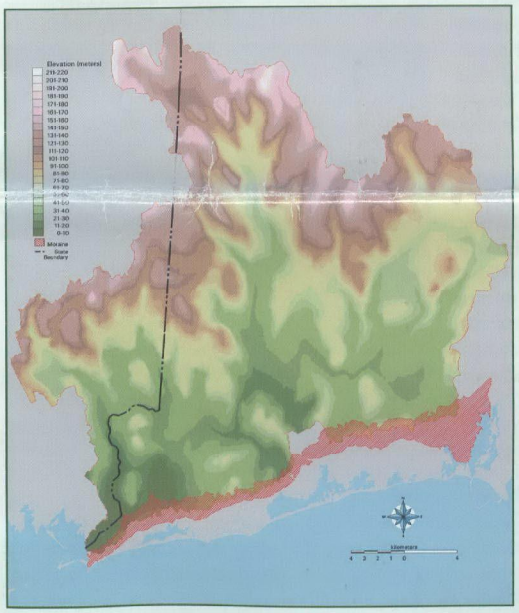
The Pawcatuck Watershed Report

What is the Pawcatuck Watershed?

Everyone lives in a watershed. Watersheds come in all sizes and shapes, and they ignore political boundaries. A watershed is all the land area that drains to a common outlet be it a lake, a stream, a river, or a bay. The Pawcatuck watershed, located in southeastern Connecticut and southwestern Rhode Island, covers a land area of approximately 300 square miles, one-quarter the size of Rhode Island, and includes all or sections of ten Rhode Island and four Connecticut towns. Seven major rivers and their tributaries: the Chipuxet, Chickasheen, Wood, Queen, and Pawcatuck Rivers of Rhode Island; and the Shunock and Green Fall Rivers of Connecticut drain to the common outlet of the Pawcatuck River and Little Narragansett Bay. These rivers along with the lakes, ponds, wetlands, and streams serve as important wildlife habitat, recreational resources, and water supplies for agricultural production. Significant groundwater resources underlie the watershed and remain the sole source of drinking water for the people living within the watershed. Groundwater and surface waters are interconnected, and the watershed is noted for having some of the highest quality ground water and surface water in the area. The watershed is one of Southern New England's "special places" and features several centuries of historical resources in a remarkably rural and unspoiled natural setting. It is rich in Native American sites, family-owned farms and farmsteads, small-scale industrial villages, summer colonies and a vital, picturesque downtown area (Westerly-Pawcatuck).

Photo by the Nature Conservancy



How was the Pawcatuck Watershed formed?

The Pawcatuck watershed is characterized by low, rolling hills separated by relatively flat valleys. Formed 16,000 to 17,000 years ago as the late Wisconsin continental ice sheet retreated from southern New England, the watershed's topography and the underlying deposits are relics of the glacial age. Erosion along pre-existing river valleys produced a series of deep north-south bedrock valleys present today beneath the cover of glacial deposits. As the glacier retreated from Block Island Sound, it deposited the 100-foot high Charlestown end moraine, a ridge of glacial sediment, running alongside U.S. Route 1 on the south shore of Rhode Island. This ridge effectively blocked southward drainage through the river valleys. Glacial lakes formed behind the moraine as the glacier retreated to the north and meltwater accumulated in the valleys. Drainage from these lakes was ultimately established to the west creating the ancestral Pawcatuck watershed. Large braided meltwater streams flowed south from the ice margin into the glacial lakes depositing sorted, stratified sediment along the valley floors. The north end of most valleys is dominated by relatively coarse (sand, gravel, and boulders) outwash deposits, whereas the southern end of many valleys is filled with fine-grained (fine sand, silt, and clay) glacial lake deposits. Accumulations of stratified sediment in the bedrock valleys exceed 60 feet in many areas and may reach thicknesses as great as 150 feet or more in selected areas. Worden Pond and the surrounding Great Swamp are the remnant of glacial Lake Worden which occupied a bedrock valley now filled with over 200 feet of sediment. Kettle ponds (Larkin Pond, Yawgoo Pond, Sandy Pond) dot the landscape where blocks of ice, buried in the glacial outwash sand and gravel, melted leaving topographic depressions that extend below the water table. Blockage of the bedrock valleys by the Charlestown moraine and the lack of significant topographic relief in many valleys have created a relatively sluggish drainage system in the Pawcatuck watershed. Rivers that would have drained southward along a relatively steep gradient, flow instead to the west behind the moraine as tributaries to the Pawcatuck River along a much shallower gradient. As a result, wetlands occur throughout the watershed and are extensive at the southern end of some valleys (for example, Indian Cedar Swamp, Great Swamp, Chapman Swamp, Watchaug Pond area). The watershed preserved today therefore represents a unique accommodation between the modern drainage system and the geologic features inherited from the last ice age. Together these forces have formed expanses of diverse, scenic, and unspoiled habitats.

NOTE: See glossary for definition of technical terms.

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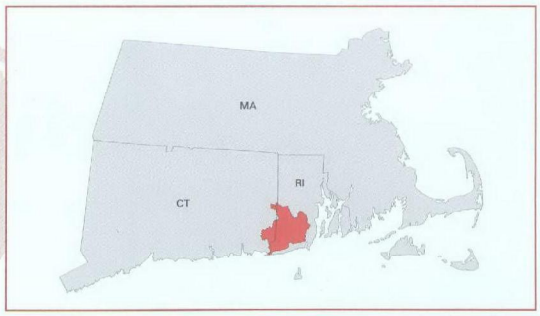
Photo by Rhode Island DEM Heritage Program



Past, Present, Future

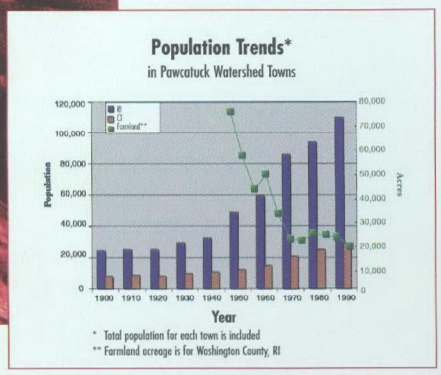
HISTORY OF THE PAWCATUCK WATERSHED

The Pawcatuck watershed is rich with historical resources. Historic use and resources produced by human settlement and occupation of the watershed are intimately associated with the area's natural environment. Human occupation extends back several thousand years and includes many sites associated with both Native American and European American inhabitants.

Native Americans first occupied the watershed soon after the retreat of the glaciers. The earliest settlers were nomadic hunters, followed in the Archaic Period (5000-2000 years Before Present) and Woodland Period (2500-200 BP) by seasonally nomadic hunters, gatherers, and farmers. In winter they occupied inland campsites in granite rock shelters, such as Rattlesnake Ledge in West Greenwich or the Tomaquag Valley in Hopkinton. In warmer weather, they migrated nearer the ocean to plant crops, to fish, and to harvest shellfish. In addition to seasonal campsites, Native American resources included prehistoric and contact-period fortifications like Fort Ninigret in Charlestown; battle sites such as Shannock Falls; and burial grounds. Today, the Narragansetts occupy their allotted "tribal lands" in Charlestown.

18TH AND 19TH CENTURIES

European contact and settlement began in the seventeenth century, but remained sparse until the eighteenth century when farm complexes began to dot the landscape. The earliest European villages developed around transportation or manufacturing centers where streams provided water power for milling operations (saw mills, grist mills, and carding mills). During this period, the mills and villages in the watershed were characterized by small scale industrial development, closely associated with the area's natural resources. Cross Mills in Charlestown, for example, grew up at a spot on the newly established Post Road where a small brook provided water power for a grist mill. By the end of the eighteenth century it included a blacksmith shop, where agricultural implements were made and repaired, and horses were shod. At Bradford, a dam was erected across the Pawcatuck River in 1758, and a sawmill was constructed on the Hopkinton side of the river. A grist mill followed in the 1770's. Avondale rose at an inlet on the Pawcatuck River and enjoyed a long association with boat building. Shannock developed at a spot on the Pawcatuck with both lower and upper falls and had both saw- and gristmills in place before 1759. Hope Valley included a sawmill, gristmill, fulling mill and carding mill by the 1770's. By 1776 Hopkinton City counted a gristmill, sawmill, tannery, blacksmith shop, distillery, and tavern. Westerly Village's location was strategic: it grew around the intersection of the Post Road and the Pawcatuck River's head of navigation immediately below a natural waterfall. With the mill or shop as the focus, these villages typically included, at most, a handful of houses, a church, a tavern or inn, a store or two, and perhaps a post office.



In the nineteenth century, railroad lines helped provide the more efficient transportation required by increasing industrialization, in turn stimulating further development in established villages. Textile and machine-tool mills began to spring up following the introduction of mechanized textile production in 1791 at Slater Mill in nearby Pawtucket, RI. Between 1810 and 1825 nine new mills were constructed in the watershed, eight devoted to textile production. The 1840's saw tremendous growth of textile manufacturing along the watershed's rivers: new mills sprang up at Kenyon (1844), Potter Hill (1844-47), Bradford (1846), Shannock (1848), Stillmanville (1848), and White Rock (1849). The nineteenth-century mills, unlike their predecessors, produced goods which were exported beyond the local community throughout the state or the region. Granite quarrying supplemented textile manufacturing after 1830.

Nineteenth-century growth brought changes in the relationship between the environment and human settlement. Industries within the watershed exploited stream and river waters for processing as well as for power. Textile mills in particular used water for various operations, but all used the water to eliminate waste with little thought about consequences to the environment. As communities grew, they came to use the rivers for sewage disposal. Lack of municipal sewer systems or individual septic systems also contributed to the contamination of subsurface drinking water supplies.

20TH CENTURY

Suburban growth exploded after World War II. In urban areas, such as Providence, the population had peaked before 1950. Federal housing policy encouraged new construction and discouraged investment in inner-city neighborhoods. The Interstate Highway Act of 1956, intended both as a defense-mobilization reinforcement during the Cold War and as a personal and commercial transportation improvement, provided easier escape from cities. Population trends for watershed towns dramatically illustrate this period of rapid growth, especially after the completion of Interstate Highway 95 in the late 1960s and the widening of Route 1 along the south shore. Large-scale commercial development soon followed the thousands of new residents.

Photo by Southern Rhode Island Conservation District

The character of suburban development differed radically from that of the previous two-and-a-half centuries. Residential suburban development typically includes large lots, often two acres, with low spreading houses and wide streets, in contrast to the historic pattern of relatively large-acreage farms and small-scale, tightly built villages. Suburban commercial development tends toward shopping centers surrounded by large parking lots. As the population increased, shopping centers, their constituent stores, and surface parking all grew in both numbers and size. Suburbanization has exerted profound effects on the watershed's environment. Suburban residential tract development has claimed former farmland and second-growth forests, leaving less and less open space. Phosphorus and nitrate nutrients from suburban septic systems can both trigger algal growth in rivers and estuaries and contaminate groundwater. Oil runoff from roads and large parking lots contributes significantly to nonpoint pollution. Large numbers of automobiles produce water- soluble exhaust contaminants that pollute both air and water.

While development before 1950 was visually cohesive with the landscape, environmental conditions were largely unaddressed. In the early twentieth century, the Pawcatuck River and many of its tributaries were heavily polluted, but today the river is cleaner. Most of the textile mills have been closed for decades. Towns have adequate sewage disposal systems, and point-specific sources of pollution are now carefully controlled.

THE CHALLENGE AND OPPORTUNITY

The future of the watershed is not secure. Populations will lead to accelerated nonpoint source pollution and to fragmented habitats. Control over many of the existing and potential threats to the environment will increasingly depend on those who live and work here. The Pawcatuck Watershed Partnership, a new effort to protect our watershed and promote sustainable economic vitality, is perhaps the mechanism by which we can better coordinate our efforts to develop healthy communities. We need to keep working harder, and smarter, to keep improving environmental and economic conditions in the watershed.

Early roads made the watershed more accessible. The Post Road (Rt 1) was established ca. 1700 to connect colonial settlements between Boston and New York. Ten Rod Road provided a direct route for driving cattle and bringing produce from the fertile inland farms after 1703.

Natural Resources

GROUNDWATER, AN IMPORTANT RESOURCE

Significant groundwater resources underlie large portions of the watershed. Much of the groundwater flows slowly through aquifers composed of stratified sand and gravel deposits that are capable of yielding large amounts of water. Groundwater is the sole source of drinking water for the people living within the watershed and supplements supplies beyond the watershed's boundary. In 1988, the U.S. Environmental Protection Agency designated the groundwater resources of the watershed a Sole Source Aquifer. This designation signifies that the drinking water supply of the area is from groundwater and no reasonable alternate source of drinking water exists, such as surface water reservoirs. Thus, protection of this resource is of utmost importance.

The watershed is noted for having the highest quality ground and surface water in both Connecticut and Rhode Island, according to their respective departments of environmental protection and management. The quality and quantity of groundwater and surface water are interconnected. Groundwater is recharged by rainfall within the watershed, then discharges into surface water bodies. During severe drought conditions streams and rivers can recharge to groundwater. Hence, the quality and quantity of one water resource affects the quality and quantity of the other.

Photo by Natural Resource Conservation Service

WETLANDS, AN IMPORTANT RESOURCE AND HABITAT

Wetlands are periodically flooded lands that are often found between high, dry, upland areas and low-lying open bodies of water such as lakes, rivers, and streams. Occasionally, wetlands can also be found in upland areas on hill slopes or in surface depressions near groundwater springs or where surface water collects. Wetlands cover about 27,000 acres of the Pawcatuck watershed, approximately 14 percent of the watershed's area.

Once thought of only as "foul quagmires" and sources of disease, scientists now know that wetlands perform many important ecological functions. Several of these functions have direct, significant human value. Wetlands protect the health of lakes and streams and improve the quality of our drinking water. Acting as natural filters, wetland plants are able to trap excess nutrients and other contaminants found in rainwater and melting snow which runs over the surface of the land. Wetlands provide critical habitat for fish, waterfowl, and other wildlife in our increasingly urbanized environment. Wetlands reduce and delay flood peaks by temporarily storing storm water in depressions in the landscape, and promote the recharge of the watershed's groundwater resources. In this way, even the smallest wetlands are part of nature's "least-cost engineering" solution to flooding. Yet to many, it is the natural beauty and wildness of wetlands that is their most valuable, or even priceless, feature. Many of the largest remaining undeveloped tracts of land in the Pawcatuck watershed are wetlands. A visit to one of these sites can provide the wilderness-like quiet and solitude needed to rejuvenate us and inspire a sense of wonder about the natural world.

Legislation to protect and regulate the use of wetlands exists at the federal, state and local government levels in both Connecticut and Rhode Island. Some of the best protection for wetlands has been provided through acquisition and conservation easements by private and public land protection programs. However, despite the recognition of ecological and human values, wetlands continue to be altered or destroyed. When small, isolated wetlands or the edges of large wetlands are filled, the loss may seem unimportant locally, but over the entire watershed the total ecological effect can be significant.

Wetlands are classified based on their overall wetness and the characteristics of their soils and plants. Besides the familiar rivers, lakes, and ponds, some less obvious wetland types found in our watershed are swamps, marshes, bogs, fens and vernal pools.

SWAMPS,

or forested wetlands, account for nearly 90 percent of the Pawcatuck watershed wetlands. Red maple swamps are the largest and most common of the forested wetland types, but the watershed also contains some of the region's largest Atlantic white cedar evergreen swamps. The water level in swamps ranges widely over the seasons, from well above the soil surface during the winter to several feet below the surface in late summer. The changing water level promotes the formation of water-filled pools and damp mounds over the swamp's surface. This variable terrain encourages growth of a wide variety of plants, each with their own particular adaptation to wetness. In turn, the diversity of trees, shrubs, and herbs attracts many different kinds of wildlife in search of food and cover. Because swamps are so common, or possibly because they often have no surface water for long periods, they are the wetland type most commonly altered by man's activities.

Figure 1. A red maple swamp in winter, Biscuit City Landing, Richmond, RI

Photo by Frank Golet

MARSHES,

also known as emergent wetlands, are generally wetter than swamps and feature leafy herbs that are often rooted underwater. Many freshwater marshes arise along the edges of lakes and streams in late spring. At this time, the salt marshes near the mouth of the Pawcatuck River begin to turn green again. During the summer, many floating-leaved marsh plants produce spectacular displays of colorful flowers while providing food for waterfowl and refuge for fish and amphibians. As winter approaches, many marshes temporarily disappear as their fragile leaves disintegrate from the effects of low temperatures and high winds.

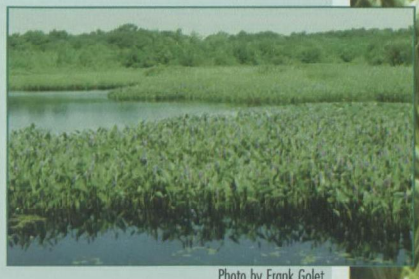


Figure 2. Flowering pickerelweed marsh, Belleville Pond, North Kingstown, RI

Photo by Frank Golet

BOGS and FENS,

or peatlands, are the least common of the wetland types found in the Pawcatuck watershed. Bogs are unusual wetlands that are completely covered by raised cushions of Sphagnum moss and rarely have any standing water on their surface. Instead, water continuously saturates the fibrous soil, or peat, composed of partially decayed bog plants resulting in a spongy surface, or mat, that often bounces, quakes, and undulates underfoot. The continuous saturation of the bog mat creates some very harsh conditions for plants to grow, including little soil oxygen, acidic water, and few nutrients. In fact, most bogs receive all of their nutrients from rainfall alone. Many bog plants are able to grow only in a stunted condition, while others have developed unusual adaptations to cope with the difficult growing conditions. Some, like the pitcher plant and sundew, have adapted to the problem of low amounts of soil nutrients by evolving specialized leaf structures to trap and digest insects attracted to the plant's odor. This delicate relationship between plants and nutrients can be upset when rainfall from polluted air brings excess nutrients to the bog surface. Under these conditions, more common plant species may replace the unusual plants found on the bog. Fens differ from bogs in that they are relatively flat, have little or no Sphagnum moss, and are sometimes flooded with surface water. Besides rainfall, fens receive nutrients from groundwater, streams, or in storm water runoff from the surrounding land. The slightly higher nutrient levels allow fens to support a wider variety of more robust plants. Like bogs, however, the plant species found in a fen can be adversely affected by excess nutrients coming from polluted groundwater or streams.

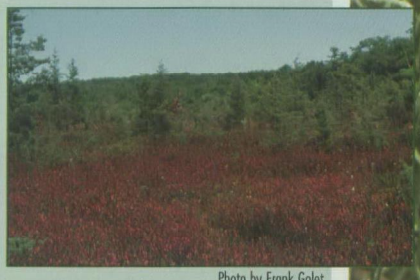


Figure 3. Autumn on a leatherleaf shrub bog, Diamond Bog, Richmond, RI

Photo by Frank Golet

VERNAL POOLS

are small, temporary ponds found in isolated, shallow basin depressions in the land. The word "vernal" means spring, and refers to the fact that by springtime, these depressions are filled with water that has accumulated over the winter months. Vernal pools are "isolated" in that they have no connection to permanent streams or other continuous sources of water. Some vernal pools form in dense soil that allows rainwater and melting snow to collect in the basin, while others fill as the groundwater table rises above the bottom of the basin during the winter and early spring. As evaporation rates increase through late spring and summer, and plants lower the groundwater table by extracting water from the soil, the water level in the pools begins to drop. By late summer or early fall, often all that remains are depressions lined with gray leaves to mark the location of where these ponds once existed. The periodic drying, high summertime temperatures, and winter freezing of vernal pools prevent the establishment of permanent populations of fish. Vernal pools are so small that they are not usually found on maps of wetlands; still, they are important as wildlife habitat and are valuable for their flood control properties as well. Several species of amphibians depend upon vernal ponds as habitat for reproduction. Examples include the common toad, spotted salamander, marbled salamander, and wood frog. The lack of predatory fish and the abundance of insect food make the pools an attractive location for amphibians to deposit their eggs. Each spring, the duck-like "quacking" of breeding wood frogs reveals the location of many woodland vernal pools. The basins where vernal pools are found can easily be overlooked in terms of their value as natural flood control structures. Though a single vernal pond may not hold much water, the many small depressions in the landscape found over an entire watershed can temporarily store large volumes of water during storms. By slowing the overland flow of water, the downstream flood peak in low-lying areas prone to flooding is often reduced and delayed.

Photo by Frank Golet

Figure 4. A vernal pool in late winter, Rte. 138 and Beaver River Road, Richmond, RI

RARE SPECIES and UNIQUE HABITATS

The Pawcatuck watershed is located at the intersection of the North Atlantic Coast and Lower New England ecoregions. The plant and animal communities of the Pawcatuck watershed therefore reflect a mix of coastal and inland, northern and southern influences. About 70 percent of Rhode Island's globally rare (generally found at fewer than 100 sites, worldwide) and 63 percent of its state rare species and natural community occurrences are found within the Pawcatuck watershed.

The watershed is a "special place." These species and communities are found here because it is relatively undeveloped and is approximately 70 percent forested. The watershed supports a high diversity of species, including forest nesting neotropical migrant birds, freshwater mussels, river invertebrates, reptiles, and amphibians. These species require large areas with relatively little human disturbance to survive, either because they range widely or because they are susceptible to water quality degradation. Continued fragmentation and suburbanization of the landscape poses a long-term threat to the survival of these species.

Some Examples:

Unique and Historic Habitats

At the origin of the Pawcatuck River, near the point where it begins its flow from Worden's Pond, is one of the largest deciduous flood plain forests in Rhode Island. Composed of red maple, green ash, and black gum, with some trees approaching 150 years in age, this dense swamp covers more than 300 acres. Possibly better than any site in the state, this swamp closely approximates the vegetation of the region prior to European settlement. Among the inhabitants of this unique forest is the Prothonotary Warbler, a bright yellow songbird most commonly found in the vast bottom lands of the South, occupying its only New England nesting site in the Great Swamp of the Pawcatuck River.

Photo by Robert Wadman

Rare and Exceptional Occurrences

When the Creeping St. John's-wort blooms at Meadowbrook Pond in Richmond during mid to late summer, over an acre of water surface is turned brilliant by the golden blossoms of this emergent shrubby plant. Considered to be rare throughout its restricted range, nowhere else does this plant attain such abundance as in the Pawcatuck River watershed.

Atlantic White Cedar is the only tree in Rhode Island that is an obligate wetland species; that is, wetland conditions are necessary for this species to thrive. Occupying a narrow band from southern Maine to Florida, some of the largest stands of Atlantic White Cedar are found in the Pawcatuck River watershed at such places as the Great Swamp, Indian Cedar Swamp, and Chapman's Swamp in Westerly. Forests of White Cedar provide a specialized habitat for many organisms, including the Hessel's Hairstreak butterfly. The caterpillars of this dainty species feed exclusively on cedar foliage, and later when they have transformed to adults, the males sit on the tips of branches waiting to engage their fellows in territorial combat.

Photo by Joanne Michaud

Biodiversity

The above examples represent a tiny fraction of the biodiversity of the Pawcatuck River watershed. Residing here are more than 36 species of mammals, 16 amphibians, 18 reptiles, 123 nesting birds, 33 freshwater fish, and literally thousands of insects and other invertebrates. In general, at least 75% of all species found in Rhode Island inhabit the watershed. Similarly, more than 70% of the species considered to be rare in the state are found in the Pawcatuck's varied environs, with several found nowhere else in the state. Included in this elite group are such organisms as Sandplain Gerardia, Northern Parula Warbler, Etuberculated Rush, Eastern Spadefoot Toad, Spatterdock Darner, Eastern Pearlshell Mussel, and the Pale Green Pinion Moth. They occupy an amazing diversity of habitats in the watershed which include pitch pine barrens, rhododendron swamps, laurel thickets, flood plain forests, marshes, bogs, fens, crystal clear ponds, deciduous woodlands, and the perennial waters of the river itself. The reasons for the rich biotic diversity of this watershed are as varied as the organisms it supports. Chief among the factors is the unique glacial history of the area that provided the topographic setting for the myriad wetlands and upland habitats.

A WATERSHED-BASED APPROACH TO MANAGING WETLANDS

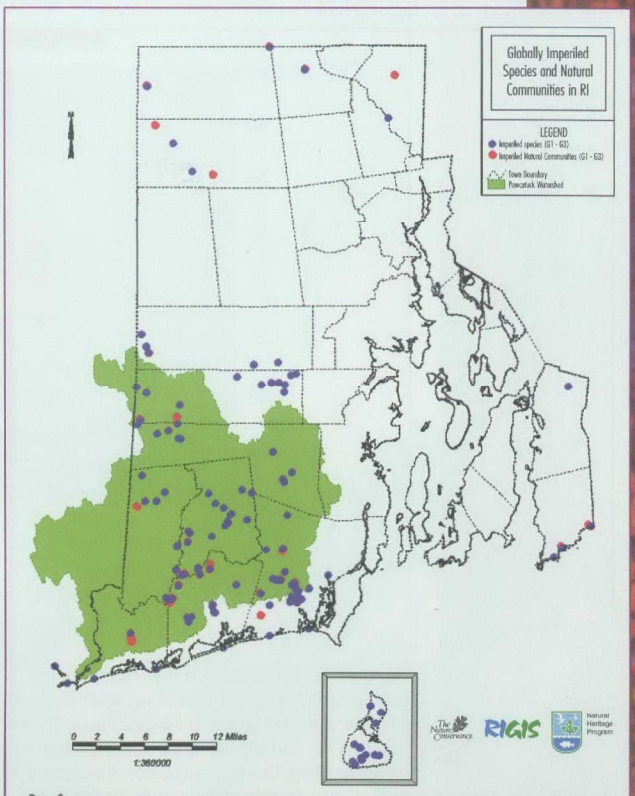
The Nature Conservancy and the University of Rhode Island have formed a partnership to demonstrate a watershed-level approach to wetlands management through the following activities: (1) locating and mapping ecologically significant wetlands, such as those supporting pollution-sensitive fresh water mussels or rare dragonflies; (2) developing a procedure to evaluate the cumulative effect of landscape features and land use on wetland water quality using computerized maps, also known as Geographic Information Systems; (3) encouraging stewardship of privately owned lands and wise land use policies through education and technical assistance to landowners and local decision makers; and (4) identifying and mapping riparian areas considered to have a high potential for protecting the environment. Riparian areas are areas of stream side vegetation. These areas can trap pollutants before they reach wetlands and water bodies. Riparian areas also provide cooling shade for trout and protected corridors for wildlife in which to move. Other critical areas mapped through this project include pollution "hot spots." These are high-intensity land use areas most likely to contribute pollutants or areas with high-risk soils that will likely generate off-site movement of pollutants to either groundwater or surface waters. The results of this assessment will be combined with conservation priorities identified by The Nature Conservancy and RI DEM in a management plan for the Queen River as a model for watershed-based wetlands management in other areas.

A FORESTED LANDSCAPE ECOSYSTEM

The landscape may be thought of as an interlocking web of different natural communities, most dominated by forest. Embedded within this web are unique habitats or rare species sites. The continued health of these unique habitats, however, is highly dependent upon the condition of the surrounding forested landscape. Many wide ranging species of birds, frogs, and salamanders are particularly vulnerable to habitat fragmentation, and may require blocks of intact forest hundreds, or even thousands, of acres in size to reproduce successfully and sustain their populations. As large expanses of habitat are broken into smaller and smaller tracts, the resident plants and animals become cramped in reduced parcels. Gradually species disappear, until what remains is a depauperate sampling of the former diversity, comprised of those species capable of surviving in the land use mosaic typical of the Northeast urban corridor.

Photo by Rick Enser

Conservation biology teaches that of most critical importance is the protection of the largest tracts of land. By concentrating on those species that require the most expansive habitats, and on those most unique to the system, we automatically extend protection to many other members of the Pawcatuck's rich natural community.



Data Sources: *Biological data on imperiled species from* ***Rhode Island Natural Heritage Program.*** Occurrence points were located in the field, mapped at 1:24,000 scale and entered into the Biological and Conservation Database (BCD). This data does not represent an exhaustive survey, but rather a current snapshot of the BCD database which is updated on a regular basis.

Town and watershed boundaries from RIGIS

Global ranks from ***The Nature Conservancy*** *central database.* G1 - G3 Species and Natural Communities typically occur at fewer than 21 - 100 sites, worldwide, with total populations of no more than 3,000 - 10,000 individuals.

©The Nature Conservancy Map produced by TNC Rhode Island Field Office, 2/98

WATER QUALITY STATUS OF THE PAWCATUCK WATERSHED

Rivers and Streams

Water quality in the Pawcatuck watershed is generally described as excellent, and a number of valuable water resources in the watershed provide unique habitats for numerous rare and endangered species. Threats in the Pawcatuck watershed are due chiefly to agricultural and nonpoint source pollution impacts. Most major tributaries to the Pawcatuck River are meeting aquatic life support, with some threatened by nutrients and metals, particularly lead. Recent monitoring on the Pawcatuck River and its tributaries suggests that the river is threatened by lead levels which may occasionally exceed the national, EPA chronic aquatic life criterion. Elevated lead levels have been measured in the Pawcatuck, Chipuxet, Usquepaug, Ashaway, and Queen rivers, and the Meadow, Tomaquag, and Canonchet brooks. Water quality criteria are inversely related to water hardness; the lower the hardness of the water the more stringent the criteria. The entire Pawcatuck watershed is characterized by extremely low hardness. As a result, additional monitoring is required on the Pawcatuck and many tributaries to determine if in-stream lead concentrations represent violations or simply background levels which exceed the more stringent criterion.

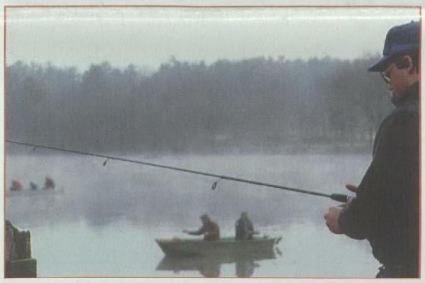


Photo by Wood-Pawcatuck Watershed Association

There are a variety of threats to aquatic life in the watershed. Elevated nutrients, particularly elevated nitrate levels, have been measured in the Pawcatuck, the Ashaway, the Queen, and Tomaquag Brook. Elevated nutrients cause excess algal growth, organic enrichment, and low dissolved oxygen problems. These conditions are not healthy for fish. Fecal coliform bacteria is another important nonpoint source contaminant, originating from farm and wild animals and failing septic systems; fecal coliform bacteria have been measured in Meadow Brook, Tomaquag Brook, and Canonchet Brook. The presence of these bacteria threatens the use of these waters for swimming and other contact recreation. Substantial amounts of water are withdrawn directly from rivers and streams for agricultural and golf course irrigation. This may be impacting water and habitat quality where withdrawals have been noted on the Beaver, Usquepaug, Chipuxet, and Pawcatuck. The upstream area of Roaring Brook has elevated sodium and chloride levels which are believed to be associated with a salt pile at the headwaters. As a result, aquatic life support in Roaring Brook is considered threatened.

RESTORING SALMON AND SHAD IN THE PAWCATUCK RIVER

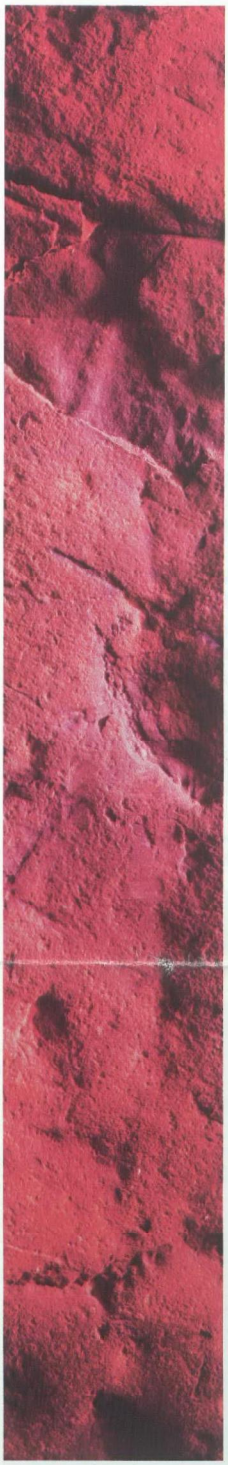
Historical records show that Rhode Island rivers and streams once contained thriving populations of anadromous fish species such as Atlantic salmon, American shad, alewives, blueback herring, rainbow smelt, sea-run trout, and white perch. This resource was of major importance to early settlers. Unfortunately, most of the anadromous runs in Rhode Island were destroyed in the early 1800s when rivers were dammed for hydropower without consideration for fish passage facilities. Since the passage of the Anadromous Fish Conservation Act in 1965, the Rhode Island Division of Fish and Wildlife has been actively involved in efforts to restore this depleted resource. The Pawcatuck River was chosen for Atlantic salmon and American shad restoration. Two large fishways were built, and shad brood stock were transplanted into the system. A process of isolation and cultivation of an appropriate strain of Atlantic salmon was initiated.

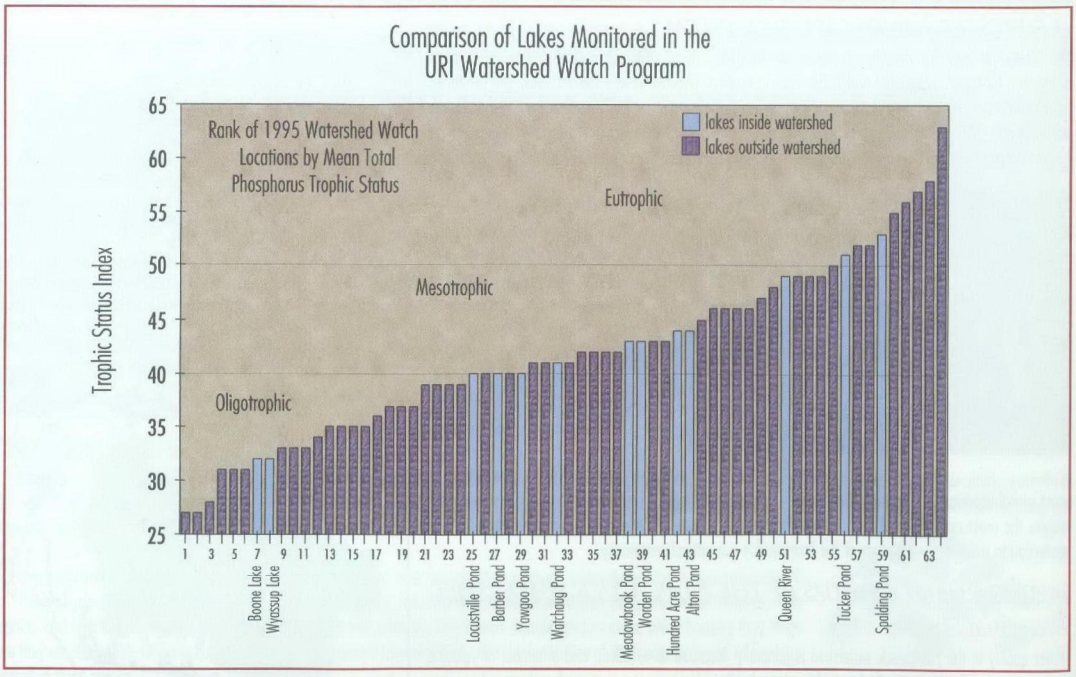
Several measurements are routinely taken in the watershed to see if the aquatic communities are healthy. A "rapid bioassessment" technique is used to identify and count invertebrate species (fish food such as insect larvae) present in the bottom sediments of the streams and river. These measures are made at many sites in the watershed during the summer. Additionally, long term biological monitoring of invertebrate communities is performed using artificial substrates at several sites in the watershed. This is a very sensitive measure of change and ecosystem health. Both of these techniques consider changes in the types of species present. These changes are an excellent measure of health for aquatic environments. Results of these assessment techniques indicate that the Pawcatuck River is stressed as is the Chipuxet, the Ashaway, the Queen, Meadow Brook, Tomaquag Brook, and Canonchet Brook. So, while the rivers and streams in the Pawcatuck watershed are now in generally good condition, there are threats actively eroding the environmental quality of the watershed.

Photo by Rhode Island Heritage Program

Lakes and Ponds

Lakes and ponds in the Pawcatuck watershed are generally stable in terms of water quality. All locations appear to be influenced by the timing and amount of precipitation, land use in their surrounding watersheds, and possibly the amount of naturally occurring tannin in the water. Since 1988, the Wood-Pawcatuck Watershed Association has sponsored volunteer monitoring of a significant number of water bodies in the watershed as a part of the University of Rhode Island's Watershed Watch program. They currently include 11 lakes and ponds (Alton Pond, Barber Pond, Barberville Pond, Boone





Lake, Locustville Pond, Hundred Acre Pond, Meadowbrook Pond, Watchaug Pond, Wyoming Pond, Yawgoo Pond, Worden Pond), the Queen River at Usquepaugh, and the Pawcatuck River at Bradford and at Potter Hill. Past monitoring has also included Chapman Pond and Breakheart Pond. There have been a number of additional sponsors of volunteer monitoring efforts in the Pawcatuck through the URI Watershed Watch program. They include volunteer monitoring at 7 locations on the Queen River by the Audubon Society of Rhode Island; 4 locations on the Falls River by the Narragansett Chapter of Trout Unlimited; and Wyassup and Spalding Ponds, the Shunock River at Babcock Road, Hewitt Pond, and the Green Falls River, all by the North Stonington Citizens Land Alliance.

These locations show varying degrees of nutrient enrichment, defined by the amount of nutrients (primarily phosphorus), algae (measured by chlorophyll content), and/or water clarity (measured by Secchi Depth Transparency). Such enrichment causes too much plant growth, choking water bodies and decreasing the oxygen content of the water. These conditions are not healthy for fish. In 1996, Watchaug, Tucker, Boone, Wyassup, Barber, and Locustville Ponds had low to moderate phosphorus levels, classifying them as oligotrophic. Alton, Yawgoo, Wyoming, and Meadowbrook Ponds all had moderate levels of phosphorus, leading to their classification as mesotrophic. Hundred Acre, Spalding, Worden, and Chapman Pond have all typically had moderate to above average levels of phosphorus, giving them a eutrophic classification. The source of the nutrients can generally be traced to the surrounding land use in each watershed. Meadowbrook Pond has been one of the most dynamic ponds in the watershed, responding to changing land use and to precipitation patterns. Meadowbrook Pond relies on adequate rainfall to flush nutrients downstream. In periods of low rainfall, when the water level drops below the spillway, there have been significant algal blooms. Yawgoo and Barber Ponds, in the Chickasheen sub-watershed, suffered from extreme eutrophication (nutrient enrichment) 1989-1991. When upstream nutrient sources diminished, both locations enjoyed a dramatic resurgence of water quality. Boone Lake has excellent water quality despite its heavily developed shoreline. Hundred Acre Pond appears to be experiencing a decline in water quality. All of the locations that are deep enough for monitoring of dissolved oxygen show depletion of oxygen in mid-summer in the bottom waters. None of the volunteer monitored lakes in the watershed appear to be capable of sustaining trout.

The river locations all have low to moderate levels of nutrients. Phosphorus levels have been declining in the Pawcatuck River. With the closure of the residential facility and the sewage treatment plant at Ladd School in Exeter, phosphorus loading to the Queen River has decreased nearly one hundred-fold. Acidification is a problem in a number of ponds in the watershed, particularly those in the northwestern portion of Hopkinton (Blue, Wincheck, Ashville, Long, and Moscow) and in Charlestown (Watchaug). These ponds have little or no buffering capacity due to the granitic bedrock which underlies them. Acid input to these ponds comes from naturally acidic soils, acid rain, and naturally occurring tannic acids from oaks and pines.

Coastal Waters

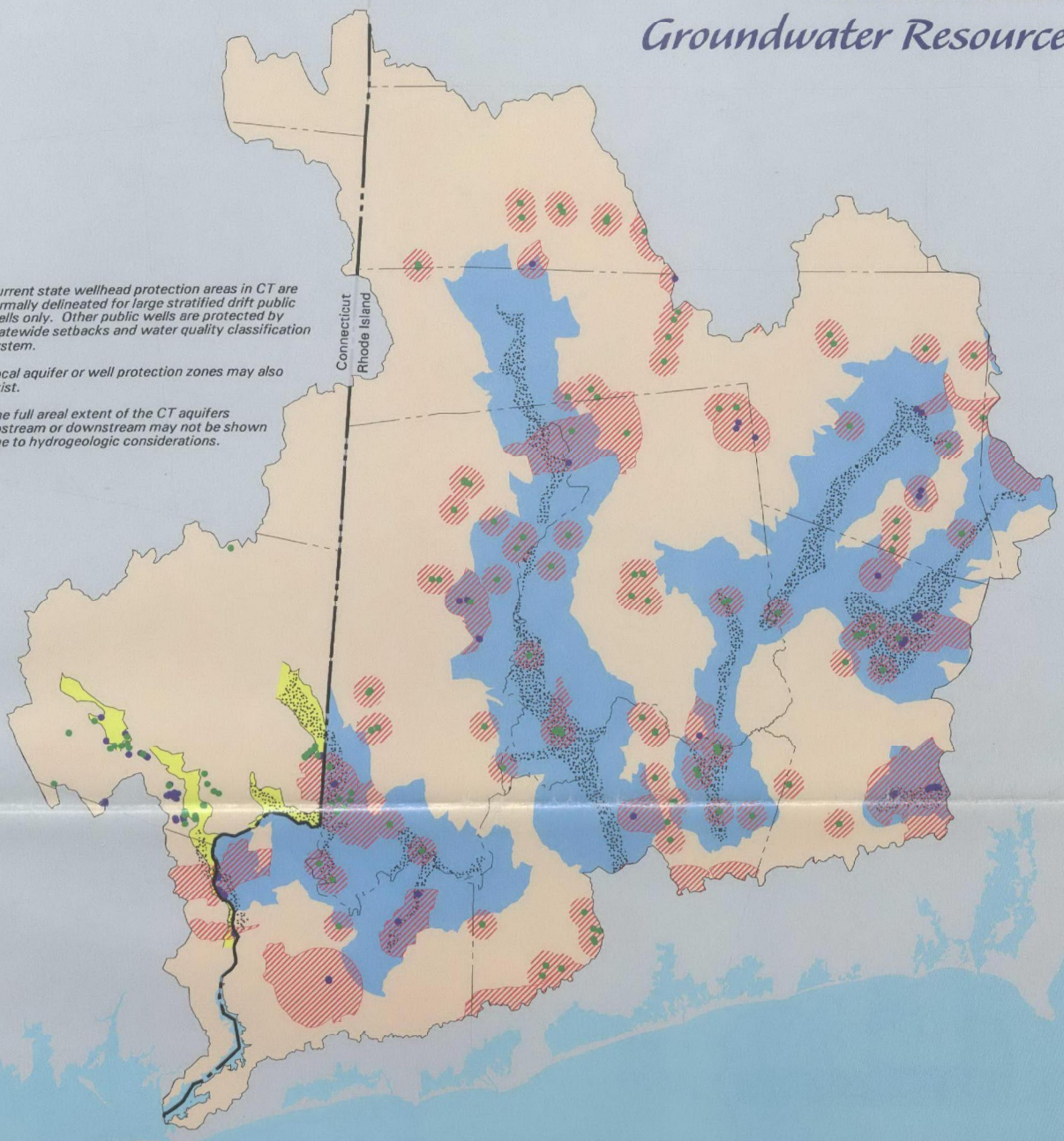
The tidal portion of the Pawcatuck River, from the Main Street highway bridge in Westerly south to the mouth of the Pawcatuck at Pawcatuck and Rhodes Points, is not designated for shell fishing; that is, shell fishing is not permitted. This reach is assessed as partially supporting aquatic life. Oxygen levels are very low because of nutrient over enrichment. Metals and pathogens are also threats in the upper tidal reach. The Westerly waste water treatment facility is considered to be a relatively minor loading source in comparison to the nonpoint source inputs (urban runoff, storm sewers, etc.) along this stretch of shoreline. Swimming and other primary contact recreation activities are not recommended in this reach. The lower tidal section is considered threatened for aquatic life support due to organic enrichment. Swimming is not allowed because of high levels of fecal coliform bacteria. Sources of pathogens in this section include upstream nonpoint source runoff and boat mooring fields.

Little Narragansett Bay is the terminus of the Pawcatuck watershed. Significant increases in the variability of coliform bacteria data collected by the RI DEM Shellfish Growing Area Monitoring Program resulted in a permanent shellfish closure of Little Narragansett Bay in 1991. The most profound change to the area is the increased density of large boats moored overnight. A recent estimate by RI Coastal Resource Management Council indicated that boat density in summer may reach 5,000 within an area of less than one square mile. RICRMC and their Connecticut counterparts developed an interstate resource management plan for this estuary in 1991. The actual implementation of this plan, along with efforts such as RI's application for federal No Discharge designation for all RI waters (RIDEM is expecting approval for the start of the 1998 boating season and several marine pump-out facilities are planned for the Westerly area) could go a long way towards restoring shell fishing. Presently, Little Narragansett Bay is assessed as not supporting shell fishing and fully supporting both aquatic life and swimming uses.

Evaluating Cumulative Impacts

The quality of water within the watershed is affected by both point and nonpoint sources of pollution. Unlike point source pollution which originates from a specific place or location on the landscape such as a discharge pipe from a factory, nonpoint source pollution originates over a widespread area of the landscape and may include: malfunctioning septic systems, soil erosion, leaking underground fuel storage tanks, storm water runoff, fertilizers, pesticides, and road salts. The best way to control nonpoint source pollution is to reduce its input into the environment. By properly installing, locating, and maintaining septic systems; soil testing to determine adequate amounts of fertilizer; preventing soil erosion; and implementing Integrated Pest Management techniques to minimize pesticide use; the input of nonpoint source pollution to the ground and surface waters of the Pawcatuck watershed can be reduced.

Pawcatuck Watershed
Groundwater Resources



Current state wellhead protection areas in CT are formally delineated for large stratified drift public wells only. Other public wells are protected by statewide setbacks and water quality classification system.

Local aquifer or well protection zones may also exist.

The full areal extent of the CT aquifers upstream or downstream may not be shown due to hydrogeologic considerations.

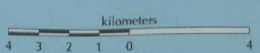
Connecticut

- Moderate to High Yield Aquifer
- Public Community Wells
- Public Non-community Wells

Rhode Island

- Groundwater Recharge Areas
- Groundwater Reservoirs
- Wellhead Protection Areas
- Public Community Wells
- Public Non-community Wells

- Town Boundaries
- State Boundary



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PULLOUT MAP

Pawcatuck Watershed
Land Use/ Land Cover

Connecticut

- High Density Residential
- Medium Density Residential
- Transportation
- Impervious Surfaces
- Barren Land
- Coastal Marsh
- Pavement
- Roof
- Pasture
- Cropland
- Forest
- Water
- Wetland

Rhode Island

- High Density Residential
- Medium Density Residential
- Low Density Residential
- Commercial
- Industrial
- Mixed Urban
- Other Urban
- Transportation
- Institutional
- Waste Disposal
- Barren
- Water
- Fields, Pastures, Orchards
- Wetland
- Brushland
- Forest
- Cropland

-- State Boundary

kilometers
4 3 2 1 0 4

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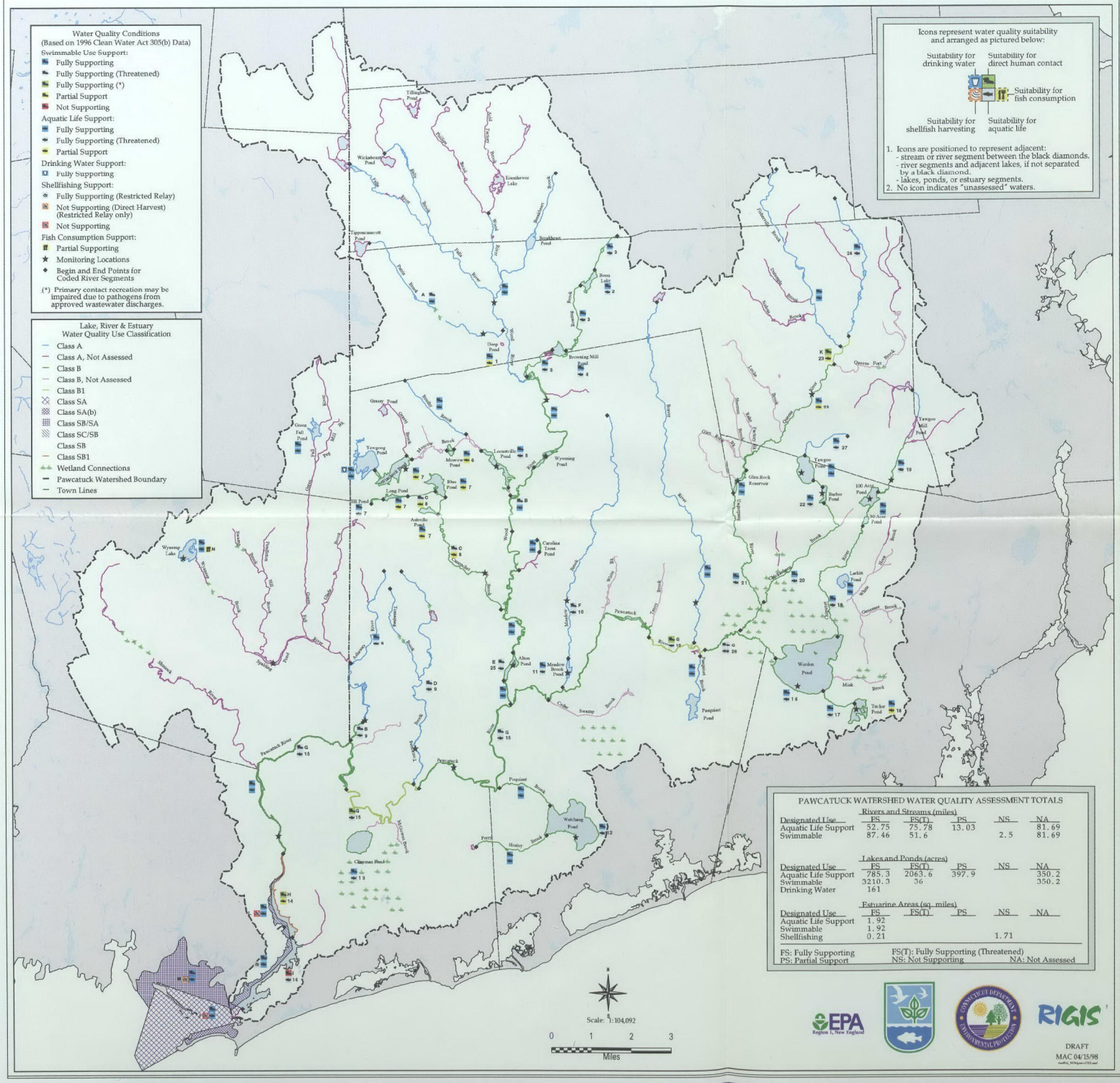
Pawcatuck Watershed Current Water Quality Conditions



PAWCATUCK WATERSHED WATER QUALITY ASSESSMENT TOTALS

Rivers and Streams (miles)

Designated Use	FS	FS(T)	PS	NS	NA
Aquatic Life Support	52.75	75.78	13.03		81.69
Swimmable	87.46	51.6		2.5	81.69

Lakes and Ponds (acres)

Designated Use	FS	FS(T)	PS	NS	NA
Aquatic Life Support	785.3	2063.6	397.9		350.2
Swimmable	3210.3	36			350.2
Drinking Water	161				

Estuarine Areas (sq. miles)

Designated Use	FS	FS(T)	PS	NS	NA
Aquatic Life Support	1.92				
Swimmable	1.92				
Shellfishing	0.21			1.71	

FS: Fully Supporting FS(T): Fully Supporting (Threatened)
PS: Partial Support NS: Not Supporting NA: Not Assessed

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SWIMMING IMPAIRMENTS - POTENTIAL SOURCES

A - Bacteria: Unknown sources
B - Bacteria: ISDS
C - Bacteria: Agriculture, Land disposal, Development
D - Bacteria: Agriculture, Stormwater runoff
E - Bacteria and Noxious aquatic plants: ISDS
F - Bacteria: Agriculture
G - Bacteria: Industrial point source
H - Bacteria: Municipal point source, Urban runoff
I - Bacteria: Municipal point source, Recreational activities, Stormwater runoff
J - Bacteria: ISDS, Recreational activities
K - Bacteria: Municipal point source

QUATIC LIFE IMPAIRMENTS - POTENTIAL SOURCES

1 - D.O. / Organic Enrichment: Unknown sources
2 - D.O. / Organic Enrichment: ISDS; Salt: Salt storage
3 - Salt: Salt storage, Stormwater runoff
4 - Nutrients and Noxious aquatic plants: Agriculture
5 - Noxious aquatic plants: Upstream source, Stormwater runoff, ISDS
6 - Nutrients and Noxious aquatic plants: ISDS; Alkalinity / pH: Natural sources, Atmospheric deposition
7 - Alkalinity / pH: Natural sources, Atmospheric deposition
8 - Lead: Underground injection; Biodiversity impacts: Agriculture, Land disposal, Golf course, Underground injection, Development
9 - Lead: Stormwater runoff; Nutrients and Biodiversity impacts: Agriculture, Stormwater runoff
10 - Lead, Total suspended solids and Biodiversity impacts: Agriculture, Agricultural water withdrawal
11 - D.O. / Organic Enrichment, Nutrients and Noxious aquatic plants: Agriculture, Land disposal
12 - Alkalinity / pH: Natural sources, Atmospheric deposition
13 - Salt: Salt storage; Noxious aquatic plants: Land disposal
14 - D.O. / Organic Enrichment: Industrial point source, Municipal point source, Urban runoff
15 - Lead: Stormwater runoff, Industrial point source; Nutrients: Agriculture, Stormwater runoff, ISDS, Industrial point source, Urban runoff, Development; Biodiversity impacts: Agriculture, Stormwater runoff, ISDS, Industrial point source, Urban runoff, Development
16 - Nutrients and Noxious aquatic plants: ISDS, Development
17 - D.O. / Organic Enrichment and Nutrients: ISDS
18 - D.O. / Organic Enrichment, Nutrients and Noxious aquatic plants: ISDS, Agriculture
19 - D.O. / Organic Enrichment, Lead and Biodiversity impacts: Stormwater runoff
20 - Lead: Stormwater runoff; Nutrients: Agriculture, Stormwater runoff, ISDS
21 - Lead: Stormwater runoff, Golf course
22 - D.O. / Organic Enrichment and Nutrients: ISDS
23 - Lead, Nutrients and Biodiversity impacts: Agriculture, Unknown sources, Golf course
24 - Nutrients: Agriculture
25 - Noxious aquatic plants: ISDS
26 - Lead: Stormwater runoff; Nutrients: Agriculture, Stormwater runoff, ISDS, Urban runoff, Development; Biodiversity impacts: Agriculture, Stormwater runoff, ISDS, Urban runoff, Development
27 - Nutrients and Lead: Agriculture, Unknown sources

SHELLFISH IMPAIRMENTS - POTENTIAL SOURCES

L - Pathogens: Municipal point sources, urban runoff, marinas, natural sources
M - Pathogens: Municipal point sources, urban runoff, marinas, recreation, natural sources

FISH CONSUMPTION IMPAIRMENTS - POTENTIAL SOURCES

N - Mercury: Atmospheric deposition

RHODE ISLAND DESIGNATED USES

Freshwater

Class A — Public drinking water supply, fish and wildlife habitat, primary and secondary contact recreation (i.e. contact and non-contact recreation), good aesthetic value. These waters are also suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses.

Class B — Fish and wildlife habitat, primary and secondary contact recreation, good aesthetic value. These waters are also suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses.

Class B1 — Same as Class B, however, primary contact recreation may be impacted due to pathogens from approved wastewater discharges. All Class B criteria must be met.

Saltwater

Class SA — Shellfish harvesting for direct human consumption, primary and secondary contact recreation, fish and wildlife habitat, good aesthetic value. These waters are also suitable for aquacultural uses, navigation and industrial cooling.

Class SA(b) — Same as Class SA. Proximity of marinas and mooring fields will likely result in seasonal shellfish bed closures. All Class SA criteria must be met.

Class SB — Primary and secondary contact recreation, fish and wildlife habitat, shellfish harvesting for controlled relay and depuration, good aesthetic value. These waters are also suitable for aquacultural uses, navigation and industrial cooling.

Class SB1 — Primary and secondary contact recreation, fish and wildlife habitat, suitable for aquacultural uses, navigation and industrial cooling, good aesthetic value. Primary contact recreation may be impacted by pathogens from approved wastewater discharges. All Class SB criteria must be met.

CONNECTICUT DESIGNATED USES

Freshwater

Class A — Potential drinking water supply; fish and wildlife habitat; recreational use; agricultural, industrial supply and other legitimate uses, including navigation.

Class B — Recreational use; fish and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation.

Saltwater

Class SA — Marine fish, shellfish and wildlife habitat; shellfish harvesting for direct human consumption; recreation and all other legitimate uses including navigation.

Class SB/SA — Presently not meeting Water Quality Criteria or one or more designated uses.

Class SB — Marine fish, shellfish and wildlife habitat; shellfish harvesting for transfer to a depuration plant or relay (transplant) to approved areas for purification prior to human consumption; recreation; industrial and other legitimate uses including navigation.

Class SC/SB — Due to point or nonpoint sources of pollution, certain Water Quality Criteria or one or more designated uses assigned to Class SB waters are not currently met.

Pawcatuck Watershed
Wetlands

The difference in wetlands classification between Rhode Island and Connecticut is due to dissimilar identification and mapping methods.

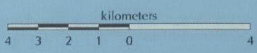
Connecticut

- Alluvial and Floodplain Soils
- Poorly Drained and Very Poorly Drained Soils
- Poorly Drained Soils
- Very Poorly Drained Soils
- Water

Rhode Island

- Forested Wetland: Coniferous
- Forested Wetland: Deciduous
- Forested Wetland: Dead
- Shore
- Estuarine Emergent Wetland
- Open Water
- Emergent Wetland: Marsh/Wet Meadow
- Emergent Wetland: Emergent Fen or Bog
- Scrub-shrub Wetland: Shrub Swamp
- Scrub-shrub Wetland: Shrub Fen or Bog

-- State Boundary



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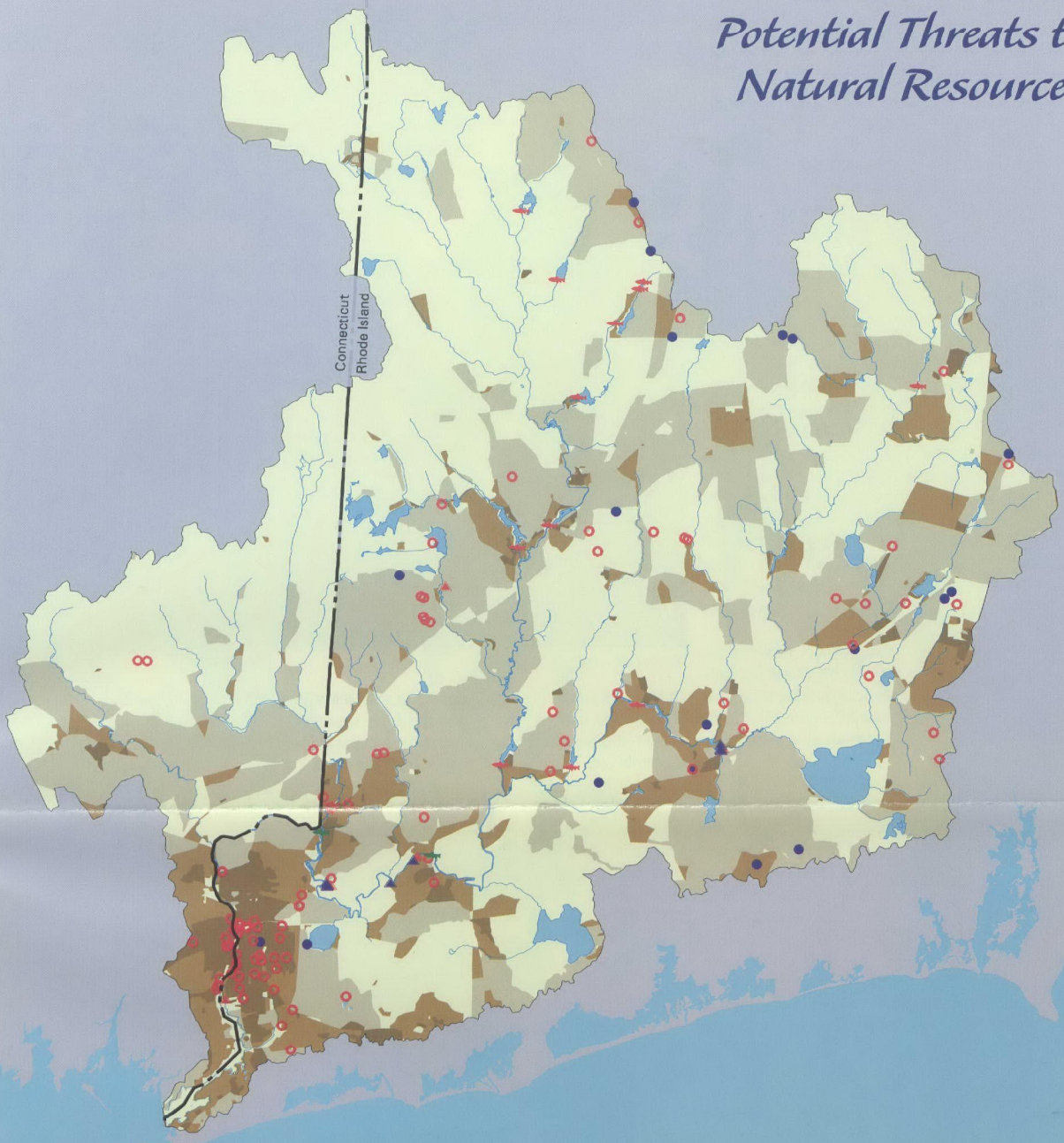
Pawcatuck Watershed
Potential Threats to Natural Resources



- Superfund National Priority List Sites
- CERCLA Sites
- RCRA Sites
- RIPDES Facilities
- RIPDES Discharge Locations
- Dams without fish ladders
- Dams with fish ladders
- 0-75 People/Sq. Mile
- 75-250 People/Sq. Mile
- 250-1000 People/Sq. Mile
- > 1000 People/Sq. Mile
- Water
- State Boundary

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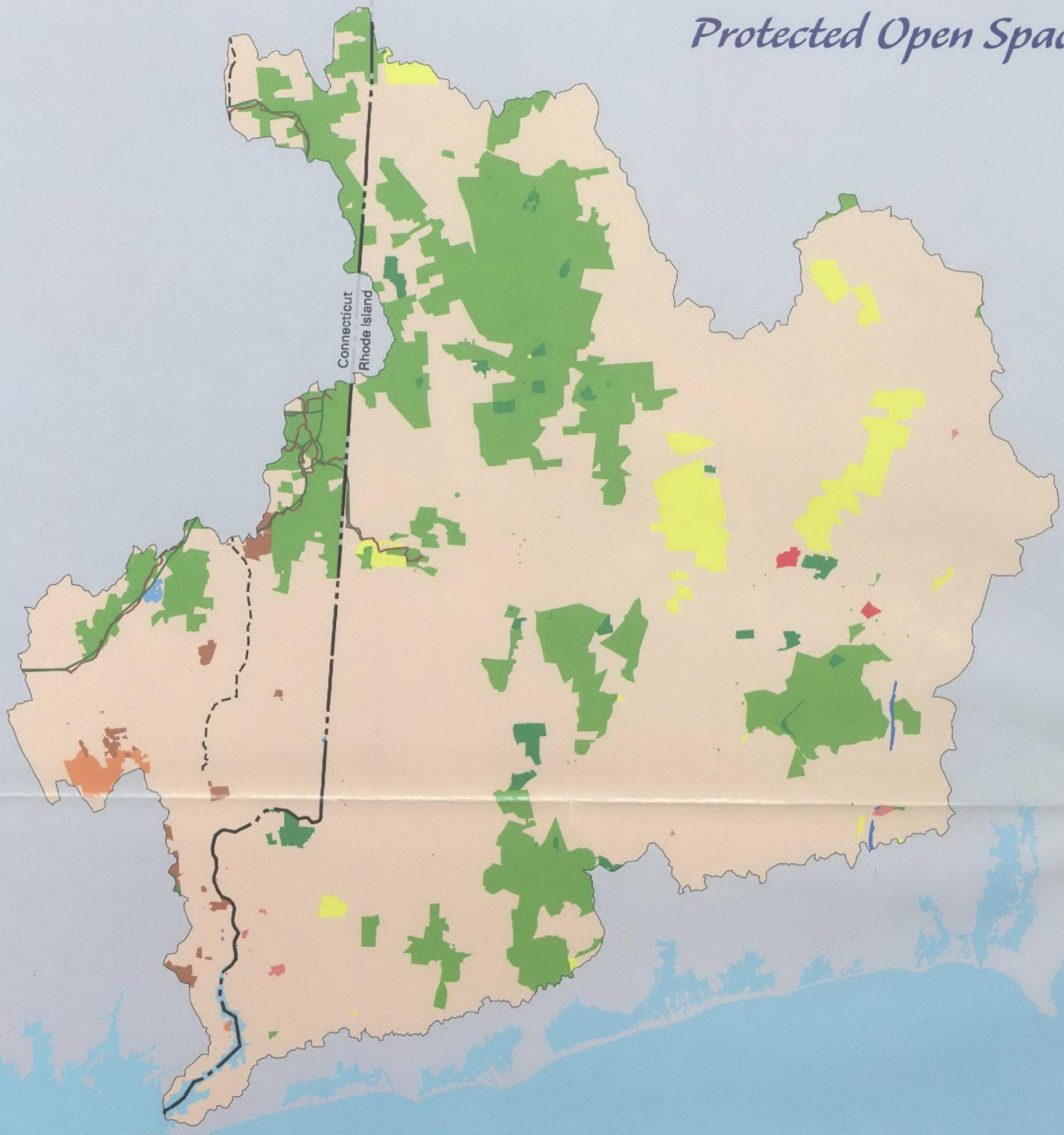
Pawcatuck Watershed
Protected Open Space



Connecticut

- Trail System
- Scenic Road
- Existing Greenway

DEP PROPERTY
- State Forest
- Wildlife Area
- Water Access
- DEP Owned Waterbody
- Other

- Golf Course
- Municipal/Private Property

Rhode Island

- State Owned
- Town Owned
- Privately Owned
- State Farmland Easements
- State Miscellaneous Easements
- Other

kilometers
4 3 2 1 0 4

The Nature Conservancy. EPA AED, Narragansett RI EPA Region 1, New England RIGIS

January 1998

A Better Way of Managing Our Environment

WHAT IS THE PAWCATUCK WATERSHED PARTNERSHIP?

A new approach to protecting and managing our environment is being promoted in this country and gaining popularity from coast to coast. This new approach redefines interactions between big government and local areas. It is often called the "community-based stewardship approach" to watershed planning and protection. More simply, it means bringing people together who have an interest or a stake in the local economy or environment. Together, the "stakeholders" develop solutions to natural resource problems.

Partnerships that are community-based have the benefit of bringing together motivated people and organizations with resources, expertise, and experience. However, most people are not used to thinking about issues from a watershed perspective. It requires thinking beyond political boundaries, considering more than one issue at a time, considering the many facets of each issue, and working in partnership with others. Although this is sometimes more difficult, it makes sense to consider not only environmental issues, but important related economic, social, cultural, and political issues as well.

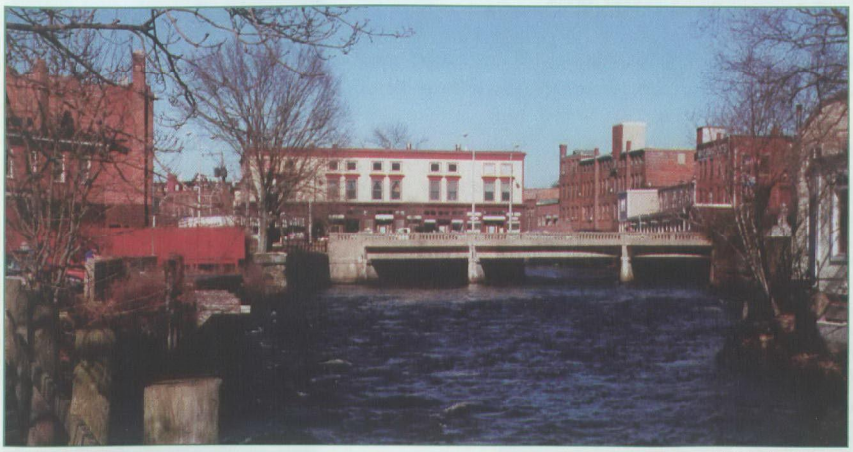


Photo by Alan Desbonnet

The Pawcatuck Watershed Partnership was organized in 1996 in response to requests of people and organizations in the watershed. It is a group of watershed towns, local groups, and agencies working together to improve environmental quality and economic health of the watershed. The Partnership seeks to bring watershed interests together to collectively address environmental and related issues. During initial stakeholder meetings, and subsequent interviews, people have expressed deep concerns about the future of both water quality and water quantity, the fast pace of development and tourism in the region, current and future gaming operations, inconsistent zoning, inadequate collaboration between towns and states, as well as other issues. With the active participation of stakeholders, key organizations like the Wood-Pawcatuck Watershed Association and the Southern Rhode Island Conservation District joined with the agencies to develop a stakeholders group that could collaboratively guide the watershed's future to ensure the quality of life people have come to know, depend on, and cherish.

In the community-based watershed approach, people who live in the watershed or rely on its resources, act as environmental stewards and take responsibility for defining the management of local resources. The community-based watershed approach focuses on problems in a particular watershed, such as the Pawcatuck watershed. It relies upon local support and voluntary commitments to managing natural resources. It also considers the economic and social well-being of communities as expressed by their stakeholders.

Over the past twenty-five years excellent progress in protecting natural resources has been achieved under national and state regulatory standards. In particular, progress has been made in the control of pollutants from point source discharges. However, even if there were perfect compliance with existing environmental laws and regulations, we would still see many disturbing environmental conditions and trends. Many of our most common environmental problems today are related to the activities and living requirements of people which result in pollutants from road drainage, urban and agricultural runoff, failed septic systems, leaking underground fuel storage tanks, and erosion of stream banks.

These and others comprise a wide array of nonpoint source discharges to groundwater, estuaries, salt ponds, rivers, and other natural areas. Unlike point source discharges, comprehensively managing these types of problems is beyond the authorities of EPA, RI DEM, CT DEP, and other federal and state agencies. Increasingly, these agencies and other stakeholders believe that many problems can, and should, be addressed locally through land use planning, education, and where appropriate, regulation. These agencies recognize that it is critical to form partnerships with local, regional, and state stakeholders to address natural resource problems collectively. Every stakeholder has an equal voice as well as responsibility to discuss issues about which they are concerned, and to offer possible options to resolve them. As partners they also share in the solution.

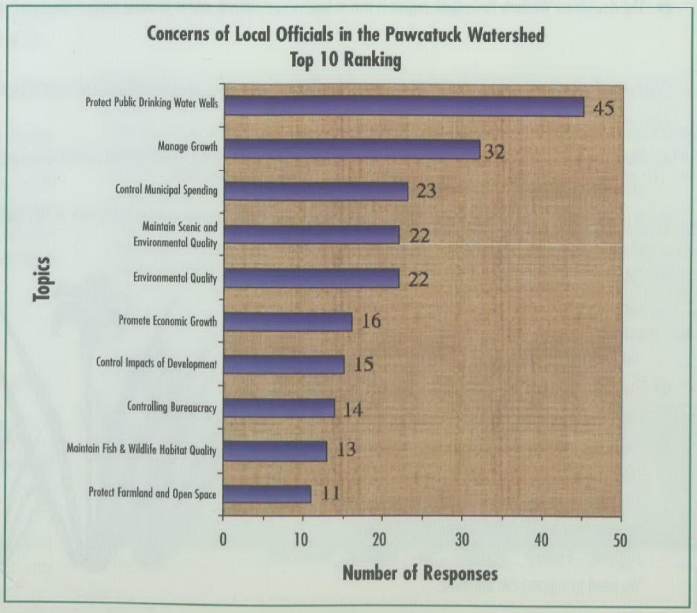
The Partnership is rapidly taking shape and needs participants from all sectors, public and private organizations as well as individuals who live, work, or recreate in the watershed. It is crucial to the success of this partnership endeavor that all interests in the watershed be involved. The Partnership provides a place for stakeholders to voice their concerns and then help to identify and support attainable solutions. Businesses, realtors and real estate developers, agricultural interests, tourism groups, industries, town governments, land trusts, environmental organizations, recreational interests, historic commissions, and citizens of the watershed need to become actively involved. These individuals and groups comprise the Pawcatuck Watershed Partnership and share the responsibility of shaping the future of the watershed.

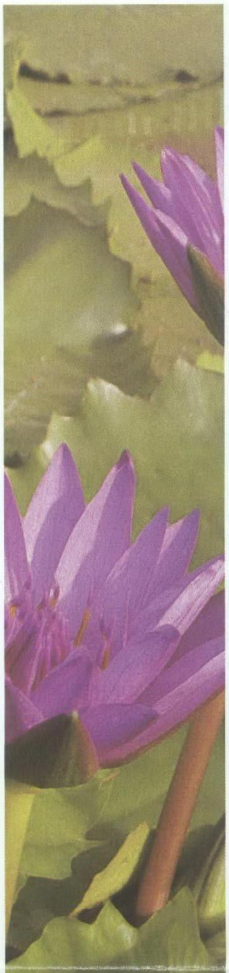
Persons who live, work, or use the Pawcatuck watershed for recreation have a "stake" in its future. Input and participation as a stakeholder is critical in creating and working towards a vision for the watershed, and in resolving the issues to realize this vision. You can influence the quality of life you enjoy, the beauty of the natural setting that surrounds you, and the sustainable economic vitality of the watershed. Now is the time to organize, support, and become involved in this community-based approach for managing the natural resources of the Pawcatuck Watershed region.

REACHING OUT, DEFINING ISSUES

A View from Town Officials

A University of Rhode Island survey invited elected and appointed local officials in the Pawcatuck watershed to rank their top concerns regarding land use and resource management in the watershed. Approximately 180 local officials from the 14 communities throughout the watershed responded to the survey. Their responses, as shown, rank drinking water protection as the single greatest concern. This survey was conducted by URI Cooperative Extension in 1997. The results are used to assist the Pawcatuck Watershed Partnership.





REACHING OUT, DEFINING ISSUES

A View from Communities and Individuals

As a part of its efforts at maintaining a healthy watershed, the Pawcatuck Watershed Partnership asked stakeholders what their issues were in the watershed. The following is a summary of those issues:

We need water for drinking and recreation. We need it clean and pure.

Photo by the Nature Conservancy

- The Pawcatuck is designated a "Sole Source Aquifer" – one of only 13 such designations in New England. Groundwater is the only source of drinking water for the approximately 60,000 people living in the watershed now and long into the future.
- Drinking water sources overlap the boundaries of two states, 14 towns, and one sovereign nation. We must foster cooperation across political boundaries to ensure protection of this critical resource.
- Stream and river quality and quantity are intimately linked to groundwater in the Pawcatuck watershed. We must ensure that our use of water does not deplete streams during summer months and badly impact ecological resources.
- A flow of clear, clean water is essential life support for many species, including trout and bass in the rivers and ponds, and shellfish in the bay.
- Clean, fresh water is required to sustain the crops and livestock of the 70 large-scale farmers of the watershed.
- Water quality and quantity must be ensured and sustained for recreation, future drinking water supplies, and business and industrial needs, while preserving ecosystem health and balancing the impact of one use on others.

Farmlands and forests are important rural traits of the watershed landscape. We need to preserve these traits.

Photo by the Natural Resource Conservation Service

- Population has increased by 20 percent in the watershed over the past decade. We must plan to ensure that growth does not cause a rapid conversion of the landscape to residential and commercial sprawl.
- Approximately 65 percent of the land in the Pawcatuck watershed is undeveloped, providing an opportunity to plan for a sustainable ecological and economic future.
- Twenty percent of the watershed land area is farmlands and fields, which provide a unique rural atmosphere while preserving open space. We need to preserve agriculture in the watershed.
- Present land use controls, including existing zoning, open the way for sprawl and strip development.
- Lack of regional planning causes competition between towns and states and creates a "win or lose" atmosphere. The result is chaotic and conflicting development. We need "win-win" growth and development.
- Aesthetic values, such as dark, star-filled night skies, quietude, scenic vistas, small town charm and unique natural landscapes need to be preserved.

The regional economy is changing, shifting from one reliant upon manufacturing industries to one based on "entertainment," tourism, and residential development. We need to define a watershed economy.

Photo by the Wood-Pawcatuck Watershed Association

- Development of tourism needs to incorporate the unique natural and cultural amenities of the watershed, not replace them.
- A variety of employment opportunities is essential for a sustainable economic future. Traditional elements of the economy should be used as a foundation for future development.
- Neighborhood villages provide diverse opportunities to create small-scale economic ventures that sustain a small town atmosphere and accommodate residential influx.
- Marinas and other water-dependent businesses promote the enjoyment of high quality natural resources and provide public access.
- Land-based recreation, such as hiking and biking, diversifies and contributes to the economy while promoting sustainable use of natural resources.
- The downtown Westerly-Pawcatuck region is rich in history and culture, and is building support for its arts and theater economies.

Natural resources, open space and habitats in the watershed are unique and of high quality. We need to protect these resources.

- Thirty-one percent of the watershed area is protected natural habitat: parks, wildlife management areas, conservation easements, and private and public land trust holdings.
- A major barrier to success for restoration of Atlantic salmon and other native species is the lack of fish passageways at dams. Providing fish access to spawning grounds is needed.
- Eelgrass beds in Little Narragansett Bay are the most robust beds along the Connecticut coastline. Nutrients from the watershed flowing into the bay and estuary need careful management to ensure their protection.
- State agencies promote a reliance on stocking programs for wildlife management. We need ecosystem management.
- The Pawcatuck watershed contains 63 percent of Rhode Island's rare plants and animals. It was selected as a national pilot project for a collaborative approach to resource management by 12 federal agencies – the New England Federal Partners for Natural Resources. We need to support this initiative.

WHAT'S YOUR VIEW...?

How can we evaluate whether our efforts are making progress...in preserving important natural resources, farms, open space, and promoting the local economy?

What should we measure as indicators to track changing conditions...

...in natural resources?
...in quality-of-life?
...in vitality of the local economy?

How to Get Involved

There are many ways that one can "make a difference." One can begin right at home, place of employment, or even play. Each of us must be responsible for how we use the land and waters around us. Inadvertent or sloppy use of chemicals, disbursing of waste oils, fertilizing lawns just before a soaking rain, forgetting to pump septic systems, landscaping that causes muddy runoff to nearby streams, all contribute to degrading our water supply, neighborhoods and reducing the value of our real estate and consequently our quality of life (See next page for list of groups to contact).

AN IMPORTANT ISSUE FOR HOMEOWNERS

Septic Systems – Problems and Solutions for the Pawcatuck Watershed

More than 7 in 10 residents of the Pawcatuck watershed depend upon septic systems to handle household wastewater. Beyond the town centers of South Kingstown and Westerly-Pawcatuck, on-site wastewater systems are the only alternative. When properly designed, installed and maintained, septic systems can be a simple, effective and economical way to dispose of wastewater while also replenishing groundwater. However, improper use, lack of maintenance, outdated systems, poor soil conditions, or thickly settled neighborhoods can lead to expensive repairs or unsanitary conditions. Untreated wastewater can seep into groundwater supplies and into nearby streams and ponds where even small amounts can have significant effects.

Why septic systems are a particularly serious problem in the Pawcatuck watershed:

- Homes built before 1970 predate R.I. septic system standards and are more likely to have cesspools or other substandard systems. In South Kingstown, for example, almost half of the homes with septic systems predate 1970. Since the typical life span of a septic system is about 20 years, many have outlived their expected usefulness.

- Dense development patterns in historical mill villages and lakefront cottage communities concentrate septic system discharges where effluent has the shortest travel time and greatest opportunity to enter surface waters without proper treatment.

- Problem soils - Rapid-draining soils, high water table, and fine, compacted soils found in 35 percent of the watershed (not including wetlands) can result in discharge of improperly treated wastes to either ground or surface waters.

- Combined impacts - All septic systems in the watershed contribute to a major source of pollution. URI estimates that septic systems account for more than 50 percent of all nitrogen entering the watershed as recharge to groundwater.

- System care and maintenance - On-site wastewater systems were once viewed as a temporary disposal solution while awaiting public sewers. System care was left entirely up to the homeowner and consequently, only emergency repairs rather than regular inspection and pumping became the norm. Some watershed communities have adopted or are now considering local septic system inspection and maintenance programs.

- Cost of regular pumping and maintenance is far less than the expense of constructing a new system or tying into public sewers where available.

What's being done:

Several Pawcatuck watershed communities are leading efforts to improve local management of on-site disposal systems through either voluntary or mandatory septic system maintenance programs. Supported by RI Nonpoint Source Bond Fund, the towns of Charlestown, South Kingstown, Narragansett, and Westerly are currently developing wastewater management plans to identify the extent of the problem, and implementing a management structure.

What citizens can do:

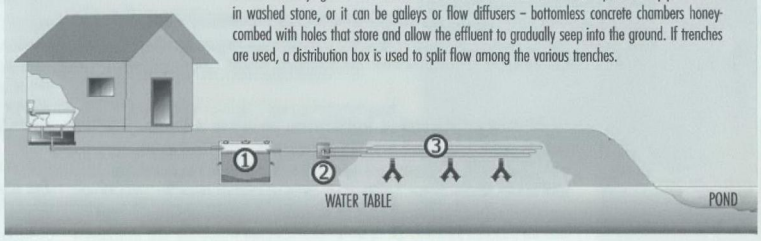
- Support adoption of the town's wastewater management efforts. Learn about proposed regulations and attend hearings.

- Have home systems inspected every one to three years and pump as necessary. Consider upgrading if substandard.

- Properly dispose of motor oil and household chemicals. Do not dump hazardous waste down drains. The well you contaminate just may be your own...

Conventional Septic System

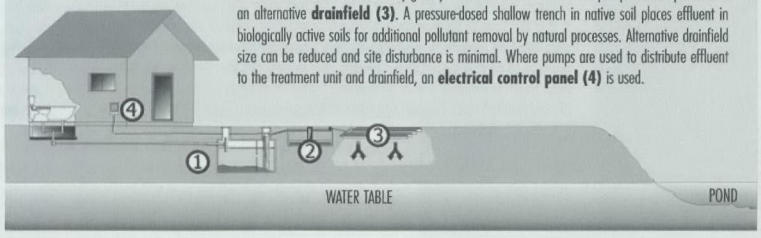
The standard conventional septic system consists of a septic tank followed by a drainfield, also called a leachfield or soil absorption field. Wastewater from toilet, bathtub, and sink drains to a **septic tank (1)** where solids and grease are trapped and decomposition takes place. The liquid effluent flows to a **distribution box (2)** which directs flow to a **drainfield (3)** where it seeps into the underlying soil. The drainfield can either be a series of trenches – perforated pipe encased in washed stone, or it can be galleys or flow diffusers – bottomless concrete chambers honeycombed with holes that store and allow the effluent to gradually seep into the ground. If trenches are used, a distribution box is used to split flow among the various trenches.



Alternative Septic System - An Example

Alternative treatment systems cover a wide variety of treatment technologies and drainfield options. Most alternative systems generally include an additional treatment step, following solids settling in a watertight fiberglass or concrete **septic tank (1)**. A pump, which may be in the septic tank or a separate unit is often used to convey the effluent to a **treatment unit (2)**, which may be placed above or below ground. Examples of treatment units include sand filters (intermittent, bottomless, recirculating), RUCK, trickling filters, aerobic units, and biofilters – peat or foam.

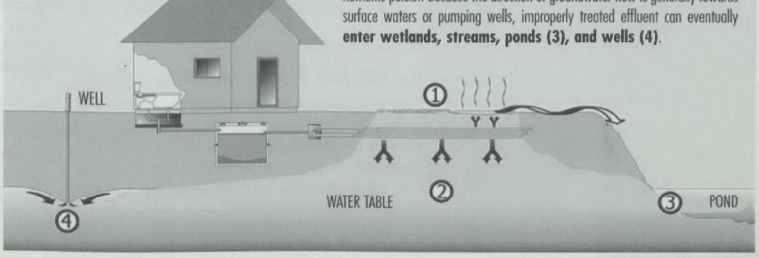
The treated effluent then flows by gravity to a conventional trench or is pumped under pressure to an alternative **drainfield (3)**. A pressure-dosed shallow trench in native soil places effluent in biologically active soils for additional pollutant removal by natural processes. Alternative drainfield size can be reduced and site disturbance is minimal. Where pumps are used to distribute effluent to the treatment unit and drainfield, an **electrical control panel (4)** is used.



How Septic Systems Fail

One type of septic system failure happens when wastewater effluent is unable to seep into the ground because of system damage, clogged soils, a solids-filled septic tank, or high water table in the leachfield. Sluggish drains and wastewater backups into the house are the most obvious problems. **Lush growth of grass, squishy patches above the leachfield, and odor (1)** are other telltale signs of this classic hydraulic failure.

Less visible but equally harmful to water quality is treatment failure where wastewater reaches **groundwater (2)** without adequate purification. Treatment failure is most common in quick-draining sandy soils where rapid movement short-circuits natural treatment in high water table areas and in shallow soils where effluent channels along compacted soil layers or bedrock fractures. Once in the groundwater, pathogens and nutrients persist. Because the direction of groundwater flow is generally towards surface waters or pumping wells, improperly treated effluent can eventually **enter wetlands, streams, ponds (3), and wells (4)**.



PROGRAMS AND ORGANIZATIONS ACTIVE IN THE PAWCATUCK WATERSHED

The Pawcatuck Watershed Partnership

The Pawcatuck Watershed Partnership With support and technical assistance from EPA, NRCS, USGS, RIDEM, and URI, interested parties have joined together as the Pawcatuck Watershed Partnership to assist local organizations and interests in managing watershed resources on a sustainable basis. Contact Rob Adler (617) 565-9306.

The 14-Town Action Committee of the Pawcatuck Watershed Partnership is a group of watershed interests committed to addressing the issues of growth and development and influencing change. The goal is to develop strategies and processes that will create a desirable future for the citizens of the watershed. They will conduct workshops/forums on growth and development in the Pawcatuck watershed to more clearly define issues, and explore opportunities for confronting them. The forum will provide a springboard by which one can begin to influence change. Everyone can help. Just get involved. Contact Alan Desbonnet (401) 874-6480 or (860) 599-5933.

A Water Use Stakeholders Group of the Pawcatuck Watershed Partnership is addressing various issues, concerns, and conflicts related to the use of water in the Pawcatuck watershed. The focus of this working group is to devise non-regulatory approaches to managing water for both human and environmental needs in the watershed. Contact Alicia Good at Rhode Island Department of Environmental Management, Division of Water Resources (401)222-4700, extension 7214.

The University of Rhode Island

University of Rhode Island Cooperative Extension provides educational programs, publications, and events to help protect and improve the State's waters. For more information on programs, educational materials, and availability of speakers, contact the following:

The Municipal Watershed Training offers training in the science, management, and regulation of water resources for community leaders and volunteer board members. Its goal is to provide decision makers with the skills and resources to identify local water quality problems and to adopt effective pollution controls. A variety of educational programs are offered throughout the year, ranging from evening or one-day workshops, to intensive, small group trainings which are tailored to meet the participant's interests and needs. Technical assistance in protecting local watersheds is available to communities on a case-by-case basis. Contact Lorraine Joubert, University of Rhode Island, Cooperative Extension Program, (401) 874-2138.

The University of Rhode Island Watershed Watch Program is a volunteer monitoring program that focuses on educating the public and providing current information on the water quality status of freshwater lakes, ponds, streams, and reservoirs throughout Rhode Island. The most significant goals of the program are to: (1) promote public education regarding water quality issues, (2) provide intensive multi-year baseline water quality information, (3) categorize the ecological health of our freshwater bodies, and (4) promote active citizen involvement. The heart of the program consists of weekly measurements taken by numerous trained volunteer monitors. The program emphasizes watershed-scale monitoring because the water quality of a given lake, pond, or stream is a reflection of the activities in the lands and waters which surround and lie upstream of it. It is the hope of this program to encourage communities, lakeside homeowners, recreational users, and local residents to understand the need to cooperatively manage and improve the water quality of all water bodies within a watershed; thus ensuring that the Pawcatuck watershed's fresh water resources remain one of its great assets. Contact Linda Green or Elizabeth Herron at Rhode Island Watershed Watch Program, (401)874-2905.

The University of Rhode Island On-Site Wastewater Training Program provides hands-on training in alternative septic systems by using fully functional, above-ground systems at an outdoor training facility in Kingston, RI. Over 25 full-scale septic tanks, treatment units, and drain field options are used to demonstrate system design, function, and maintenance. Each of the demonstration systems are selected from proven technologies that minimize nutrient and/or microbial inputs to ground water and surface waters. The Center represents a unique partnership between the University, state and federal agencies, the private sector, and municipal groups. Contact George Loomis (401) 874-4558

Rhode Island Home*A*Syst Program is a voluntary residential pollution prevention program that trains families to protect their health and the environment. The program helps residents identify environmental risks and encourages preventive, cost-effective actions. Pollution prevention from residential areas is the goal. The heart of the program is its community-based approach, focusing on working with motivated community members and trained volunteers to achieve watershed protection. Home*A*Syst offers public education workshops, a multi-session volunteer training program, and customized educational and program materials. Contact Alyson McCann at the University of Rhode Island, Cooperative Extension Water Quality Program at (401) 874-5398.

The University of Connecticut

The UConn Cooperative Extension System is noted for its Nonpoint Education for Municipal Officials (NEMO) program. NEMO focuses on land use management within municipalities to protect and conserve their natural resources. The program utilizes GIS (Geographic Information Systems) as a tool for better decision-making, as well as for educating local officials in better understanding land use management. UConn CE provides technical assistance in a strategic fashion to help towns sustain their natural resource base and protect key ecological areas using watersheds as the scale of study and implementation. Contact Chester Arnold, (860) 345-4511.

Towns

The Westerly-Pawcatuck Downtown Task Force is developing both a vision and strategies for the revitalization of the economic viability of this historical center of the watershed. Contact Linda Ozga (401) 348-0733.

The Town of Stonington is developing its "Stonington 2000" economic development plan. This initiative will ultimately serve as the foundation on which to create a coordinated plan for growth and development in the watershed. Contact Nick Smith (860) 535-5050.

Nonprofit Organizations

The Wood-Pawcatuck Watershed Association is a non-profit organization whose mission is "to promote and protect the lands and waters of the Wood-Pawcatuck watershed." The Association relies upon member support for its activities and functioning. The Association is active in many areas, offering recreational opportunities to members through hikes and canoe trips, educational opportunities through homeowner seminars, as well as "in the field" workshops. The Association is also active in providing educational opportunities to schools throughout the watershed by providing both field trips and classroom programs focusing on watershed resources, uses, and problems. The WPWA was a founding participant in the URI Watershed Watch Program, and through the assistance of over 30 member volunteers, monitors 16 sites for water quality in the watershed. Contact Nina Rooks, Executive Director, (401) 539-9017.

The Audubon Society of Rhode Island is a non-profit chapter of the National Audubon Society. The organization's headquarters are open to visitors who can browse through their educational exhibits and other offerings. RI Audubon is open to membership and offers a variety of natural history and conservation programs to its members and the general public. RI Audubon maintains several sanctuaries within the Pawcatuck watershed and offers volunteer opportunities through which to involve its members in various educational programs, monitoring studies, and research/rehabilitation efforts. Contact Lee C. Schisler, Jr. (401) 949-5454.

The Rhode Island Wild Plant Society is a non-profit organization whose mission is the protection of Rhode Island's native plants and their habitats. The Wild Plant Society is a member-supported organization that offers a variety of educational programs, field trips, workshops, and lectures focusing on Rhode Island's wild plants. The organization also conducts inventories of plants throughout the state of Rhode Island and offers volunteer opportunities for becoming involved in its efforts and programs.Contact Debra Poor, Executive Director, (401) 783-5895.

The Nature Conservancy is an international non-profit organization working to preserve ecologically significant habitats, including those of rare and endangered species through acquisitions, easements, and other similar arrangements. The organization is member-supported and has opportunities for volunteer assistance in some of its monitoring, inventory, and research efforts. Contact Douglas Parker, RI Executive Director, (401) 331-7110.

The Salt Pond Coalition is a member-supported non-profit organization whose focus is the preservation and enhancement of the environmental quality of Rhode Island's south shore salt pond ecosystems. The Coalition offers a variety of educational programs and maintains volunteer opportunities. The Salt Pond Watchers, a volunteer monitoring effort of the Coalition, has conducted water quality monitoring in the region's salt ponds for over a decade while serving as a national model for volunteer monitoring programs. Contact Dave Monk, Executive Director, (401) 322-3068.

Trout Unlimited is a national non-profit organization dedicated to the preservation, enhancement, and protection of cold-water fisheries. The Narragansett Chapter of the national affiliate provides oversight to all of Rhode Island. The organization is member-supported and is active in a variety of areas including: habitat and stream restoration, trout and salmon stocking, water quality and habitat monitoring, educational programming, and fisheries management. Volunteer opportunities are available in all areas of activity. Contact Pat Kapsner, President, (401) 724-2932.

The Rhode Island Natural History Survey enhances communication among Rhode Island's environmental and life scientists to advance scientific knowledge of Rhode Island's biota, ecological communities, and environmental resources. It further facilitates and coordinates the gathering and dissemination of information on Rhode Island's biota and natural communities. Contact Lisa L. Gould, Executive Director, (401) 874-5800.

North Stonington Citizens Land Alliance is a member-supported non-profit organization dedicated to the preservation of open space and rural character in the North Stonington area. The Alliance offers a variety of educational programs, including lectures and field trips to its members and the general public. Volunteer opportunities are available in a variety of programs and activities. The Alliance participates in lake and pond monitoring in cooperation with the University of Rhode Island Watershed Watch Program. Contact Madeline Jeffery, Executive Director, (860) 535-8256.

The Southern Rhode Island Conservation District and the New London Soil and Water Conservation Service interact with agriculturists in the watershed and provide technical expertise and other resources that help keep farmers farming. Contact Alicia Leher (401) 822-8832 or Seth Lerman (860) 887-4163.

Glossary

Anadromous fish: Fish that spend their adult lives in the sea but swim upriver into fresh water to spawn.

Anoxia: A condition of no oxygen in the water. Often occurs near the bottom of eutrophic, stratified lakes in summer.

Algae: Green plants that occur as microscopic forms suspended in water (phytoplankton), and as single cell or filamentous forms attached to rocks and other solid surfaces.

Algal bloom: A sudden increase in the abundance of suspended algae, especially at or near the water surface, producing a green scum or a "pea soup" appearance.

Aquifer: A geologic formation that can hold, and provide large quantities of water readily.

Bedrock: A general term for the rock that underlies soil or other unconsolidated, superficial material.

Biodiversity: The number and variety of different organisms in the ecological complexes in which they naturally occur.

Criteria: Descriptive factors taken into account by EPA in setting standards for pollution control. For example, water quality criteria describe the concentration of pollutants that most fish can be exposed to for an hour without showing acute effects.

Endangered species: Animals, plants, birds, fish, or other living organisms threatened with extinction by man-made or natural changes in the environment.

Estuary: Regions of interaction between rivers and near-shore ocean waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife.

Eutrophic: A term used to describe very productive or enriched lakes. These lakes tend to exhibit some or all of the following characteristics: an abundance of rooted plants; turbidity due to algal blooms; loss of oxygen in bottom waters during the summer months; rapid accumulation of soft bottom sediments; and abundant fish, which may include stunted and/or rough species in the most fertile lakes.

Fecal coliform: Coliform bacteria that originate in the intestinal tract of humans and other warm-blooded animals; fecal coliform are used to indicate the potential presence of other harmful bacteria.

Ground water: Water beneath the earth's surface at varying depths; in reservoirs called aquifers.

Hot spot: A problem area or location where pollution, especially a chemical concentration, is very high. Generally located near urbanized areas or point-source discharges.

Hypoxia: A condition where very low concentrations of dissolved oxygen are in the water column.

Loading: The quantity of a substance entering the environment.

Mesotrophic: A term used to describe lakes which are moderately productive. These lakes tend to exhibit some or all of the following characteristics: moderate growth of rooted plants and algae; some loss of oxygen from bottom waters during the summer months; some sediment accumulation; relatively good fish production of cool or warm water species, such as perch, bass, pike, and panfish. Most lakes are in this category.

Moraine: A mound, ridge, or other distinct accumulation of unsorted, unstratified glacial drift, predominantly till, deposited by direct action of glacier ice.

Nitrogen: An element necessary for the growth of aquatic plants; may be found in several forms, including nitrates, nitrites, and ammonia.

Nonpoint source pollution: Pollution of surface or ground water supplies originating from land use activities and/or the atmosphere, having no well-defined point of entry.

Nutrients: Chemical elements or substances, such as nitrogen and phosphorus, that are essential for plant and animal growth.

Oligotrophic: A term used to describe a relatively unproductive lake or one poorly supplied with plant nutrients. Because of low biological production, these lakes tend to exhibit some or all of the following characteristics: clear waters; limited growth of algae or rooted plants; bottom waters well supplied with oxygen throughout the year; low rate of sediment accumulation; low fish production, but often of desirable species, such as trout and perch.

Outwash: Stratified sand and gravel removed or "washed out" from a glacier by meltwater streams and deposited in front of or beyond the terminal moraine or the margin of the active glacier.

Phosphorus: An element necessary for the growth of aquatic plants. It is naturally present in low concentrations, and lack of phosphorus often limits plant growth. Thus the addition of phosphorus can affect water quality by increasing the production of algae and rooted plants.

Point source pollution: Pollution of ground or surface water supplies at well-defined, usually constructed, "points" or locations; discharges of treated wastewater from municipal and industrial treatment plants are common point sources of pollution.

Recharge area: Land area over which precipitation infiltrates into the soil and percolates downward to replenish an aquifer.

Secchi disk: A simple device widely used to measure the transparency or clarity of water, consisting of a metal or plastic plate, usually 8" in diameter, painted black and white, on a calibrated line.

Watershed: A drainage area or basin; all land and water areas which drain or flow toward a central collector, such as a stream or a lake at a lower elevation.

Water table: The boundary between the saturated and unsaturated zones in the ground. Generally, the level to which water will rise in a well.

Wellhead protection area: A protected surface and subsurface zone surrounding a well or well field that supplies a public water system and through which contaminants could likely reach well water.

Wetlands: Any of a number of tidal and nontidal areas characterized by saturated or nearly saturated soils most of the year that form an interface between terrestrial and aquatic environments; include freshwater marshes around ponds and channels (rivers and streams), brackish and salt marshes; other common names include swamps and bogs.

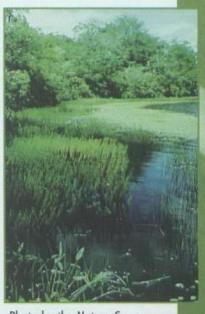


Photo by the Nature Conservancy

Photo by the Wood-Pawcatuck Watershed Association

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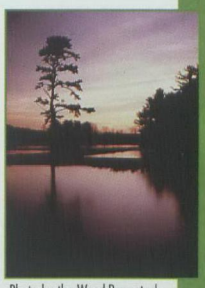

Photo by the Wood-Pawcatuck Watershed Association

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Jerry Pesch - Project Coordinator, US EPA, Atlantic Ecology Division, Narragansett, RI

Deborah Mercogliano - Graphic Design Manager, Creative Arts Department, Foxwoods Resort Casino, Ledyard, CT

Heather Dailey - Graphic Designer, Creative Arts Department, Foxwoods Resort Casino

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Hal Walker, Suzanne Lussier, Walt Galloway, US EPA, Atlantic Ecology Division, Narragansett, RI

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Robert Adler, David Turin, US EPA, Region 1, Boston, MA

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Anne Veeger, Geology Department, University of Rhode Island, Kingston, RI

Lorraine Joubert, Alyson McCann, Arthur J. Gold, Peter August, Department of Natural Resource Science, University of Rhode Island

Linda Green, Elizabeth Herron, Watershed Watch, Cooperative Extension Service, University of Rhode Island, Kingston, RI

William McKenzie Woodward, Rhode Island Historical Preservation Commission, Providence, RI

Alan Desbonnet, Coastal Resource Center, University of Rhode Island, Narragansett, RI

Nina Rooks, Charlie Hickox, Wood-Pawcatuck Watershed Association, Hope Valley, RI

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Robert Hust, Connecticut Department of Environmental Protection, Hartford, CT

Chris Powell, Dennis Erkin, Division of Fish and Wildlife, Rhode Island Department of Environmental Management, West Kingston, RI

Richard W. Enser, Rhode Island Natural Heritage Program, RI DEM, Providence, RI

David Schweid, Planning and Community Development, Mashantucket Pequot Tribal Nation, Mashantucket, CT

Vicky O'Neal, Natural Resource Conservation Service, US Department of Agriculture, Warwick, RI

Charlotte Spang, Southern Rhode Island Conservation District, Warwick, RI

U.S. EPA, NHEERL/AED
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