawk Island occurs very infrequently (the last disposal was in 1988 and the earliest next planned disposal is for the fall of 1997) a detailed long term plan for the site should be developed, and made public. The plan should address the following issues:

1) How will disposals' impact on wildlife that have recolonized the site be mitigated? Use of BMP disposal methods that enhance, rather than destroy, the site's value to wildlife should be incorporated.

2) How clean (or contaminated) is existing (and future) dredge material on Hawk Island? According to Charlie Meyers of the Army Corp of Engineers, results from a 1996 test showed nothing in the material unsuitable for human contact. The methodology and results from this recent test should be made readily available to the municipality and concerned residents in the adjacent neighborhood.

3) Are beneficial uses of dredge material (for example, road fill, landfill cover, hazardous waste site remediation, and habitat development) planned for material deposited on Hawk Island? If so, how and when will the material be transported off the peninsula? Again, impacts on wildlife and their habitat, as well as impacts on the adjacent neighborhood, should be addressed.

4) What are the maintenance and monitoring plans for the site? For example, issues such as seepage of deposited dredge material back into the river and eroded particles of dredge material windblown into the adjacent neighborhood should be addressed.

5) What is the site's remaining capacity, and what are the long term plans for dredge disposal on Hawk Island?

To reach a consensus among the parties affected, the plan should be developed by the NJDEP with input from the Army Corp of Engineers, the U.S. Fish and Wildlife Service, the county, the municipality, and local neighborhood and environmental groups such as Citizens United to Protect Hawk Island. A complementary use (a passive park and nature center) for the remainder of Hawk Island is discussed in the following section; "Development Potential Parcels".

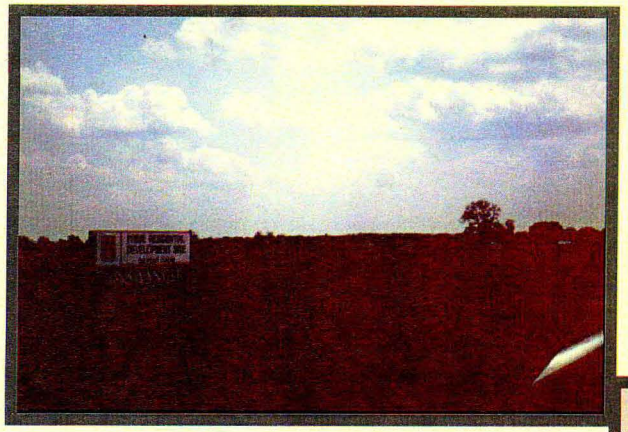
Another site proposed for development is the tract of land between the Rancocas and Creek Road in Delran Township. Although owned by several landowners, the area is often collectively referred to as the Anderson Farm. According to the township manager, prospective developers have attended township meetings to discuss development options for the tract, but no formal plans have been submitted, and parcels are not currently up for sale. The township manager also said that Delran has a lot of parkland and is not necessarily looking for more public open space, although they do want to see natural areas protected. The best approach would therefore be to adopt a stream corridor conservation overlay district, and to mandate cluster development on the site. That these concepts are already largely supported in the township master plan make these preservation techniques easier to implement.

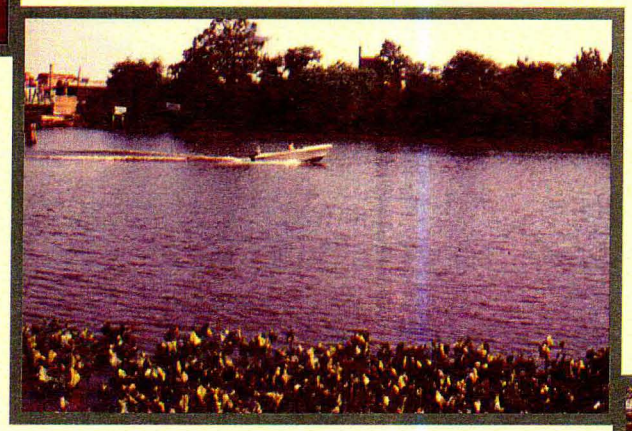
<u>Development Potential Parcels</u>

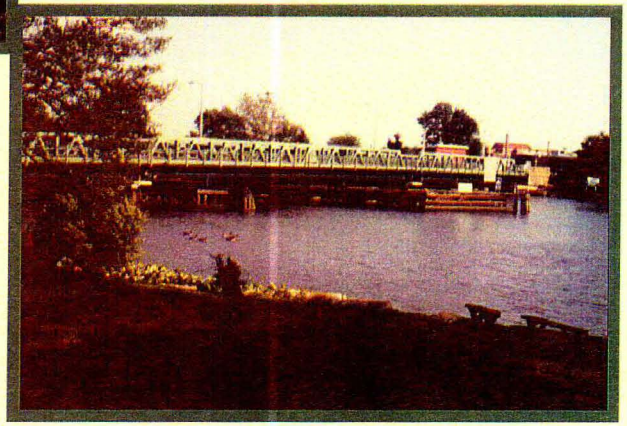
These are the parcels with natural and scenic features that no known developer interest or plans have been proposed to date, but their status could change at any time. Depending on the site, the municipality, county, state and/or Rancocas Conservancy may wish to contact these landowners to discuss options for protecting the property's natural resources and still receive an equitable return on their investment, should they decide to eventually sell or develop. Preservation options may include municipal

adoption of mandatory cluster development ordinances, stream corridor protection overlay districts, voluntary conservation easements, and acquisition. For example, the Rancocas Conservancy is currently working on a conservation easement with a large landowner along the Main Stem who does not want to see his property developed. The conservation easement may permit the landowner to deduct the value of the donated easement from federal income taxes as a charitable contribution, and he may also be eligible to receive a reduction in property taxes for the easement, if the assessed value of the land is lowered.

On Hawk Island, the second, subsequent threat to the site's importance as a wildlife refuge may occur if the site is eventually closed to dredge material disposal. Currently, about 44 acres of the site are held by the State of New Jersey, and the remainder of the 118 acre peninsula is in private hands, but there are unresolved legal questions concerning title to some of the properties. Although the peninsula offers wonderful views of both the Delaware and Rancocas, development has not yet occurred presumably due to the site's lack of road access and its status as an active dredge disposal area. To protect this special riparian habitat for wildlife, and to preserve the outstanding waterfront views for the public, the County and the State should consider acquiring the remainder of Hawk Island and converting the peninsula into a passive park with a nature center. The educational focus of the nature center could be on restoring and enhancing disturbed wildlife habitats. The staff and volunteers from the nature center could work with the NJDEP and Army Corp of Engineers to ensure that the periodic disposal of dredge material improves rather than destroys the site's value to wildlife. In this way, Hawk Island would serve as a real life laboratory for habitat restoration and maintenance.







Chapter 3

MAJOR ISSUES, GOALS and RECOMMENDED ACTIONS

Chapter 3
RANCOCAS CREEK GREENWAY
MAJOR ISSUES, GOALS, and RECOMMENDED ACTIONS

The combination of planning analysis and discussions with the public elicited the following major issues and goals for the Rancocas Greenway. Recommended actions for municipal, county and state government agencies are included, together with actions for the Rancocas Conservancy and local school districts.

I. *Issue: The Rancocas ecosystem is bounded by fragile environmental features including floodplains, wetlands and wooded uplands. These areas serve important functions in absorbing floodwaters and stormwater runoff, filtering out non-point source pollution before it reaches the creek and groundwater reserves, and providing habitat for wildlife. Inappropriate development, uncontrolled stormwater, and non-point source pollution all threaten the health of the Rancocas ecosystem.*

Goals

A. Conserve environmentally sensitive open space areas and unique resources along the creek (Appendix B provides a list of funding opportunities for open space planning and acquisition);

B. Protect the water quality of the Rancocas Creek and the surrounding aquifers;

C. Promote good land stewardship practices among residents in the Rancocas watershed.

Actions

1. **Municipalities in the study area should consider adopting an overlay Riparian Corridor Conservation Ordinance.** This type of ordinance would be overlaid on top of the existing zoning district regulations that might currently allow residential, commercial or industrial uses. The Riparian Corridor Ordinance would ensure that vegetated riparian buffers are maintained by requiring development to be set back from sensitive floodplain and wetland areas and by limiting the use and intensity of activities within the corridor.

2. **Municipalities should consider adopting mandatory cluster development districts along the creek's edge.** The cluster development district is advantageous over conventional large lot developments in that a larger contiguous area of open space along the creek can be preserved, protecting the fragile ecosystem, providing waterfront access to all residents within the subdivision, and maintaining the scenic value of the property.

3. **Riverside, Willingboro, Westampton and Mt. Laurel Townships should rezone their parkland and marshland Conservation District.** Currently, the Rancocas Creek State Park is zoned industrial and residential in Westampton and floodplain in Mt. Laurel. Mill Creek Park is zoned industrial, Olympia Lakes is zoned mixed use, and the tidal lands in Riverside are zoned industrial. These areas could potentially be developed as such should the lands eventually be sold off or wetlands regulations repealed. In order to better ensure the protection of these open spaces, they should be rezoned as Conservation Districts.

4. **Delanco Township should request the NJDEP to develop and make public a detailed long-term plan for dredge material disposal and re-use on Hawk Island.** The plan should address dredge material disposals' impact on wildlife, level of contamination, and beneficial uses of, as well as the site's maintenance, monitoring and long-term capacity. To reach a consensus on the plan, the NJDEP should work with the Army Corp of Engineers, the U.S. Fish and Wildlife Service, the county, municipality, and local groups such as Citizens United to Protect Hawk Island.

5. **New Jersey Department of Environmental Protection and the Burlington County Soil Conservation District should work together to produce a watershed based stormwater management plan for the Rancocas Creek Watershed. Municipalities should develop plans and adopt ordinances consistent with the watershed based stormwater management plan.**

6. **The New Jersey Department of Environmental Protection and the County Soil Conservation Districts should create and require a training program on proper sediment, erosion, and stormwater control measures for building foremen responsible for land disturbing activities during construction.** The states of Delaware and Maryland run such programs and report positive feedback from both communities and the building industry.

7. **The Rancocas Conservancy, the non-profit land trust and conservation organization for the Rancocas watershed, should develop and distribute brochures on good landowner stewardship to property owners in the Rancocas watershed.** The brochure should also list telephone numbers of responsible agencies to which to report environmental infractions. For example, the brochure would identify the county soil conservation

district as the agency in which to report erosion and sedimentation problems resulting from construction activities. Excerpts from the brochure could also be incorporated into municipal newsletters. Samples of stewardship pamphlets are shown in Appendix D.

8. **The Rancocas Conservancy should contact landowners about acquiring voluntary conservation easements to environmentally sensitive and scenic portions of their property.** In exchange for giving up development rights to that portion of the property, the landowner may be able to deduct the value of the donated easement from federal income taxes as a charitable contribution, and may also be eligible to receive a reduction in property taxes for the easement, if the assessed value of the land is lowered.

9. **The Rancocas Conservancy should acquire the findings from the National Fish and Wildlife Foundation's "Wildlife Links Program", and should contact the Willingboro Country Club about implementing recommended actions.** The "Wildlife Links Program" will fund research, management and educational projects needed to provide the game of golf with state-of-the-art information on protecting and enhancing the wildlife, fish and plant resources typically found on golf courses.

10. **School districts should incorporate river ecology programs into their curriculum, with a particular grade becoming the riverwatcher for a portion of the Rancocas.** The New Jersey Audubon Society offers educational classes and materials on which programs can be based. Riverwatchers monitor water quality by conducting chemical and biological assessments of stream conditions. Water quality data should be presented to public officials to influence land use decisions.

II. *Issue: Burlington County needs to develop additional public open space to meet current and future recreation needs. The Rancocas Greenway area is a population center surrounding a unique regional resource. These two factors make the area ideal for additional county owned open space. However, the popularity of the creek for recreational use has sometimes resulted in increased pollution, erosion and trespassing on private property.*

Goals

A. Acquire appropriate properties for public open space (Appendix B provides a list of funding opportunities for open space planning and acquisition);

B. Provide additional public access and develop additional recreational facilities, such as trails, in appropriate areas;

C. Preserve scenic views along the creek;

D. Instruct recreational users to respect the waterway.

Actions

1. **Willingboro Township should consider expanding the trail network beyond Mill Creek Park to link it with the Crystal Lake and Olympia Lakes sites.**

2. **Moorestown Township should consider developing a perimeter park around the land fill, and linking it with the adjacent Little Woods property**, provided any hazards to users and the environment can be secured.

3. **The Burlington County Office of Land Use Planning should focus immediate preservation efforts on properties labeled Development Proposed in the Prioritized Resource Protection Map, such as the Russ and Pennington Farms in Delanco.**

4. **Burlington County and the New Jersey Department of Environmental Protection should examine the possibility of acquiring Hawk Island for passive recreational use and a nature center focusing on wildlife habitat restoration and maintenance.**

5. **The New Jersey Department of Environmental Protection should develop public fishing piers in the Rancocas Creek State Park, and, provided parking and safety issues can be addressed, under bridges such as the Route 130 bridge.**

6. **Marina operators and concerned boaters should form a Rancocas Patrol, a volunteer boatwatch program based on the premise that watchful eyes will deter reckless and illegal boating behavior.** The Delaware Riverkeeper Network is initiating such a program, called Riverkeeper Patrol, primarily intended for the Delaware Bay, but it may venture into Delaware tributaries such as the Rancocas as well.

7. **The Rancocas Conservancy should produce a brochure on good stewardship for Rancocas recreational users.** The brochure would explain why it is important for boaters and jet skiers to obey speed limits, to not litter, and to respect riverfront landowners' privacy. The pamphlet would also designate public areas that are appropriate for stopping and picnicking. Pamphlets could be distributed at marinas and parks, and excerpts could be published in municipal newsletters.

III. *Issue: The neo-traditional town planning movement is promoting the mix of uses and walkability that Riverside and Delanco already naturally possess. By together capitalizing on their small town design, vernacular architecture and their unique location at the confluence of the Delaware and Rancocas Rivers, these two towns have the potential to not only enhance community pride but to spur economic development as well.*

Goal

A. Build on and market the strengths of Riverside and Delanco to make them a local destination.

Actions

1. **Riverside and Delanco should join efforts to market their unique location at the confluence of the Delaware and Rancocas Rivers to boost community pride and economic development.**

2. **The New Jersey Office of State Planning should designate Riverside and Delanco as a "Town Center" in the State Development and Redevelopment Plan, and should offer technical assistance to these communities in defining their vision and strategy for center designation.** Benefits of center designation can include prioritized funding from state agencies.

3. **Riverside and Delanco, as well as the other municipalities hosting historic resources and neighborhoods with special character, should consider incorporating preservation techniques into their master plans and zoning and subdivision ordinances.** Without the help of certain protections, the uniqueness of some of the places along the Rancocas may be jeopardized or lost through neglect, demolition and/or surrounding inappropriate development. Local preservation controls can offer protection by regulating the private use, maintenance, alteration and demolition of targeted special places.

Appendices

Appendix A
LIST OF LOCAL CONTACTS

ANJEC
P.O. Box 157
Mendham, NJ 07945
201-539-7547

Burlington County Soil Conservation District
Tiffany Square Suite 100, RD #2
2615 Route 38
Mt. Holly, NJ 08060
609-267-7410

Burlington County Office of Land Use Planning
49 Rancocas Road
Mt. Holly, NJ 08060
609-265-5787
Al Buchan, Open Space Coordinator

Delaware Valley Regional Planning Commission
111 South Independence Mall East
Philadelphia, PA 19106
215-592-1800
Patty Elkis, Greenway Project Manager

Joe Arsenault
Arborist specializing in
native plantings
609-697-6044

National Fish and Wildlife Foundation
1120 Connecticut Avenue N.W. Suite 900
Washington D.C.
202-857-5676

NJ Audubon Society
Rancocas Nature Center
794 Rancocas Road
Mt. Holly, NJ 08060
609-261-2495
Brian Vernachio, Teacher/Naturalist

NJ Department of Environmental Protection
Office of Environmental Planning
CN 418
Trenton, NJ 08625-0418
609-633-1179

Rancocas Conservancy
P.O. Box 4109
Mt. Holly, NJ 08060
609-265-1401
Mark Thomas, President

Riverkeeper Network
P.O. Box 326
Washington Crossing, PA 18977
215-369-1188
Fred Stine, Delaware Estuary Coordinator
609-854-5108
Pollution Hotline
1-800-8-DELAWARE

Appendix B
LIST of GRANT OPPORTUNITIES for FUNDING OPEN SPACE PLANNING and ACQUISITION

1. Burlington County Open Space and Farmland Preservation Programs
Funds raised through the collection of a maximum tax of two cents per $100 of assessed valuation in any given year will be used to preserve open space and farmland. This funding, estimated at about $3.8 million per year will supplement the county's continued active participation in the State's Farmland Preservation Program and Green Acres land acquisition program. This program will expire in 2012 unless voters reauthorize the program to continue. Contact persons are Alan B. Buchan for open space and Cindy Gilman for farmland. Both can be reached through the Burlington County Office of Land Use Planning at 609-265-5787.

2. Conservation Foundation American Greenways Dupont Award
Eligible applicants: Primarily nonprofit organizations, although individuals and local governments may apply
Eligible projects: Mapping, assessments, surveying, conferences and design activities, printed and audio-visual interpretative materials, building paths or bridges and other creative projects
Maximum grant: $2,500
Required Match? No
Application Round: Applications typically due December 31 of each year
Contact person: 703-525-6300

3. Delaware River Watershed Initiative
This project will offer annual grants to selected projects that either protect natural and cultural resources, provide public education, improve public open space facilities, provide river-related economic benefit to build technical skills for project work. The Watershed Initiative will be directed by the Heritage Conservancy, and the William Penn foundation is a major supporter of the project through their 3 year grant to the Heritage Conservancy in May of 1996. For more information about this new initiative call Linda Meade, Director of the Heritage Conservancy, 215-345-7020.

4. Dodge Foundation
Eligible applicants: Non-profit organizations with 501 (c)(3) status
Eligible projects: Projects that fit under the foundation's "Public Issues" category that focus on issues of sustainability, ecosystem preservation, energy conservation, pollution prevention and reduction, and environmental education and outreach that lead to enlightened environmental policy

Maximum grant: Grants generally range from $10,000 to $100,000
Required Match? No
Application Round: A one-page letter of inquiry by the applicant is encouraged to determine if a project falls within the foundation's guidelines. Applications for Public Issues Grants must be post-marked by September 15 of each year.
Contact Person: 201-540-8442

5. Environmental Endowment for NJ
Eligible applicants: Preference for nonprofits with 501(c)(3) designation, but other nonprofits also eligible
Eligible projects: Research, litigation, public education and other activities that will promote the conservation, preservation and improvement of the air, land, water and other natural resources
Maximum grant available: $20,000
Required Match? no
Application Round: Typically announced in November with applications due in January
Contact person: Richard Sullivan, President, 609-737-9698

6. National Parks Service Rivers, Trails and Conservation Assistance Program
Eligible applicants: Community groups, municipalities, partnerships
Eligible projects: Greenway plans, stream restoration, trail design, conservation workshops, inventories of natural, cultural and recreational resources
Maximum grant: Staff involvement (technical assistance) rather than financial assistance
Required match?: Projects are undertaken as partnerships, and costs are shared with other organizations. Cost-sharing arrangements may involve money and/or in-kind services.
Application Round: On-going assistance offered to applicants developing proposals, July deadline for formal application for assistance
Contact person: Robert Potter, Program Manager, 215-597-1787

7. New Jersey Conservation Foundation Matching Mini Grant Program
Eligible applicants: Nonprofit organizations such as emerging land trust, citizen groups and greenway planning groups (organizations do not need nonprofit status)
Eligible projects: land planning, land acquisition, conservation easements
Maximum grant available: $5,000
Required Match? yes, 50%
Application Round: Typically announced in October or November, applications due 4 to 6 weeks after announcement
Contact person: Beth Davisson 908-234-1225

8. New Jersey Green Acres Program
Eligible applicants: Municipalities and counties
Eligible projects: open space acquisition and outdoor recreational facility development
Application Round: Applications typically due October 31 for that year of funding

Project Categories:

a. Standard Program - Offers 2% loans to finance eligible costs associated with the acquisition and development of recreation lands. Acquisitions are for the purchase of lands which may not possess inherently unique or sensitive natural resource characteristics, but which will serve as sites for active and/or passive open space recreation opportunities. Although there is no definite ceiling limit, proposals in excess of $500,000 are subject to additional criteria, such as project phasing or partial funding consideration.

b. Grants Incentive (Acquisition Only) - Offers 75% loans and 25% grants to finance up to 100% of eligible project costs. Proposals must meet one or more of the following criteria: environmental significance, historic significance, donations or waterfront parks.

c. Urban Aid Program - Funding is available in the form of 75% loan and 25% grant. This category is limited to acquisition and development projects sponsored by local units eligible to receive state aid pursuant to P.L. 1978, c. 14 (C.52:27D-178 et seq.) Willingboro Township is eligible.

d. Planning Incentive (PI): awards 25% grant and 75% loan funding to a municipality or county to acquire lands for recreation and conservation purposes identified in its Open Space and Recreation Plan (OSRP). In addition to an OSRP, the local government applicant must also have established and be collecting an open space tax pursuant to either N.J.S.A. 40:12-16 for a county or N.J.S.A. 19:37-1 et seq for a municipality to participate.

NOTE: Grants may be up to 50%, with 50% loans, depending on available funds each year

e. Nonprofit Organization Program: The Green Acres Program also runs Green Trust Funding Rounds for nonprofit charitable conservancies, subject to funding availability. This program was not part of the October 31, 1996 funding round. The program offers 50% grants, with the match being made with cash or a donation of land. Maximum grants are $500,000.

f. Tax Exempt Program: Program provides exemption from local property taxes to eligible nonprofit organizations which own recreation or conservation lands and open their private lands to the public

Contact person: Kathleen Z. Croes 609-984-0500

9. New Jersey Local Coastal Planning Grant Program

Funds projects that promote sustainability and environmental protection in the coastal zone. The program is dependent on the availability of funds. For updated status of the grant program, call Dorrina Frizzera of the Coastal Planning Unit, Office of Environmental Planning, NJDEP, at 609-777-3251.

10. Office of Environmental Services Matching Grants Program
Eligible applicants: Local environmental agencies
Eligible projects: Projects that promote the protection of natural resources by documenting those resources, preparing policy recommendations to protect those resources, and by preparing and disseminating information about the ways in which the public can participate in protecting the environment. Examples of previously funded projects include natural resource inventories, water quality studies, master plan and zoning ordinance amendments, open space plans, greenway planning, and public education programs.
Maximum grant: $2,500
Required match?: Yes, at least 50%
Application Round: Typical deadline is early December for awards in following year
Contact person: Dianne Shatin, Coordinator, 609-984-0828

11. Pew Charitable Trust
Eligible applicants: Organizations classified as non-profit under section 501(c)(3) of the IRS Code, and as charitable under 509(a) of that Code
Eligible projects: Projects whose goals are to reduce the use and production of highly persisten toxic substances that adversely affect the environment and public health, and projects that halt the destruction and further degradation of forest and marine ecosystems in North America
Maximum grant: Majority of grants range from $50,000 to $250,000
Required match? No
Application Round: Proposals accepted year round and reviewed on rolling basis
Contact person: Nahed Danial, 215-575-4744

12. Public Lands Clean-Up Program
Eligible applicants: Volunteer Groups
Eligible projects: Litter clean-up and removal
Maximum grant: Contributions to volunteer groups for Public Lands Clean-Up Days, supply of trash bages, gloves and protective clothing to volunteers, rental of eqipment used soley for litter clean-up, fees for proper disposal for non recyclables at the applicable solid waste facility
Required match?: Labor
Application Round: Ongoing, dependent on funds
Contact person: Clean Communities Grant Program - Burlington County Office of Waste Management - Kevin Stark, Coordinator, 609-499-5209

13. Schumann Fund for New Jersey
Eligible applicants: Non-profit organizations with 501(c)(3) status
Eligible projects: Projects that support protection of natural resources, environmental quality and wildlife.
Maximum grant: No maximum was stated in the foundation's annual report, but previous environmental protection grants ranged from $10,000 to $80,000
Required match?: No, but preference given to proposals indicating a high level of time and/or money contributed from the group to be served
Application Round: No yearly deadline; proposals are reviewed

quarterly
Contact: 201-509-9883

14. Victoria Foundation
Eligible applicants: Non-profit organizations with 501 (c)(3) status
Eligible projects: For land acquisition - projects must be eligible for consideration by the State Green Acres Program, must have passed their initial screening process and must be in active consideration by Green Acres. Special consideration is given to projects that will protect wetlands and transition areas, farmland, critical wildlife habitats, headwaters, exceptional ecosystems, watershed lands, and aquifer recharge areas. Other eligible projects involve environmental education and leadership training, environmental research, public education and advocacy, and resource conservation in New Jersey..
Maximum grant: Land Acquisition - grants may be used toward all or part of the 50% match for Green Acres grants, usually up to $500,000. Other projects generally range from $8,000 to $50,000
Required match?: Land acquisition - Green Acres grant; Other grants - No
Application Round: Ongoing
Contact person: Nancy Zimmerman, 201-783-4450

15. Wetlands Reserve Program of the USDA Natural Resources Conservation Service (NRCS):
Eligible applicants: Landowners (NRCS determines final eligibility)
Eligible projects: Land with the potential to contribute to desired ecosystem functions and values fitting into one the following categories: agricultural lands with restorable wetlands, former or degraded wetlands occurring in range and forest production land, riparian areas that connect with protected wetlands along streams or other waterways, adjacent lands that will contribute significantly to the wetland functions and values, previously restored wetlands under a State or Federal restoration program, privately developed wetland areas meeting NRCS restoration standards
Maximum grant: The program offers landowners three options to choose from when enrolling: a permanent easement, a 30 year easement, and a cost-share agreement in lieu of requiring an easement. Easement payment is for the agricultural value of the land, an established payment cap, or an amount offered by the landowner. Restoration projects are fully funded by the NRCS for permanent and 30 year easements, and are funded 50 - 75% for non-easement agreements.
Required Match: 25-50% for non-easement agreements.
Landowner is responsible for protecting and maintaining the wetlands within the boundaries of the easement. Public access to the easement area is not required. Acceptable uses of the land will be spelled out in detail and approved, and may include hunting, fishing, timber harvest, and haying or grazing, depending on the situation.
Application round: Ongoing, open sign-up in New Jersey began October 1, 1996.
Contact person: Tim Dunne, Resource Conservationist, USDA, 908-735-0733

16. William Penn Foundation
Eligible applicants: Non-profit organizations with 501(c)(3) status
Eligible projects: Projects that support the goals of promoting open space preservation, promoting development, maintainance and use of natural areas within Philadelphia, and that support environmental education
Maximum grant:?
Required match?: No, but the Foundation prefers to make grants for projects that receive support from several sources and that do not dependent upon the Foundation for total funding
Application Round: Accepts grant requests throughout the year.
Contact person: 215-988-1830

Other sources of information on grants:

Environmental Grant Making Foundations, distributed by the Environmental Data Research Institute, Rochester, NY. 1-800-724-1857. Costs $90

The Mitchell Guide to NJ Foundations, published by Janet Mitchell, 430 Federal City Road, Pennington, NJ 08534-4209, 609-737-7224. 1995 edition available for the reduced price of $50.00. The 8th edition will be published in the spring of 1997. The guide profiles 412 private foundations which donated more than $200 million to 18,000 charitable agencies.

Appendix C
RANCOCAS CREEK GREENWAY IMPLEMENTATION PLAN
SOURCES AND METHODOLOGY
for parcel specific tabular inventory and maps

Base Information

Tax parcel maps, parcel numbers, owners, addresses, approximate sizes and land uses were supplied to DVRPC by the Burlington County Office of Land Use from the Burlington County Tax Assessors Office in March of 1995. Where the property's acreage listed in the tax assessor's books differed from that listed on the tax map, the size on the tax map was used. Tax maps were digitized to scale into the DVRPC Intergraph GIS system, and identified by their parcel number. The parcel ID numbers can be cross referenced between the tables and display size maps (available for review at DVRPC, the Burlington County Office of Land Use Planning, and the Rancocas Conservancy). The reduced size maps included in the report are too small to clearly show the parcel numbers.

Map 1 - Natural Resource Areas

a. Natural Resource Areas Map: DVRPC's Natural Resource Areas Map was overlaid on the Rancocas Creek Greenway parcel map to illustrate the presence of environmental features. The Natural Resource Areas map was generated by DVRPC from a variety of sources. FEMA defined 100 year floodplains were digitized into the GIS from FEMA's Flood Insurance Rate Maps. Wetland boundaries were determined by the US Department of Interior's Fish and Wildlife Service National Wetlands Inventory (NWI). This inventory defines several different types of wetland, which have been combined into one category for the purposes of the map. Significant woodlands were identified from an interpretation of the 1990 aerial photographs. The Natural Resource Areas map is intended to be used as a guideline for where such environmental features occur, rather than as documentation of exactly where such features lie on any given parcel.

b. Natural Resource Comments in Tables: Five types of significant environmental features are listed on the tables when they occur on a parcel: floodplains, wetlands, wooded, wooded wetland and wooded floodplains. The presence of these natural features on the parcels was obtained from the DVRPC Natural Resources Areas map. Like the map, this data should be used as a guideline for where such natural resources probably occur, rather than as precise documentation that such features exist on any given parcel. In addition, the tabular data does not indicate how much of a parcel is in floodplain, wetlands, or woodlands etc., only that such features probably exist on the site.

Map 2 - Land Use

a. Land Use Map: The DVRPC 14 category land use map was overlaid onto the Rancocas Creek Greenway parcel map to show land use by parcel in the corridor. DVRPC completed a digital land use file based on aerial photography flown in 1990. Land use was interpreted in 14 categories from the aerials at the 1 inch = 400 feet scale. The annotated photographs were digitized to create computer aided mapping (CAM) linework which was registered to USGS 1 inch = 2,000 feet quad maps. Each area was annotated with its land use classification and the result incorporated into the DVRPC CAM/GIS system. The fourteen categories are single-family residential, multi-family residential, manufacturing, transportation, utilities, commercial, community service, military, recreation, agriculture, mining, wooded, vacant and water. The Rancocas Creek Greenway Land Use Map was reviewed by the Burlington County Office of Land Use and the Rancocas Conservancy and was revised accordingly.

b. Land Use Comments in Tables: The land use comments were derived from several sources. Basic land use comments, such as whether the parcel is vacant or has a residence, farm, commercial structure, etc, was obtained from the county tax assessor's database. Comments on drainage easements, riparian grants and tideland licenses were obtained from the tax parcel maps. Notes on development proposals are from telephone conversations with the township managers made in the spring of 1995 and the fall of 1996.

Map 3 - Type of Ownership/Accessibility - Parcels were assigned an ownership/access code for both the tables and the map.

a. Private ownership implies a private residence, business, club or a privately owned vacant parcel zoned for residential or commercial use.

b. Quasi-public ownership implies land that may be in private ownership, such as the Willingboro Golf Course, but is accessible to members or others on a fee basis. Utility authorities are also shown as quasi-public.

c. Public ownership/access implies that the land is owned by a public entity, such as the state, township or school board, and is usually intended for public access. There are several cases along the Rancocas, however, where the publicly owned properties are tidal lands without public access.

Map 4 - Type of Zoning

The parcels' zoning districts and the zoning key at the bottom of each table are from each municipality's zoning ordinance and map. For the composite zoning map, parcel's zoning districts were categorized into high, medium or low density residential, commercial, industrial, mixed use or floodplain districts. The cluster overlay option was mapped where a cluster development was permitted or required.

Map 5 - Type of Open Space Map

This map shows parcels coded as either developed, or as a type of open space categorized as tidal/marshland, parkland, farmland, vacant land or golf course. The information determining the code was primarily based on the tax assessors records. Aerial photographs, the land use map, and local knowledge were used to further categorize vacant parcels as marshland (undevelopable) or vacant (developable).

Map 6 - Prioritized Resource Protection Map

The Geographic Information System was first employed to determine which undeveloped parcels in private ownership had natural features (floodplains or wetlands) or scenic resources (farmland) and could be further subdivided according to their zoning. Municipal managers were then asked the development status of parcels meeting these criteria. Development status was categorized as one of the following:

a. Development Approved - Preliminary or final site plan approval was issued by the township.
b. Development Proposed - Development has been proposed to some degree on these parcels. Some proposals were as preliminary as a discussion of development possibilities with the township planning board, and other proposals were as formal as an official submission of site plans. These are the parcels that are most likely to be developed in the very near future.
c. Development Potential - There are no known proposals for developing these parcels, but to preserve the natural and scenic features on these sites.

Other Information

Historic/Archaeological Resources: Documented historic and archaeological resources in close proximity to the greenway study area were included in the inventory. The information was obtained from the Office of New Jersey Heritage, Division of Parks and Forestry, NJ Department of Environmental Protection. The numbers shown on the map and list of sites correspond to the numbered site location marked on the Office of NJ Heritage's quad maps.

Rare, Threatened and Endangered Species: There are several rare, threatened or endangered species and natural communities found in the vicinity of the greenway study area. The vertebrates listed as endangered or threatened in the study area include the Cooper's Hawk, Red-shouldered Hawk, Wood Turtle, and Bog Turtle. Invertebrates include the Yellow Lampmussel, Tidewater Mucket and Eastern Pondmussel. Vascular plants include the Bur-Marigold, Black-Fruited Spikerrush, Parker's Pipewort, Virginia False Gromwell, Torrey's Bulrush, and Narrow-Leaved Vervain. In addition, the entire Freshwater Tidal Marsh Complex along the Rancocas is considered rare in NJ. This information was obtained from the Office of Natural Lands Management at the New Jersey Department of Environmental Protection - See attached sheet on cautions and restrictions on natural heritage data. In addition, sitings of a pair of bald eagles was reported from the Endangered Nongame Species Program of the NJDEP Division of Fish, Game and Wildlife.

CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the data base. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEP Land Use Regulation Program, CN 401, Trenton, NJ 08625-0401.

This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.

Appendix D
EXAMPLES OF STEWARDSHIP BROCHURES

Much has been written about good land stewardship. The following materials have been included as examples of stewardship information designed for easy reproduction and dissemination. These flyers and pamphlets were developed, respectively, by:

1) The Media Area League of Women Voters in cooperation with the Darby Creek Valley Association and the Chester/Ridley/Crum Watersheds Associations;

2) The Heritage Conservancy for the Delaware River Greenway Partnership;

3) The New Jersey Coalition for Alternatives to Pesticides and the NJ Envionmental Federation, with printing costs funded by Whole Earth Center ;

4) Joe Arsenault, an arborist specializing in native plantings.

Another excellent source of information too lengthy to include here is "The Clean Water Book - Lifestyle Choices for Water Resource Protection" produced by the NJ Department of Environmental Protection, Office of Environmental Planning. Copies of this booklet can be obtained by calling Kyra Hoffman at 609-633-1179.

HOW TO CARE FOR YOUR STREAM

DO: ...plant trees and shrubs along your stream.

WHY: The roots of woody plants stabilize the banks and reduce erosion. Trees and shrubs also shade and cool the stream, which is better for fish.

DON'T: ...remove native vegetation from stream banks.

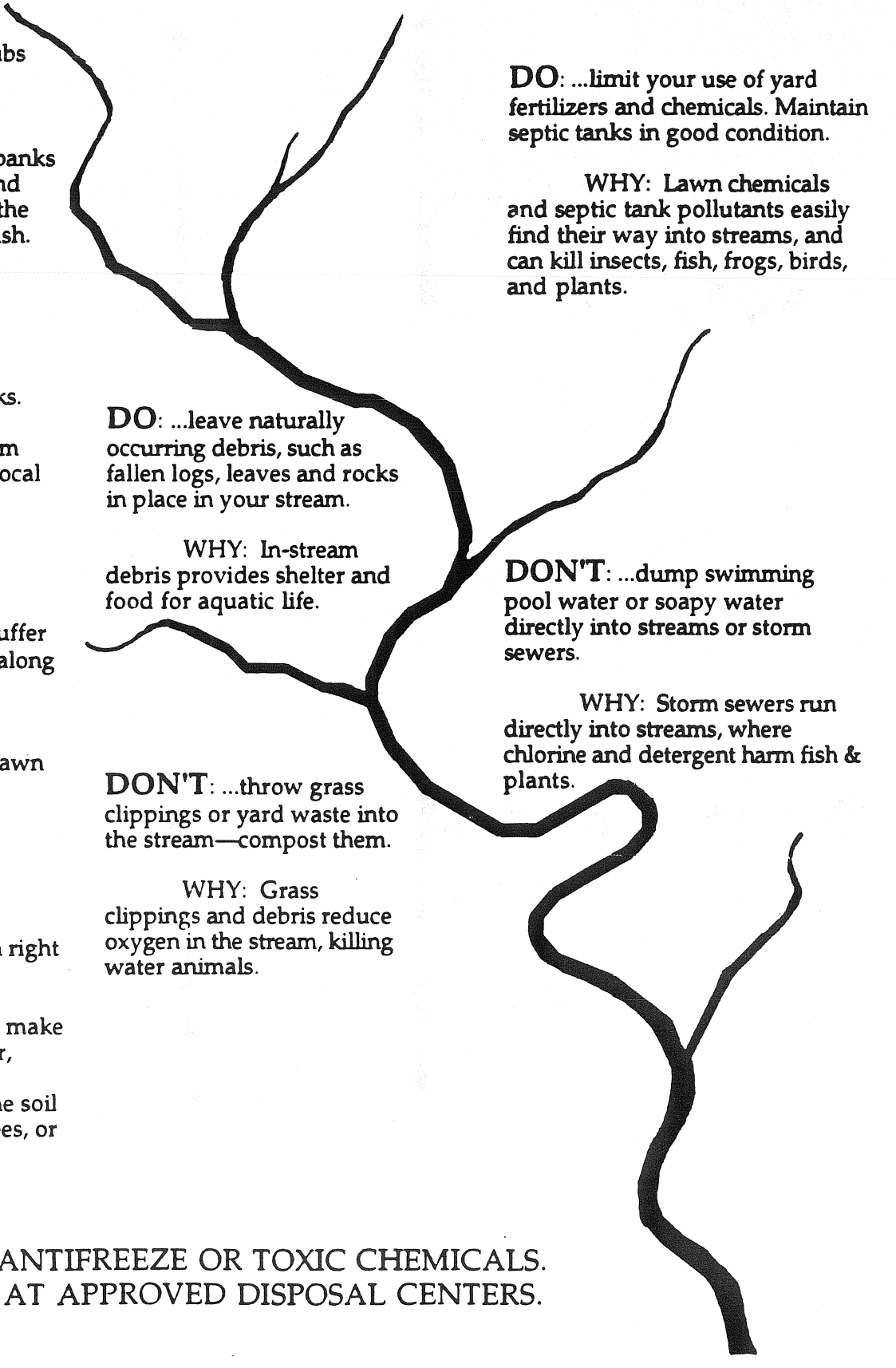
WHY: Leaf litter from native plants is part of the local food chain.

DO: ...maintain or create buffer zones (the wider the better) along streams and wetlands.

WHY: Buffer zones absorb water and filter out lawn chemicals, fertilizers and sediment.

DON'T: ...mow your lawn right up to the stream bank.

WHY: Turf does not make a good buffer. It sheds water, especially on slopes, and its shallow roots do not hold the soil as well as native grasses, trees, or shrubs.



DO: ...limit your use of yard fertilizers and chemicals. Maintain septic tanks in good condition.

WHY: Lawn chemicals and septic tank pollutants easily find their way into streams, and can kill insects, fish, frogs, birds, and plants.

DO: ...leave naturally occurring debris, such as fallen logs, leaves and rocks in place in your stream.

WHY: In-stream debris provides shelter and food for aquatic life.

DON'T: ...dump swimming pool water or soapy water directly into streams or storm sewers.

WHY: Storm sewers run directly into streams, where chlorine and detergent harm fish & plants.

DON'T: ...throw grass clippings or yard waste into the stream—compost them.

WHY: Grass clippings and debris reduce oxygen in the stream, killing water animals.

NEVER DUMP OIL, ANTIFREEZE OR TOXIC CHEMICALS.
DISPOSE OF THESE AT APPROVED DISPOSAL CENTERS.

EVERY LITTLE STREAM COUNTS . . .

The stream on your property may be a spring-fed rivulet, or a real creek. All are part of a single system, feeding into the Delaware River. Even the smallest stream supports aquatic plant and animal life, and is an important part of the water cycle. Every stream deserves to be cared for, and kept free of pollutants, to keep the whole system healthy.

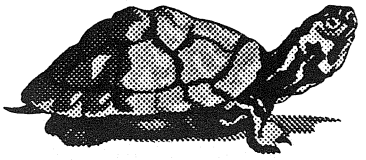
SOME HELPFUL DEFINITIONS:

A STREAM BUFFER or RIPARIAN BUFFER is a strip of land along a stream where trees, shrubs, and small plants are encouraged to grow. Recently scientists have learned the importance of buffers in keeping streams healthy.

The U.S. Forest Service now recommends a 50 foot buffer, free of all development, on each bank of a stream. Buffers of 300 feet or more are often used to protect the natural character of streams. On smaller properties, aim for a minimum of ten feet between your lawn and the stream bank. Even a single row of trees or bushes will help protect your stream.

NATIVE VEGETATION refers to plants that have always grown in this area. The animals in our streams use specific tree leaves for food and building material and thrive best when those species are present.

Non-native plants can contribute to a buffer zone by reducing erosion, but they may be invasive, and are less well suited to the existing food chain.



BEAUTIFUL AND HEALTHY:

We may be used to seeing streams edged by neatly mown grass. But running water offers an opportunity for imaginative landscaping. A buffer zone of trees, shrubs and ferns will add interest to your landscape and protect your stream. Here are some of the native species you might try:

Flowers: Purple stemmed aster; rose mallow; blue flag; yellow iris; cardinal flower; turtlehead; swamp milkweed; Joe-Pye weed.

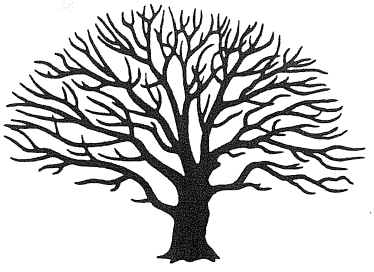
Ferns: Sensitive fern; cinnamon fern; royal fern.

Grasses & Sedges: Soft-stem bulrush; fringed, lurid or tussock sedge; big bluestem; cattails.

Woody Plants: Buttonbush; red-twig or silky dogwood; spicebush; Virginia sweetspire; shadbush; cranberry bush viburnum; red or black chokeberry; sweet pepperbush; inkberry and winterberry holly; common alder.

Trees: Many kinds of willow; river birch; ash; box elder; red maple; sweet bay magnolia.

Ask your local arboretum or nursery for information about these or other stream side plants.



WHO IS RESPONSIBLE FOR OUR STREAMS?

We all are! Most of us live upstream from someone else, and what we do affects others' water as well as our own. We need to work together to keep our streams clean and healthy. We are all stewards of the land.

Your township or borough is responsible for making regulations to protect the streams that run through it. These may cover development on steep slopes or flood plains, storm water management, sewers and septic tank regulations. Most streams run through more than one jurisdiction, and ordinances vary. Encourage local officials in towns along your stream to cooperate to protect it.

Local watershed groups work across municipal boundaries to monitor and enhance the various creeks in our area. You might want to start your own stream protection group, or contact:

Darby Creek Valley Association
P.O. Box 583
Lansdowne, PA 19050

Chester/Ridley/Crum Watersheds Association
P.O. Box 972
Edgmont, PA 19028

Brandywine Valley Association
1760 Unionville-Wawaset Road
West Chester, PA 19382-6751

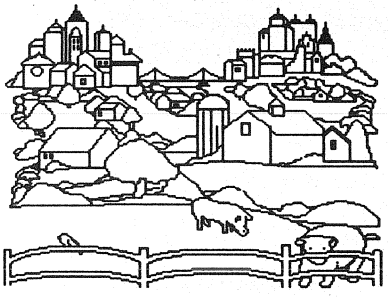
This pamphlet was developed by the Media Area League of Women Voters, in cooperation with the Darby Creek Valley Association and the Chester/Ridley/Crum Watersheds Association. Layout courtesy of Taylor Memorial Arboretum.

9/95

The Delaware River Guide

... information, resources and educational activities about the Delaware River and its tributaries

Stewardship



GOALS:

- **To develop an understanding of how people rely on the Delaware River, what pressures are placed on the river in meeting human needs, and how to lessen negative impacts.**
- **To understand and practice conservation and preservation techniques to aid the watershed.**

OBJECTIVES:

1. **Describe (using an appropriate method) historic uses of the river and how uses have changed over time.**
2. **List ways that people use and pollute water.**
3. **Create action plans that will improve water quality.**
4. **Explain conservation and preservation practices that are currently in place along the river basin and describe why these practices are needed.**
5. **Design and implement plans that will support or improve conservation and preservation practices within the Delaware River watershed.**

Stewardship For The Delaware River Basin

Water quality is best preserved by protecting a river or stream's watershed. Two major avenues of protection are used for conserving and preserving lands. One, community planning, occurs at the municipal level, deals with municipality-wide land use, and can involve any interested citizen. The second, land trusts and estate planning, involves privately held lands and arrangements landowners determine individually to preserve their property. By understanding their choices and creating workable alternatives, individual citizens can make positive improvements to the region.

Community Planning

The Pennsylvania Municipalities Planning Code allows for land use planning as a legal basis for land use decisions. Municipalities use this code to adopt a comprehensive plan as a "vision" or guide for future community growth. This guide, however, is not the legal document that determines what can and cannot be done regarding land use. Municipal zoning and subdivision

Continued on page 2

Activities

Many of the topic and activity suggestions given below can be applied to any region of the Delaware River Basin. Although some specific projects are suggested, these topics lend themselves to different assessment forms: written papers, oral presentations, group projects utilizing audio, video, computers, or multi-media, displays, creative dramatics and crafts, bulletin boards, 3-D hallway representations, community projects — the list is limited only by the energy and imagination of you and your students! A complete activity is also provided on pages 6- 8.

✓ Trace the path that water travels in order to serve humans in the local community. Consider the water's origin in surface and ground sources, movement to home wells or public storage facilities, to home treatment systems or public treatment plants, to home and industry uses, and eventually its return to the natural environment.

Continued on page 2

Did you ever stop and think
How precious our water is
to drink?
Close those drips,
Don't spoil our streams,
So on the lakes our children
can dream.
Tricia Bonamo, age 12

Activities – *continued from page 1*

✓ Investigate the relationship between drinking water quality and human health and explain why private and public drinking water supplies must be tested for quality.

✓ View residential or public drinking water facilities and explain how treatment techniques meet the regulatory standards that are applied to water before its use. How does treatment differ to meet the regulatory standards that are applied to water *after* its use?

✓ Investigate personal water use habits and develop plans to involve their families and community in water conservation efforts.

✓ Have students understand how water is important in their lives, have students identify water related products and recreation experiences that are part of their lives.

✓ Work with language arts and creative arts teachers to help students experience the aesthetic impact of a water resource on their lives.

✓ Analyze how local water use decisions can affect human lifestyles, quality of life, and standard of living. This can be done by examining local water use ordinances, zoning laws, special water quality regulations and status that waterways may be granted. How can and do these regulations affect the way people utilize water resources and the surrounding watershed?

✓ Summarize the evolution of a local use of water, and interpret the impact of that evolution on the environment. Investigate any local doctrines of water ownership that apply to water use in your area and conflicts caused by changes in water demand. (Water uses which could be

Continued on page 3

The Delaware River drainage area provides 10 percent of the U.S. population with potable water.

Stewardship for the Delaware River Basin – *continued from page 1*

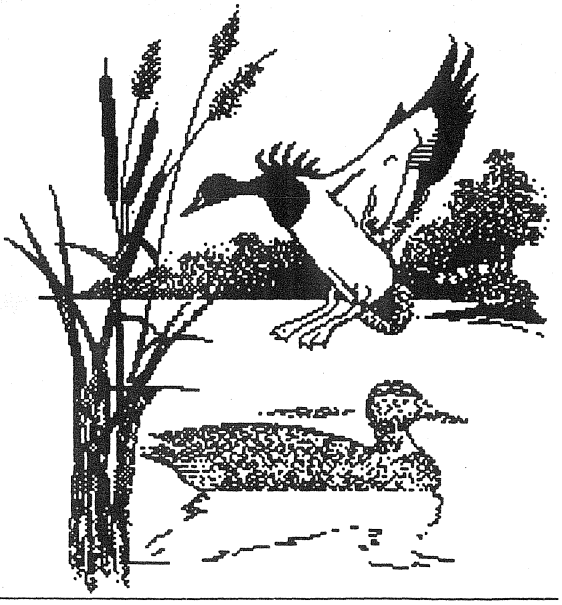
ordinances serve as the legal basis for all land development decisions. These ordinances are very specific. They define the minimum number of acres land may be divided into based on the "zone" that the land is determined to be in (i.e., residential, commercial, agricultural). Zoning ordinances provide for protection of natural and historic resources such as steep slopes, floodplains, wetlands and historic districts. In Pennsylvania and New Jersey, county planning agencies serve only as advisors to individual municipalities for land planning. Each municipality makes planning and zoning decisions for its own community. Development plans must be submitted for approval to municipalities through municipal planning boards, which work out all changes and details and then recommend approval to municipal supervisors. This process, which maintains the rights of individual communities, presents numerous challenges for regional planning.

In both Pennsylvania and New Jersey, existing legislation allows for the creation of municipal "environmental advisory councils" (in PA) or "environmental commissions" (in NJ). These are special committees which review development plans regarding environmental issues and resource protection compliance. The committee (when a municipality has one) provides comments to the municipal planning commission for consideration. EAC's also take on special projects, such as inventories of environmental resources. This process gives municipalities the opportunity to provide for protection of their natural and historic resources. Informed citizen involvement is critical.

Land Trusts and Estate Planning

There are various techniques landowners can choose to protect the significant resources of their property. Many groups and organizations already exist in the Delaware Valley whose goals are protection and preservation of various resources. All would welcome your, your students and your neighbors questions and participation. (Contact the Delaware River Greenway office, 215·345·7020, for groups near you.) By working with land trusts, private non-profit groups whose mission is to protect natural and historic resources, landowners can reduce estate taxes. Trusts may be organized to protect a specific resource, or they may have more specific goals and objectives. Land trusts are non-regulatory; they have no governmental powers. Trusts work directly with landowners to permanently protect resources through land donation and acquisition methods, and through conservation easements which provide tax benefits to the land/easement donor. Often partnerships of land trusts with government agencies provide the best and most diverse opportunities for land protection.

If the drainage area of the Delaware River were a state, it would be the 10th smallest state, but the 10th largest in terms of population.



Water Usage and the Delaware River Basin

Consumptive Water Use

Not all the water withdrawn from a stream or river is lost to that resource. In fact, much of the water is returned to the stream after use through sewage treatment plants, power plants and industries. The water that is not returned is said to be *consumptively used*. This water may be evaporated, incorporated into products, used by plants or lost through other uses that do not return it to the watershed.

In Pennsylvania, electrical power plants use more than 10 billion gallons of water each day. Most of this water is used for cooling to condense steam in the generation of electricity. One Pennsylvania plant uses cooling towers 37 stories high to cool water from 115° F to 85°. One tower circulates 225,000 gallons and loses almost 3,500 gallons each minute through evaporation. This is an example of consumptive loss.

Industry accounts for the second major share of water used in Pennsylvania, using approximately 5.5 billion gallons each day. Some processes incorporate water as an actual component of the product, such as beverages, food products and other liquid products. Water is also used for cleaning, mixing and cooling in manufacturing.

Public water supply is the third major water use in Pennsylvania, using 1.5 billion gallons each day. This water is used for fire protection, street cleaning and domestically for bathing, drinking and car washing.

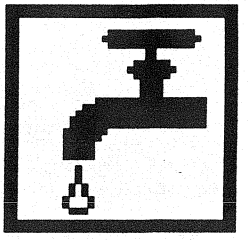
Agriculture is not a major water user in Pennsylvania, although it is in western states. Irrigation, livestock watering and other agricultural uses account for less than 650 million gallons per day in Pennsylvania.

Transportation and recreation cannot be described by the number of gallons they require per day. Waterways must remain open as navigable water highways. Swimming, boating and fishing require bodies of water that are uncontaminated and of reliable quantity.

Source: *Water Instructor's Guide to Water Education Activities.* PA DER. 1986.

Benjamin Franklin left money to Philadelphia in his will specifically for developing a municipal water system.

Levels of Wastewater Treatment

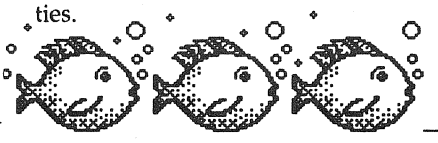


Modern wastewater purification begins with primary treatment. During this step solids found in raw wastewater settle out of the liquid. Solids removed from the bottom of the tank are called primary sludge. This process removes 45-50% of the pollutants.

In 1972, the Clean Water Act also required secondary treatment. While primary treatment is mostly a physical approach, using devices to remove various-sized particles, secondary treatment uses biological methods. In this stage, bacteria are intentionally used to consume most of the remaining waste materials.

Primary and secondary treatments remove some 90% of the pollutants in the wastewater. The resultant sludge disposal has become one of the most difficult parts of improving water quality. It is anticipated by the year 2000 New Jersey will be processing 14 million dry metric tons of sludge into products for reuse. In 1993 New Jersey used the following methods of disposal: 57.1% of the sludge was shipped out of state to landfills, 19.4% of the sludge was reduced in incinerators, 23% was beneficially used as soil conditioning products and directly land applied and 0.5% was disposed of in other ways. There are 451 wastewater treatment plants in New Jersey generating 330 thousand dry tons of sludge per year.

Source: *My World, My Water, and Me.* The Association of Environmental Authorities.



Activities – *continued from page 2*

considered include: the historical increase in an urban population, evolution of commercial fishing or textiles industry, or use of water in food production processes over time.)

✓ Investigate human actions which affect water quality in your community. Predict which pollutes "most" to "least." Do discharge regulations apply? How much of this pollution comes from non-point sources? Can these amounts be quantified and regulated? Have students devise some approaches.

✓ List local environmental factors which affect the potential of pollution sources to contaminate groundwater and predict land uses appropriate to protect those factors. (Environmental factors might include soil types, geologic formations, proximity of water sources, height of water table, climate factors, potential of flooding, scenic qualities, etc.)

✓ Meet with representatives of regulatory agencies to learn about likely causes and effects (on humans, fish and wildlife) of pollutants found in their community that exceed advisory levels. Discuss what actions are being taken to deal with these pollutants.

✓ Investigate how water quality changes are measured over time and

Continued on page 4

Activities *– continued from page 3*

summarize what those measurements indicate about local water quality. Understanding the change should include knowing how human behavior affects degradation, as well as historical improvement of local water quality.

✓ Assess the relative environmental quality of a local body of water – conduct a "stream study." Refer to the Watershed Packet of *The Delaware River Guide* for the activity "Water Quality in a Watershed." In addition, many aquatic ecology textbooks explain techniques for determining the *biotic index* of a waterway. These indices evaluate streams based on aquatic organisms and can give a good indication of its water quality even if you do not or cannot conduct chemical water quality tests.

✓ Identify local and regional agencies which monitor and control pollution caused by humans. Observe the strategies and equipment they use to identify water quality problems, sources and solutions.

✓ Identify local and regional agencies which monitor and control natural disasters; interview professionals from these agencies to learn how they prepare for and prevent natural disasters related to water.

✓ Demonstrate understanding of best management practices (BMPs), which minimize the risk of water contamination from agricultural chemicals, by making farm visits, through farm management simulations and talking with county extension service agents.

✓ Identify appropriate questions and sources of information for evaluating a local water issue.

✓ Evaluate the effects of different kinds of land use on water habitats. Describe and evaluate lifestyle changes and community planning options that could minimize damaging effects. Is there a

Continued on page 5

Pollution and Pipes –
Point and Non-point Source Pollution

Waterways can be contaminated by *point source pollution* or *non-point source pollution*. Point source pollutants are major specific discharges that can be pinpointed, such as the discharge from a sewage treatment plant or industry. Non-point sources include general runoff and/or leaching from urban, suburban and agricultural areas.

When sewer systems were built, it was cheaper to use one set of pipes to carry stormwater runoff as well as sewage. During a rainstorm, the amount of water entering the pipes can be up to 100 times the normal flow. This water, which picks up oil, litter and an astonishing amount of dog manure from the pavement, rushes into the pipes and scours them out. Most of this dirty storm water goes directly into the river because there is no place to store it until sewage treatment plants can process it.

Ninety percent of beach closings in New Jersey are due to pollution from stormwater flows. A survey conducted by the National Oceanic and Atmospheric Administration found that urban stormwater runoff, sewage treatment plant effluent, agricultural runoff and increased boating activity cause most shellfish harvest restrictions. Separate storm sewer pipes need to built, but this is very expensive. How much is a day at the beach worth to you? How much is a fully functioning estuary worth?

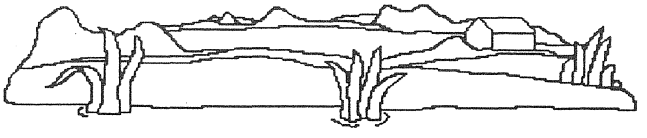
Since 1936, more than one and a half billion dollars have been spent to build and improve sewage treatment plants in the Delaware watershed.

In places without storm sewers, rain picks up sediment and nutrients from building sites, agricultural fields, lawns and gardens. The dirty rain water flows overland into ditches and tributaries, eventually ending up in the river and its estuary. Such non-point source pollution may not be as obvious as point source pollution, but that doesn't mean it is not significant. Sixty-five percent of all water pollution in New Jersey is believed to be non-point source pollution.

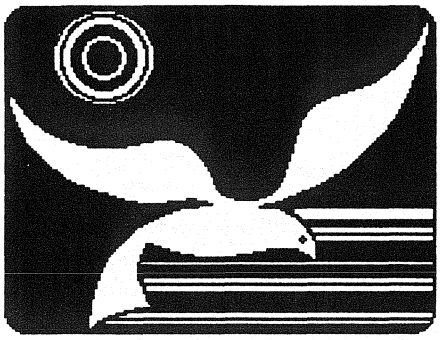
What are ways this type of pollution can be controlled? States can encourage landowners, homeowners and farmers to use *best management practices* (BMPs) which help control nutrient runoff. Examples of BMPs include strips of trees and vegetation (buffer zones) around cropped fields, settling ponds and other controls at construction sites to prevent sediment runoff, special composters and impervious liners under poultry houses, and more careful use of insecticide and fertilizer on farms. Most homeowners use *ten times* more pesticide than they need!

Studies also show that nutrients can be added to estuaries as rainfall cleanses air overhead. At least 25 percent of all the nitrogen in the Chesapeake Bay Estuary may come from this source. It could be a problem in the Delaware Estuary, too. A single trash incinerator in Delaware releases 328 tons of nitrogen monoxide, 504 tons of sulfur dioxide, 70 tons of carbon monoxide and 140 tons of particulates into the air each year. Is any of that trash yours? Do you know where your trash goes? Are you recycling? Cars produce 4 grams of nitrogen oxides per mile. How much nitrogen did you put into the air this morning? Is your car well-tuned? Do you carpool and plan your driving with your family or friends? Are you beginning to see how connected you really are to what is happening to the Delaware River watershed?

Source: Delaware Estuary Issues, U.S. Fish and Wildlife Service and the U.S. EPA.

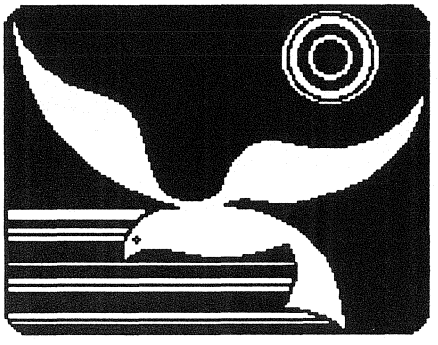


How Much Water Does It Take?



- 40,000 gallons of water to make one ton of steel.
- 150 gallons of water to make just one copy of a Sunday newspaper.
- 6 gallons for every 1 gallon of gasoline oil companies produce.
- 75,000 gallons of water to produce a ton of high grade paper.
- 600,000 gallons of water to produce a ton of synthetic rubber.
- 44,000 gallons of water to produce the steel in a car.
- 1,000 gallons of water to produce a ton of sugar.
- over 100,000 gallons of water to make one car.
- 5,000 gallons of water to produce one pound of meat.
- 150 gallons of water to produce one loaf of bread.
- 1,400 gallons of water to make a hamburger, fries and a soda.
- A cow drinks 3 gallons of water to produce 1 gallon of milk.
- One ton of recycled paper saves 7,000 gallons of water.
- 11.6 gallons to process one chicken and 9.3 gallons to process one can of fruit or vegetables.
- 5.4 gallons of water to make one foot board of lumber.
- 24 gallons of water to make one pound of plastic.
- 23 gallons of water to produce one pound of potatoes.
- 10 gallons to do one load of laundry.
- 47 gallons of water to produce one pound of oranges.
- 5 gallons of water for the average person to wash their face and brush their teeth.
- 120 gallons of water to produce one egg (this includes the water for growing grain to feed the chicken).

Source: *My World, My Water, and Me.* The Association of Environmental Authorities.



In 1930, Philadelphia alone was discharge 350 million gallons of raw, untreated sewage and 247 tons of industrial waste into the river *every day.*

The Delaware River is one of the last remaining undammed* U.S. rivers

* along its mainstem

Activities – *continued from page 4*

local issue that developed from this kind of problem? If so, have students contact agencies and committees to follow the resolution of the issue. Identify and plan ways students could become involved.

✓ Identify personal actions that can help lessen or prevent water pollution.

✓ Utilize a local or regional water issue to stimulate investigations that use observation, measurement, data recording, prediction, inference, classification and problem solving skills to enhance student understanding of the science, community values and policies of the issue.

✓ Develop solutions to a water issue by analyzing and applying the science, community values and policies that relate to that issue.

✓ Communicate what has been learned about any positive or negative impacts of changing local conditions on the water resource in an appropriate forum or medium.

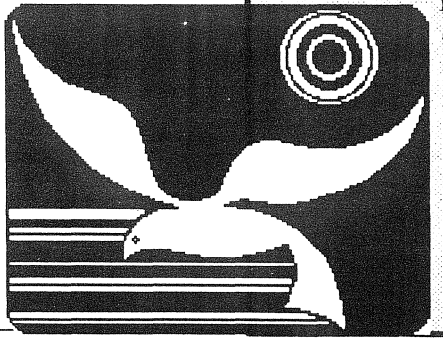
✓ Research the types of restrictions and differences for each type of land use zone (residential, commercial, agricultural) in your community. Compare the restrictions placed on similar lands by different communities. Why do different communities zone their lands differently? Find support for these reasons.

✓ Research the types of commissions townships have – what each does, what its responsibilities are. Set up mock committees and review a development plan.

✓ Investigate "performance zoning."

✓ Go to a local municipal meeting.

✓ Research model protection ordinances. Design a development plan that utilizes them and satisfies needs of government and private landowners.



Student Activity ~ Water – Making It Dirty, Getting It Clean

For the Teacher:

Materials: (for each group of 4)

- Alum - ($KAl(SO_4)_2H_20$ - 10-20 gms
- Sand (washed)
- Gravel (washed)
- Funnel
- Aquarium charcoal granules (washed)
- Stirrer
- Paper clips - 1 or 2
- Beakers (250 ml), 3
- Paper cups
- Erlenmeyer flask (250 ml)
- Filter paper
- Marking pencil
- Quart or liter jar, 2
- Beaker (150 ml)

"Pollutants" for entire class (see background)

- Soil
- Sugar
- Vinegar with a few drops of food coloring added
- Spices (salt, pepper and/or garlic salt work well)
- Vegetable oil
- Small pieces of "trash" (plastic, paper, etc.)

Preparation:

1. *Lightly* color the vinegar with a few drops of food coloring.
2. Set out materials for class use.

Total water usage per person each day in the U.S.:

Industrial Use =	1,040 gals
Agricultural Use =	600 gals
Domestic Use =	+160 gals
Total =	1,800 gals

Source: Aquatic Project WILD, Western Regional Environmental Education Council, 1987.

Background:

A typical water filtration plant uses a number of techniques for producing "pure" water. *Coagulation* is the process of adding chemicals, such as alum, that form aggregates of suspended solids, including bacteria. These materials then settle to the bottom and form a sludge. *Sedimentation* requires dirty water to remain still in a large basin. After a long retention time, solid particles settle out. The water then passes through a number of sand beds to further remove objectionable substances. The latter process is referred to as *filtration*. Finally, *chlorination* is a step that adds chlorine to the water to kill any bacteria that found its way through the preceding steps. In some filtration plants, water may be passed over charcoal beds to remove objectionable colors and odors from the water as well.

In this activity, students will "make the water dirty" by simulating the activities of a town, and then try to clean it using the techniques described above. You may want to pre-measure the "pollutants" that will be added to each group's water supplies. This will provide for a better comparison in the end. In real-life, however, some towns pollute their water supplies more than others and you may choose to give each group random amounts.

Procedure:

1. Give each group of 4 students a liter or quart jar 1/2 to 2/3 full of tap water and tell them this is their town's water supply. They are going to see what happens to the water in their town in one day. Relate the following story to them, having them follow the instructions in brackets. Stress that the students carry their jar with two hands, or at least with two fingers underneath, so it will not slip out of their hands.

"In your town, as in towns all around you, many things happen that use water everyday. There is a farmer who plowed and fertilized his fields. It rained soon after, and soil and fertilizer washed into your town's water supply." [Have a student bring their town's water supply (the jar of water) up to the front and add some soil and sugar into the jar. The sugar represents the fertilizer.]

"Later that day a person changed the oil in a car, and rather than dispose of the oil properly, s/he poured the used oil down the storm drain and it entered your water supply." [Have another person bring up the water supply from each town and add a little vegetable oil to simulate the motor oil.]

"Near your town there is a mine. The mine operator has not reclaimed the soil and tailings properly, and when it rains, acid mine drainage runs off into your town's water supply." [Have another person bring up their town's water supply and add some colored vinegar to the jar to represent the acid mine drainage.]

"People in your town cook food and in the course of making dinner, some food scraps are washed down the drain and into your town's water supply." [Have another person bring up the town's water supply jar and add some spices to it.]

"Since your town is near the river that supplies its water, people like to picnic along the river's banks. Unfortunately, they are not all always careful with their litter and some trash blew into the river." [Have one more person carry up the jar and add some bits of trash into the water supply.]

"Yelch, your water looks pretty dirty now that your town is done with it! But, not to worry. Where does the water go when your town is done with it?" [Back into the river, downstream to the next town.] So, I would like each of you to pass your town's used water downstream to the next town. [The town at the bottom of the stream can pass their water to the town at the top of the stream - afterall, everybody needs water!] So, now, this is the water supply for your town. Your job now, as the town's water authority, is to purify the water so it is fit for your town to use."

2. Pass out the lab sheets with the options and techniques the towns can use to clean their water.

3. Instruct the groups to create a plan and write down their course of action, carry it out and record their results.

4. When all are done, compare the results of the different towns. How clean were the students able to get the water? What are some other techniques they might try? How do municipal water authorities clean their water? Do towns have to clean their water before they discharge it back into the river? (Yes!) How? Invite a speaker from the water authority to come to your class to explain how this is done. Take a trip to the sewage treatment plant to see for yourself, or arrange for a speaker. Ask industry representatives to explain what kind of water treatment goes on at their facilities before they can discharge water. Power companies, chemical companies, metal processing companies, paper companies, land fills, and others will, more than likely, have some sort of water treatment at their sites.

"Never doubt that a small group of thoughtful, concerned citizens can change the world... indeed, it's the only thing that ever has."

—Margaret Mead

Thirty-two rivers carry more water than the Delaware

NOTE TO THE TEACHER:

You may want to simulate the real world by putting restrictions on the amount of materials your students can use, such as 3 pieces of filter paper, or only so much charcoal, etc. This would be similar to the budgetary restraints faced by townships. Challenge the groups to see who can end up with the most water and the cleanest water as well.

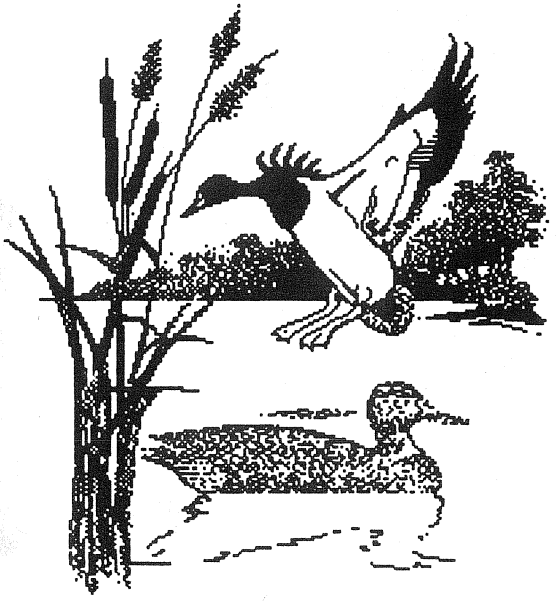
You may also want to supply a variety of other, "low-tech" cleaning techniques, such as strainers, coffee filters, cotton and straw that the students can use in addition to, or in place of, the techniques described on their work-sheet. Challenge the class to develop their own techniques for purifying their water samples. Larger sand and gravel filters can be constructed out of plastic soda bottles. Diatomaceous earth (used in pool filters) could also be used. Aquaria can be set up for long-term filtration experiments.

CHLORINATION: Chlorine is very dangerous. If you decide to use this step with your class, dispense the chlorine (household bleach will do) under a hood and be sure students (or you - whoever is handling the chemical) wear safety glasses and follow proper safety procedures. Since the amount of "pollution" in town's water samples will vary, it is impossible to recommend an amount of chlorine. Backpackers used to use 5-10 drops of chlorine per quart of water to purify it for drinking. (The discovery of *giardia* has altered this practice somewhat but this may give you a good starting point.) You may wish to have your students design some kind of experimental procedure to determine how much chlorine is needed. How will they test if the water is uncontaminated? Perhaps a water testing company can provide some answers.

Adopted from: "What Are Some Methods of Water Purification?" from Clean Water Works, Water Resources Activity Guide for Grades 10, 11, 12, *Delaware Estuary Program*

— and — Watersheds Environmental Education Week Packet, *Pennsylvania Alliance for Environmental Education, Pennsylvania Department of Education.*

Most of the remaining miles of non-tidal river are under study for inclusion in the Wild and Scenic Rivers System.



One hundred ten miles of the 200 mile non-tidal portion of the Delaware is contained in the National Wild and Scenic Rivers System.

The Delaware River Guide is a project of the Delaware River Greenway Partnership*, in cooperation with the Delaware & Lehigh Navigation Canal National Heritage Corridor Commission, Bucks County Audubon Society's Honey Hollow Environmental Education Center, and the Pennsylvania Coastal Zone Management Program.

(*hosted by the Heritage Conservancy)

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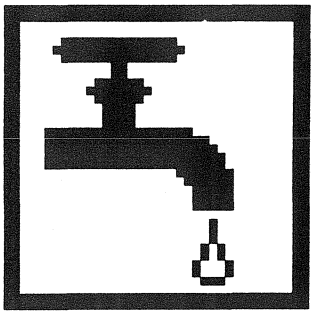
Name_____ Date_____ Period ____

Student Worksheet ~ Water – Making It Dirty and Getting It Clean



Directions: Read the directions for the different filtration techniques. Choose which of them your group will utilize to clean your town's drinking water supply. Your teacher may also provide you with strainers, cotton, cloth, straw, coffee filters and other materials for filtering your water as well. On a separate sheet of paper develop and describe the steps your group will undertake to clean the water in your jar. In addition to answering the questions at the bottom of this page, include descriptions of techniques, observations of results and conclusions.

Background: In order for water to be pure enough to be used for drinking, suspended and dissolved materials that make water objectionable and harmful must be removed. A typical water filtration plant uses a number of techniques for producing "pure" water. *Coagulation* is the process of adding chemicals, such as alum, that form aggregates of suspended solids, including bacteria. These materials then settle to the bottom and form a sludge. *Sedimentation* requires dirty water to remain still in a large basin. After a long retention time, solid particles settle out. The water then passes through a number of sand beds to further remove objectionable substances. The latter process is referred to as *filtration*. Finally, *chlorination* is a step that adds chlorine to the water to kill any bacteria that found its way through the preceding steps. In some filtration plants, water may be passed over charcoal beds to remove objectionable colors and odors from the water as well.

Questions to Consider:

1. What do water treatment plants do with the sludge and floc that settles out of the water they treat?
2. In what ways are coagulation and filtration the same? Different?
3. What is the purpose of using the charcoal filter system?
4. Would you be willing to drink this water? Why or why not?
5. How are these procedures the same/different from those used in a water filtration plant?
6. How is the water purified that you use at your home or school? What happens to the water when your household or school is "done" with it?
7. Keep track of what your family puts down the drain for a week at your house. What will the effect of these materials be on your – or someone else's – water supply? What are some ways to lessen negative effects? increase positive effects?
8. Devise some techniques to try to get your water sample cleaner.

By the 1930's, the tidal portion of the Delaware River received the raw wastes of more than 2 million people.

Filtration Techniques

Coagulation and Sedimentation:
Add 10-20 gms of alum to your jar and stir well. Set aside for about 30 minutes. What will you do with the floc that settles out?

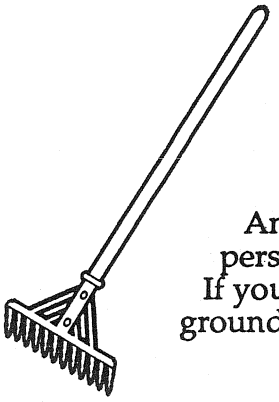
Filtration - with sand and gravel
1. With a straightened paper clip, poke about 30 holes in the bottom of a paper cup.
2. Add 1 cm of gravel on the bottom of the cup and 3 cm of sand on top of the gravel. The bottom layer of gravel keeps the sand from clogging the holes. On top of the sand, add another layer of gravel about 1 cm thick. The upper layer of gravel keeps the sand from being churned up as water is poured onto the sand filter.
3. Gently pour the water from your jar into the sand and gravel filter. Use a beaker or another jar to collect the water that comes through the filter.

Filtration - with charcoal
1. Add charcoal granules to a 150 ml beaker to a depth of about 2 cm. Add water that needs to be purified. Stir.
2. Fold and fit a piece of filter paper to a funnel. Place the funnel on top of the flask or empty jar.
3. Add the charcoal-water mixture from the 150 ml beaker to the funnel a little at a time. Make sure that none of the transferred water spills over the edge of the filter paper.
4. Continue until all water has been filtered.
5. If the filtrate contains some charcoal particles, refilter the liquid using a clean piece of filter paper, if your budget allows.

Chlorination - due to the toxic nature of chlorine, check with your teacher to see if you will be allowed to use this technique to purify your water supply.

A Supplement to

The Delaware River Guide

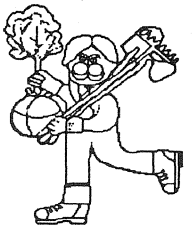


How Environmentally Friendly is Your Yard?

Answer the following questions to reveal the environmental and personal cost of maintaining your yard in its present condition. If you don't live in a single family dwelling, use the apartment grounds or a commercial building with landscaping surrounding it.

Approximate size of property (in square feet or acres) _____
Check one: single family residence ___apartment or condo ___commercial___

1. How many hours per week on the average are spent mowing the grass?_____
2. Do the shrubs and or trees require periodic trimming? _____
3. Does the grass and or other landscape plantings require irrigation during dry periods? _____
4. How many times are fertilizers and pesticides applied in one season? _____
5. What do you estimate the cost per week is for maintenance? _____
   (Include an average cost for seasonal maintenance during a 20 week growing season)



In addition to the human cost in time and money, traditional lawn maintenance damages our environment in the following ways:

- Lawn mowers account for 10% of the nation's air pollution.
- Fertilizers from lawns are the number one source of nitrogens and phosphorous polluting streams and causing overgrowth of algae.
- Pesticides applied to lawns kill useful insects as well as harmful ones and upset the balance of nature. Insect-eating birds and animals may be poisoned as well as aquatic life when pesticides are washed into streams.
- Exotic plants (those brought from other countries or regions) frequently have little or no value to our native wildlife. Non-native landscapes, therefore are frequently impoverished in diversity of both plant and animal life.

Which of the following suggestions could be implemented in your yard to make it more environmentally friendly?

1. Reduce the amount of fertilizer applied to the yard or use only organic fertilizers that will not readily be dissolved by water. _____

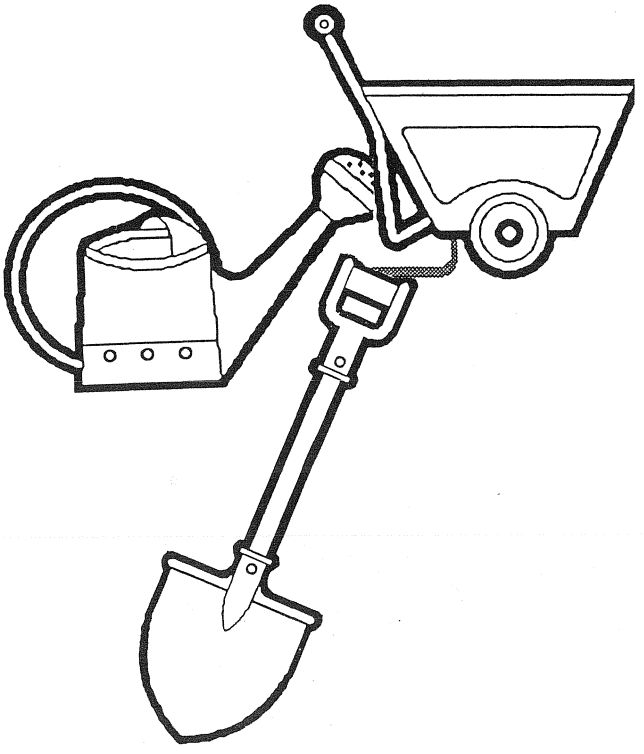
2. Select a portion of the yard for a native wildflower meadow that could be mown only once each season. _____

3. Create groupings of native shrubs and understory trees around existing trees or in corners of the yard where additional privacy may be desired. _____

4. Plan for wildlife corridors along creeks, valleys or ridge lines by allowing natural succession to take place. _____

5. Do not use pesticides; a natural balance of insects should soon return. _____

6. Cut grass at a higher height, allow clippings to remain in the thatch. _____



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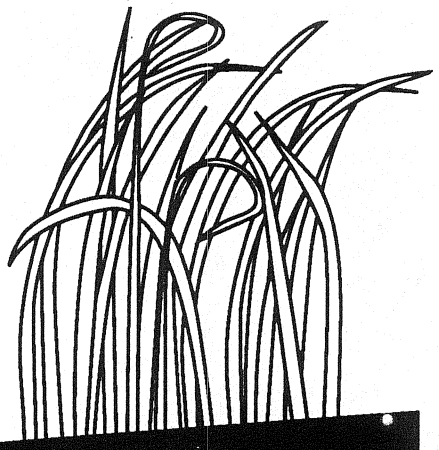
LAWN CARE



WITHOUT TOXIC CHEMICALS

ENVIRONMENTAL FEDERATION

Our thanks to Nancy Coleman & Susan Wolf of NJ Coalition for Alternatives to Pesticides and Jane Nogaki and Tom Moritz of the NJ Environmental Federation.

Printing costs funded by Whole Earth Center
A natural food store • 360 Nassau St.,
Princeton, NJ 08540 • (609) 924-7429

MONITOR THE LAWN

Identify problems:
Sufficient sunlight and air? Diseases? (eg. dollar spot, leaf spot) Pests? (Chinch bugs, etc.) Treat only the problems that exist and use alternative controls specific to the problem.

MOWING

Set mower 3"– 4." Taller grass chokes out weeds (like crabgrass).
To prevent compaction, rotate mowing pattern. Mow lawn as needed, never cutting more than 1/3 of leaf blade at a time, and leave grass clippings on lawn for nutrient recycling.

TEST SOIL FOR FERTILITY AND pH

Have soil tested each year.
Adjust pH to the needs of your lawn. Pulverized or pelletized lime should be added according to need determined by pH test results. Fertilize twice a year, once in the fall and once in the spring or fertilize four times a year at half/rate.

Use natural organic fertilizers; they feed the soil, and release slowly throughout the season. They enhance and encourage beneficial organisms which aerate soil and naturally break down thatch. Never fertilize in hot weather. Established lawns may need less frequent fertilization, especially with "cut it and leave it" practices.

PLANT PROPER VARIETIES OF GRASS

Choose appropriate grasses for your soil and light conditions. Re-seed bare spots, preferably in the fall. Over-seed (rake in) if grass plants are aging. You can contact the Rutgers Cooperative Extension Program for more information.

AERATE SOIL

Aeration helps prevent weeds and reduces compaction. Core aeration is ideal. Aerators can be bought or rented. A good supply of earthworms will aerate the soil adequately as long as there is no compaction problem.

REMOVE THATCH

Thatch is the accumulated dead material at the base of the grass. Rake frequently by hand or rent a thatching machine. Dethatch only if thatch is one inch or more. Organic fertilizers help break down thatch naturally. Worms do too!

REDUCE WEEDS

Use correct mower height. Re-seed bare spots preferably in the fall. In the spring, use seed soaked in water for 24 hours to speed up germination and mix with soil and sand in bare spots.
Identify weeds and establish tolerance levels. Hand dig weeds until competition by grass plants eliminates most weeds.

WATERING

If less than 1" of rain falls per week, water deeply and infrequently. This encourages deep root growth. Sandy soils and sloped lawns need more frequent watering. Water only in cool of morning. Lawns in full sun need more frequent watering.

ELIMINATE PESTS

Attract birds, "nature's insect control," by planting proper shrubs and by offering housing, water and food. Identify pests, then use biological pesticides specific to that pest. E.G. B.t. for leaf eating caterpillars; milky spore powder for the long-term control of Japanese beetle grubs. Use beneficial nematodes to control high populations of Japanese beetle grubs. Natural pesticides such as pyrethrum, rotenone and sabadilla are broad spectrum and toxic, but are short lived in the environment. They should be used with caution and only as a last resort, in accordance with label directions.

LAWN SERVICE

Avoid chemicals entirely. Get a written contract, specifying what chemicals the service will use. Reserve the right to cancel use of any chemical product. Don't let them treat problems that are not there!

LAWN CARE... WITHOUT TOXIC CHEMICALS

PLANTS FOR STREAM BANK STABILIZATION

by Joe Arsenault

Common trees, shrubs and herbs provide natural protection against the erosive forces of water. Plants can be part of a stream side strategy to lessen the impacts of scouring water as long as there is sufficient light and soils to allow proper growth. North facing stream banks or areas under high shade of a nearby forest canopy are difficult erosion areas to treat with a planting prescription. The best success is attained where sufficient sunlight reaches the stream bank which can ensure a vigorous and healthy plant. The conditions where this is true is a suitable spot for the use of plants rather than any other kind of hard shoreline protection.

In order for a plant to act as a good stream bank stabilizer, it has to have a close network of fibrous roots capable of holding soil particles in place. For this reason, plants with long reaching roots or deep tap roots are less valuable that those with dense fibrous root mats. Some roots are better than no roots, but fibrous ones are superior to all others. It is also important to use plants which persist throughout the year rather than ephemeral species which are useful only during their active season.

Here are some of the plants recommended for the Rancocas Creek and vicinity:

Trees:

Wet Banks:

1. American Sycamore
2. Atlantic White Cedar
3. Birches, gray, river, black, yellow
4. Black Gum
5. Maples, red and silver
6. Sweet Gum
7. Willows, such as black, pussy, silky

Dry Banks:

1. Oaks, white, black, willow, pin
2. Dogwood
3. Blue Beech or Musclewood
4. Tulip
5. American Beech

Shrubs:

1. Silky Dogwood
2. Arrowwood
3. Spicebush
4. Highbush Blueberry
5. Mt. Laurel
6. Fetterbush
7. Summer sweet spire
8. Leatherleaf
9. Alder
10. Buttonbush
11. Elderberry
12. Chokeberries: red or purple
13. Bayberry
14. Rhododendrons
15. Azaleas
16. Dangleberry
17. Spireas: hardhack and meadowsweet
18. Sumacs
19. Swamp Rose
20. Sweet Pepperbush

Herbs:

1. Sedges
2. Rushes
3. Slender and blue iris
4. Arrow arum
5. Cattails
6. Pickerel weed
7. Grasses
8. Mints
9. Composites such as goldenrods, asters
10. Ground covers like clovers, common blue violets and speedwell

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