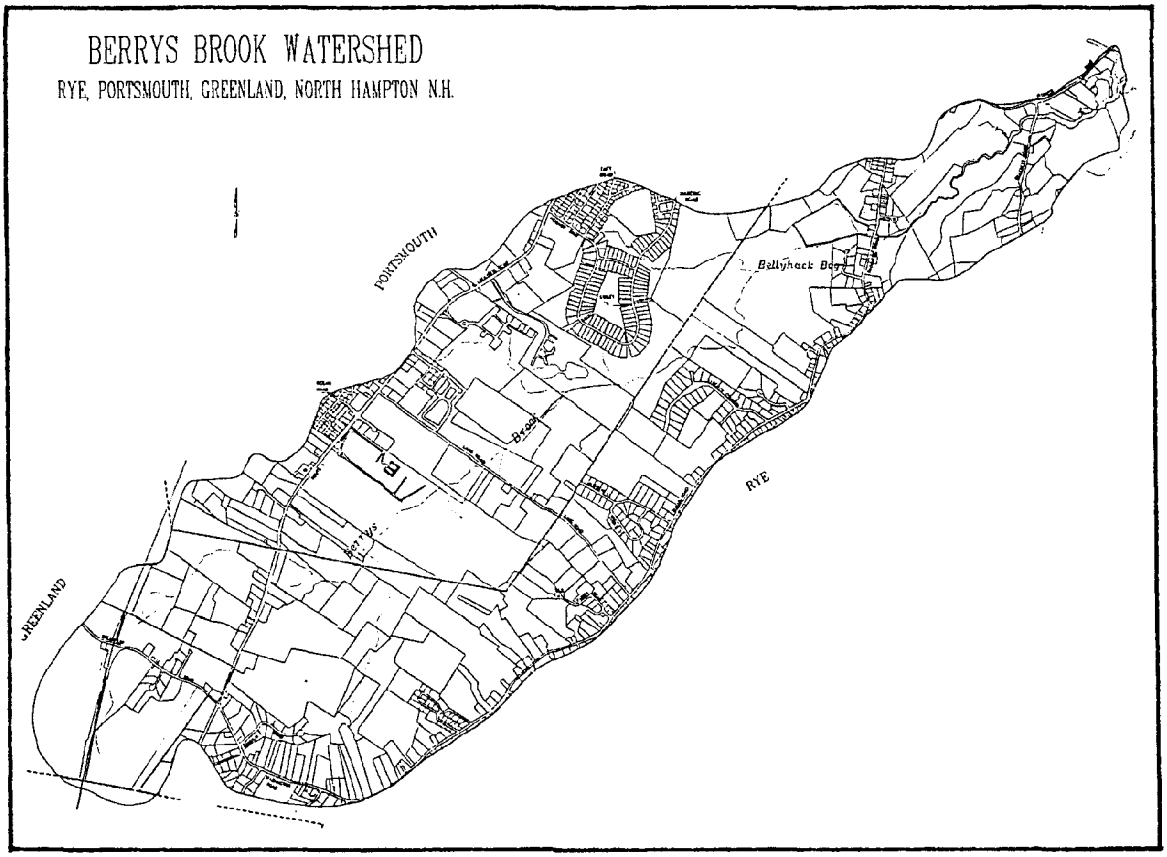
WORK TASK 92-7.3

BERRY'S BROOK WATERSHED MANAGEMENT PLAN



Prepared For:

Berry's Brook Watershed Protection Council

JUNE 1993

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BERRY'S BROOK

WATERSHED MANAGEMENT PLAN

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June 1993

Prepared For:

Berry's Brook Watershed Protection Council

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TABLE OF CONTENTS

		Page
o	**Acknowledgements**	1
o	**Background**	2
o	**Inventory and Analysis of Watershed Resources** - Watershed Description - Natural Resources - Analysis of Land Use Regulations	3 - 22
o	**Potential Threats to Watershed Resources**	23 - 26
o	**Watershed Build-Out Analysis**	27 - 28
o	**Action Plan** - Goal and Policies - Regulatory Strategies - Non-Regulatory Strategies	29 - 47
o	**References**	
o	**Appendices** - Appendix A - Map Inventory - Summary Report - Appendix B - Water Quality - Appendix C - Rare, Threatened, and Endangered Species - Appendix D - Straus Field Studies - Appendix E - Erosion and Sediment Control Standards - Appendix F - Sample Educational Fact Sheet - Appendix G - Non-Regulatory Land Management Strategies	

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ACKNOWLEDGEMENTS

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BACKGROUND

BACKGROUND

The Berry's Brook Watershed is a unique 5.9 square mile coastal ecosystem comprised of a 6.2 mile long stream with associated freshwater wetlands, an estuary and tidal marsh. Approximately 55% of the drainage basin is in the Town of Rye and 40% is in the City of Portsmouth (see **Figure 1 - Watershed Map**). The headwaters in the Town of Greenland comprise 5% of the Watershed. There is a very small portion of the Watershed in the Town of North Hampton.

During the 1970's and 1980's there was substantial residential and commercial development within the Watershed. The multifamily developments off of Lafayette Road and residential subdivision off Washington/Wallis Roads in Rye are examples. Concern about the continued growth in the Watershed provided the impetus for the formation of the Berry's Brook Watershed Protection Council. This group of local citizens from Portsmouth, Rye and Greenland came together to develop a watershed management plan that would balance the demands for development with the protection of sensitive resources in the Berry's Brook ecosystem.

The first task of the Berry's Brook Watershed Protection Council was to develop a series of resource maps of the Watershed. These maps were prepared by IEP, Inc. with a Coastal Zone Management grant using ARC/INFO, a computer-based map system software. This task was completed in 1992.

The Council's second task has been the preparation of this Watershed Management Plan in cooperation with Appledore Engineering, Inc. and Fugro-McClelland (East), Inc. This plan includes:

- An Inventory and Analysis of Watershed Resources;
- A Documentation of Existing and Potential Threats to the Watershed;
- A Build-Out Analysis to better determine the potential impact to the Watershed of full development; and
- An Action Plan that includes goals for the Watershed and a series of recommendations to implement the goals.

BERRYS BROOK WATERSHED

RYE, PORTSMOUTH, GREENLAND, NORTH HAMPTON N.H.

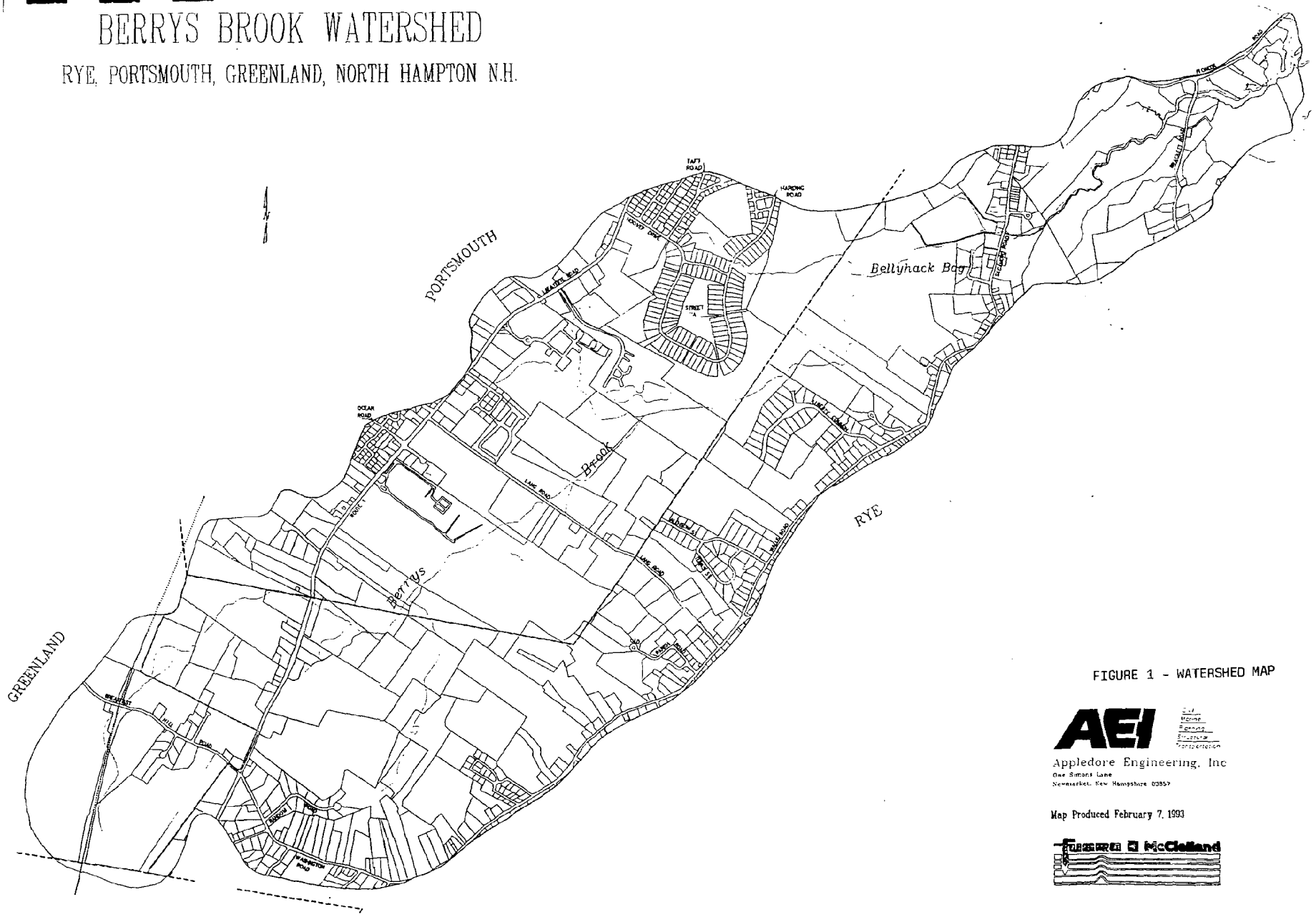

FIGURE 1 - WATERSHED MAP

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Map Produced February 7, 1993

Fuss & McClelland

INVENTORY AND ANALYSIS OF WATERSHED RESOURCES

Inventory and Analysis of Watershed Resources

Watershed Description

Berry's Brook Watershed comprises an area of 3,802 acres in four (4) seacoast communities -- Greenland, North Hampton, Portsmouth and Rye. The brook is 6.2 miles long beginning at its headwaters in the Breakfast Hill area of Greenland and flowing northeasterly along the Portsmouth - Rye border becoming Seavey Creek as the waters begin to mix with saline waters before discharging into Little Harbor near the bridge on Pioneer Road.

The Berry's Brook system is a relatively small but important estuary; one of many that border the Gulf of Maine. As an estuary it is a significant functional ecosystem because of the generic characteristics shared by all water bodies that join land and fresh water with the marine environment; they contribute basic nutrients to the marine environment, aid in dispersion of terrestrial derived wastes, provide habitat for uniquely adapted plants and animals, and act as a breeding and nursery area for many marine species.

Estuaries are also a valuable transitional area that contain species that are in evolutionary flux from the saline coastal waters to brackish waters. Important fisheries exist in many estuaries and, beyond the estuary itself, there are both nutritional and life stage links with coastal marine fisheries. All these recognized estuarine ecosystem values are found in Berry's Brook. In addition to these actual values, although slight in a global sense, estuaries have benefit as an instructional tool for the educational objectives that are part of this plan. While it is difficult to measure quantitatively the positive contributions of Berry's Brook to the Gulf of Maine and to the terrestrial watershed area it drains, it should be recognized for its long term value to the marine environment.

The Watershed is an area of great natural beauty and is a valuable ecosystem that contains an extensive wetland system that includes upland drainage, feeder tributaries, Bellyhack Bog, nine (9) potential Prime Wetland areas, an estuary and tidal marsh. At present, it is the most pristine watershed/wetland complex in the four-town area. It has a diversity and abundance of plant and animal species, including a number that are rare, endangered or threatened, such as the Atlantic white cedar. The Watershed offers great recreational opportunities from hunting and fishing to cross-country skiing, bird-watching and ice skating. There are also two (2) historic mill sites -- Seavey Mills 1 and 2 just below Sagamore Road.

The New Hampshire Coastal Resources Management Program (1979) and the Rye Master Plan (1985) have identified the watershed and its wetland system as an unusual coastal resource, because of the rare plant species found along the banks of the brook, such as spice bush and Atlantic White Cedar and the brook's sea run brown trout. The Portsmouth Open Space Plan (1972) has identified this area as one of several in Portsmouth "accorded high ecological values because they contain unique or significant ecological communities." The Conservation Master Plan for the Town of Rye (1978) declares that "the Berry's Brook - Bellyhack Bog ecosystem is the largest wilderness watershed in the Town of Rye".

Thus, by all accounts the Berry's Brook Watershed is a unique natural system. In spite of the recognition of this resource as a high quality ecosystem, there have been and continue to be, impacts from real estate development and inappropriate land use activities. These threats to the natural integrity appear to be associated with developments such as those along Lafayette Road, Lang Road and Liberty Common off Wallis Road, where watershed resources such as wetlands have been directly impacted.

For purposes of this study only Greenland, Portsmouth, and Rye were included in the inventory, analysis and action plan, since North Hampton has only a small amount of acreage in the southernmost portion of the Watershed.

Natural Resources

The following discussion is an inventory and analysis of the Watershed's natural resources, including: topography and slope; geology and soils; water resources (including wetlands); vegetation; and fish and wildlife. In 1991, IEP, Inc. conducted a natural resources map inventory of the watershed using the ARC/INFO geographic information system. Copies of these maps are located with community officials in Portsmouth and Rye. A description of these maps is found in **Appendix A** of this report. These maps are referred to in the Watershed description.

Topography and Slope

The Berry's Brook Watershed tends to be gently sloping with elevations that range from sea level to 151 feet at Breakfast Hill near the headwaters in Greenland. More significant topography is located in Rye and Greenland between the Portsmouth boundary and Breakfast Hill Road and Washington Road where the range is from 40 feet to 140 feet. Further down the Watershed are several areas of higher topography that also coincide with the roadway crossings. The first is at Lang Road where the elevations are between approximately 40 and 60 feet. The second is at Sagamore Road where the elevation is approximately 16 feet and the third is at Brackett Road where the elevation is between 10 and 12 feet. See **Map 7, Topography**, from the Berry's Brook Watershed Map Inventory.

This map also displays slope derived from the Soil Conservation Service (SCS) soil classifications. The most predominant category of slope is 0 - 3%, although there are significant areas of 3 - 8% slopes along the watershed boundaries near Breakfast Hill, Washington Road and Wallis Road. Another area of 3 - 8% slopes is between Brackett and Sagamore Roads. There are only a few areas of 8 - 15% slope, most of which are in the headwaters area near Breakfast Hill.

Land use limitations based upon slope usually begin when slope is between 12% and 15% and become more restrictive as slope increases. While the Breakfast Hill area has relatively significant topography, in general, slopes are not steep enough to limit development in the Watershed nor be considered as a resource that may require protection.

Geology and Soils

The Watershed area is generally composed of glacial and marine geologic deposits that overlay bedrock composed of granite and mica schists. The predominant deposits include stratified drift, unsorted glacial till, marine clays, and swamp deposits.

Each soil type in the Watershed reflects its derivation from one of these deposits. Thus, the poorly and very poorly drained soils are found associated with the marine clays and swamp deposits. The **Soils Map (Map 5)** from the Watershed Map Inventory was derived from the Rockingham County Soil Survey, interpreted for drainage class. This type of interpretation provides an indication of the moisture regime in the Watershed in supplementing (or replacing) a vegetative analysis or as an aid to determine wetland locations. The drainage classes also indicate the potential suitability for development; that is, the more poorly drained soils have greater limitations for development than the more well drained soils. **Table 1** summarizes the acreages of the various drainage classes as well as land use codes (eg., gravel pit), where soil interpretations were unable to be accomplished because of pre-existing land uses.

Table 1 Acreages and percentages of the Berry's Brook Watershed according to land use and drainage class.

Land Use/Drainage Class	Acres	Percent of Total
Urban Land*	429	11.3%
Gravel Pit	43	1.1%
Open Water	26	0.7%
Excessively Drained	558	14.7%
Well Drained	932	25%
Moderately Well Drained	59	1.6%
Poorly Drained	1161	30.5%
Fresh Water Muck and Peat (Very Poorly Drained)	524	13.8%
Tidal Marsh (Very Poorly Drained)	70	1.8%
Total	**3,802 acres**	**100%**

* These areas consist of lands that are covered by streets, parking lots and buildings. They are rectangular or irregular in shape and are 4 - 250 acres in size.

Source: Soil Conservation Service Soil Survey of Rockingham County, New Hampshire.

The soil drainage categories in order of predominance include:

- *Poorly drained* - these soils make up almost one third of the Watershed (1161 acres) and are generally associated with the lowland area adjacent to Berry's Brook between Sagamore Road and the headwaters of the watershed.

- *Well and moderately well drained* - These soils are associated with glacial till deposits. Taken together, these soils make up 26% of the watershed or 991 acres. Between Sagamore and Brackett Road these soils exhibit shallow-to-bedrock characteristics of the Hollis-Charlton soil type and are limiting for foundations and septic systems. The Sutton soil type, and those similar to it, are found in the transition areas between the poorly drained and excessively drained soils along Washington and Wallis Roads. Seasonal high water table may pose limitations to development.

- *Very poorly drained* - These soils include freshwater muck and peat (524 acres) and tidal marsh (70 acres). Poorly and very poorly drained soils generally constitute what the Soil Conservation Service considers hydric soils. These soils are often used as the basis for wetlands regulations in many New Hampshire communities, including Rye. Poorly and very poorly drained soils constitute almost one half (46%) of the watershed's soils. By including open water, 46.87% of the watershed may be considered "wetland".

- *Excessively drained* - These gravelly loam soils associated with stratified glacial drift are found along the ridgeline that constitutes the boundary of the watershed in Rye. These soils have exceedingly high permeability and tend to be the most suitable for development. However, problems should be anticipated from residential developments where the lots along the watershed boundary may be on well drained soils while back lots closer to the Berry's Brook or its associated wetlands may encounter seasonal high water table or poorly and very poorly drained soils. In addition, the rapid infiltration rates associated with these soils make groundwater susceptible to contamination from septic systems or roadway runoff.

The remainder of the Watershed -- 498 acres or approximately 13% -- is composed of either open water, urban land (particularly adjacent to Lafayette Road) and the Coakley gravel pit/landfill in Greenland.

Water Resources

The water resource or hydrologic system in the watershed is complex and due to the lack of specific, comprehensive data, only a qualitative analysis follows, based in large part upon the *Water Quality Management Plan for the Town of Rye* (Wright - Pierce Engineers, 1982).

Berry's Brook is a sluggish brook flowing through freshwater and tidal marshes for much of its 6.2 mile length. Its average fall is only 13 feet per mile as compared to the other streams in the area that fall at least 26 feet per mile. Its mean flow is estimated to be 1.8 cubic feet/second (cfs). This flow does not include the influence of the twice daily tidal flush that results in a significant flow of oceanwater into the lower reaches of the brook. Wright-Pierce estimated the fill volume (based upon water depth at high tide) to be 5.1 million cubic feet compared to Bailey Brook which has a fill volume of only 1.2 million cubic feet. Berry's Brook also has an estimated tidal flow of 470 cfs compared to Rye Harbor which has a tidal flow 111 cfs. The tidal flow in Berry's Brook is quite significant relative to other tidal streams in Rye and is far in excess of freshwater flows, thus providing significant dilution of pollutant loads. (Wright-Pierce, 1982).

Groundwater

Groundwater levels within the Watershed tend to approximate tide levels in the lower reaches of the watershed and streamwater levels in the lowland inland areas. In the upland areas it is believed that groundwater is bedrock controlled, although elevations are generally unknown except where there are larger sand and gravel deposits (stratified drift) along the ridge lines along Washington and Wallis Roads in Rye and along Lafayette Road in Portsmouth and Rye. In these areas, subsurface contours indicate depths of 40 to 80 feet to groundwater significance. See **Map 8, Aquifers** from the Watershed Map Inventory.

Although these areas are not used for municipal supplies and many of the Watershed's residents and businesses are on municipal water, the existing groundwater in the Watershed may be susceptible to impacts from leaking septic systems, or urban runoff that infiltrates into the soil. Sands and gravels tend to be more permeable than other soils and are particularly susceptible to contamination.

Floodplains

Floodplains are valuable because they have the ability to store flood waters during storm events. They are generally best left undeveloped, providing habitat for flora and fauna and potential passive recreation. Due to the relatively small size of the drainage area of the watershed, floodplains are confined to the tidal marsh areas at the lower reaches of the watershed and to the wetland and ravine areas adjacent to the brook itself in the inland areas.

Portsmouth, Rye and Greenland participate in National Flood Insurance Programs and have regulations that manage development in Zone A -- 100 Year Special Flood Hazard Area. Berry's Brook in Portsmouth and Rye is within Zone A. At present, however, the segment of Berry's Brook in Greenland is not in the 100-year floodplain.

In Rye, the undeveloped land in the 100 - year floodplain is also generally classified as wetlands and thus is strictly regulated by ordinance to ensure that only appropriate activities are allowed. Portsmouth, on the other hand, does regulate activities in the floodplain through a floodplain ordinance, but without a wetlands regulation it does not have the same degree of control over its floodplain areas.

Surface Water Quality

Berry's Brook is legally classified as a Class B water under RSA 485A:8, meaning that it is suitable for fishing and swimming. The water quality standards for Class B waters are found in **Appendix B**. Two critical parameters for Berry's Brook that determine water quality are: (1) dissolved oxygen (DO) which must be maintained at not less than 75% of saturation, and (2) Escherichia coli that must not exceed greater than 153 per 100 milliliters in any one sample. In tidal waters where the growing and harvesting of shellfish occurs the number of enterococci can not exceed 104 per 100 milliliters in any one sample.

The State of New Hampshire through the Water Supply and Pollution Control Division of the Department of Environmental Services conducts a statewide water quality sampling and analysis program. The closest stations to Berry's Brook are located in Little Harbor with two (2) on Frost Point (Odiorne State Park) and one (1) in mid-channel of the harbor near the breakwater. The water quality at these stations in 1977, based on total coliform, was of good quality -- consistently at or below 15 total coliforms/100 ml (at that time the standard was 70 total coliforms/100 ml). Subsequent monitoring has not been conducted.

In 1979, as part of the Water Quality Management Plan for Rye, a water quality sampling and analysis program was undertaken. The purpose of the program was, in part, to assess Rye's general surface water quality and to determine the impact of known potential point and nonpoint sources of contamination on surface water quality. Four (4) sampling stations were located in the Berry's Brook Watershed:

- Station 21 - in the estuary at Brackett Road.
- Station 22 - at Sagamore Road near Bellyhack Bog.
- Station 23 - off the main channel on a small tributary at the Liberty Common Subdivision.
- Station 24 - near Breakfast Hill Road in Greenland.

A summary of the results follows in **Table 2**. According to the Wright-Pierce report, total coliform concentrations generally exceed the standard for both fresh and marine waters in Berry's Brook, although the tidal water sampling station (#21) further down the brook indicates lower coliform counts than the other three fresh water stations. The report concludes that high total coliform counts are generally soil-based or naturally occurring rather than contamination from human sources.

Table 2 Summary of Water Quality Data, 1979

		Logarithmic Average (H/100 ml. Membrane Filter)					Arithmetic Average	
Station	No. Samples	Total Coliform	Fecal Coliform	Fecal Strep.	FC/FS	DO Sat. (%)	Nitrate (mg/l)	Total Non-Filterable Residue (mg/l)
21*	4	280	28	52	0.5	85	0.05	45
22	3	1,615	43	83	0.5	62	0.05	39
23	2	2,088	20	85	0.2	39	0.32	39
24	4	698	29	161	0.2	20	0.11	46
Totals	**13**	**757**	**30**	**88**	**0.3**			

For Comparison: (logarithmic averages)	Total Coliform	Fecal Coliform	Fecal Strep.	FC/FS
1976 Merrimack R. at Nashua	30,500	1,770	180	9.0
1976 Saco R. at Bartlett	50	10	18	0.6
1978 Androscoggin R. at Gorham	88,600	13,700	---	

* Indicates tidal water.

Source: Water Quality Management Plan, Town of Rye, 1982.

The brook also exhibits a dissolved oxygen (DO) deficiency from its source in Greenland to the tidal portion of the stream. At the time of the sampling in 1979, this condition was attributed in part to upstream beaver impoundments, that created a marsh environment, resulting in a DO deficiency. This condition was unable to be mitigated until the tidal estuary was reached, because of the slow moving, marshy environment in the freshwater portions of Berry's Brook.

The nitrate levels were relatively low and it was concluded that there appeared to be no significant contributions of effluent to the brook from human sources, such as septic tanks or failed septic systems. In addition, even at saturation build out, it was predicted that nitrogen loading to the brook would not be significant (Wright-Pierce, 1979). Wright Pierce concluded that the low dissolved oxygen levels, high suspended solids, moderately high and erratic total coliform densities, low fecal coliform densities and low FC/FS ratios are typical of small, sluggish streams with a preponderance of marshes such as Berry's Brook.

Since 1984, there has been a state interagency group (including the Department of Public Health, the Fish and Game Department and Water Supply, and Pollution Control Division) that has been monitoring the estuarine waters of the state to determine coliform and contaminant levels in sediment, water and shellfish. Several documents summarizing the results of bacterial contamination in shellfish waters have been published since 1987. Little Harbor is one of the designated areas that has been sampled and analyzed. There are four (4) stations in the Berry's Brook area: one at the Brackett Road crossing, one at the Pioneer Road crossing, one at Sheafes Point and a final one at the Little Harbor breakwater. See **Figure 1.** Results of this sampling and findings can be found in:

- o Interagency Report on the Shellfish Waters of New Hampshire, 1989,
- o Coastal Shellfish and Water Quality, August 1991,
- o Draft Report, Findings and Recommendations, Legislative Shellfish Committee, November 1992, and
- o Annual Sampling Summaries, Department of Public Health Services.

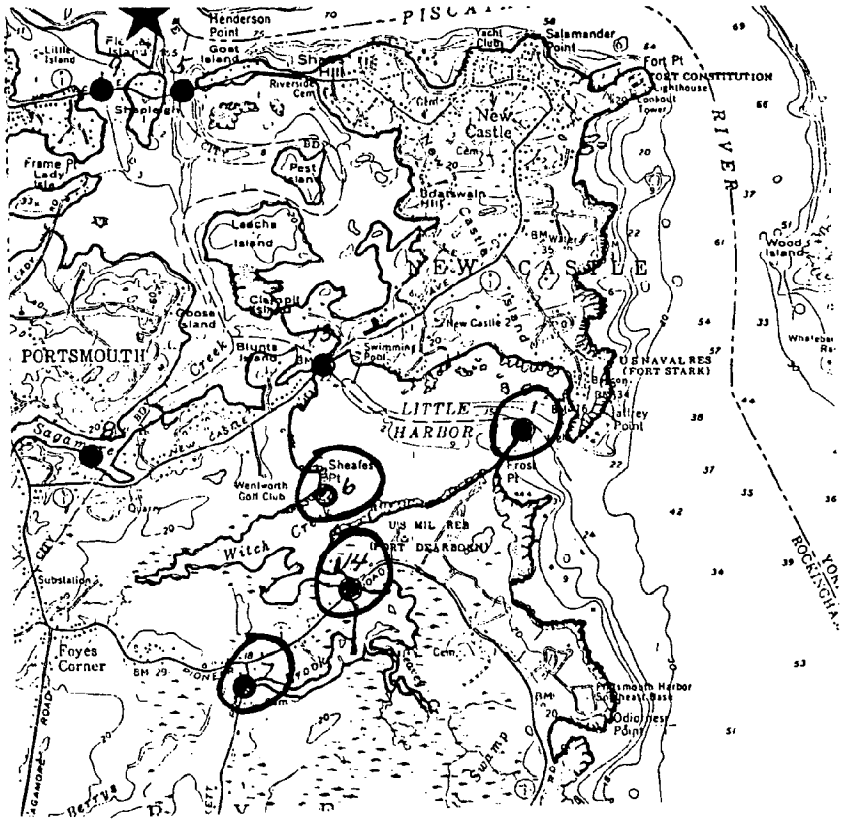

Figure 2 - Water Sampling Stations in Little Harbor Area
Source: Coastal Shellfish and Water Quality - Progress Report, 1992

In the original 1984 sampling, high coliform counts were discovered at the sampling stations in Berry's Brook. Given the available funding and the decision to concentrate on areas where there was expected to be more improvement in the water quality, the interagency shellfish group decided to eliminate the sampling stations in Berry's Brook.

These reports attributed much of the past water quality problems in the Little Harbor/Berry's Brook area to the Portsmouth Sewage Treatment Facility. In 1992, Portsmouth activated an advanced primary system that is expected to settle heavy metals and organic pollutants, thereby improving the water quality in the Lower Piscataqua and Little Harbor area. Other potential sources of coliform bacteria include marinas on a seasonal basis and unsewered locations in Sagamore Creek (Fish and Game, 1991).

The 1989 Interagency Report made several recommendations to improve water quality in shellfish waters that might lead to re-opening the shellfish beds: 1) initiate a sanitary survey and take appropriate actions to eliminate any failed septic systems, and 2) identify causes and sources of coliform problems due to nonpoint-source pollution. The Legislative Committee report recommends an expansion of the basic monitoring program, both in terms of the number of stations sampled, and also in terms of more frequent sampling.

A program that has been sponsored by the UNH Sea Grant Extension Program, called the Great Bay Watch, has been monitoring the water quality of the Great Bay Estuary and the Coastal Marine Laboratory in New Castle. Unfortunately, at this time, there are no stations in the area of Berry's Brook.

The quality of the surface water in Berry's Brook needs to be maintained at a Class B standard. Although the brook has been given this standard, past water quality monitoring has been inconsistent and needs to be conducted on a routine basis to provide a more accurate assessment of the key water quality parameters. In addition, testing for such parameters as heavy metals and organic compounds can provide a more accurate measure of the pollutants reaching the brook from urban runoff -- ie. streets, parking lots, commercial land uses, etc.

Wetlands

Berry's Brook watershed contains over 1,340 acres of wetlands or approximately 35% of the watershed based upon the wetlands map from the watershed map inventory conducted in 1991[1].

Using data from the Portsmouth and Rye wetlands maps, the wetlands in the watershed, were grouped on the basis of the predominance of certain plant communities and then aggregated onto a single map for the Watershed inventory. The wetland types were classified into seven general categories based upon the major characteristics and vegetative species likely to be encountered. These include: open water, scrub/shrub, forested wetlands, fresh marsh, tidal marsh, and mud flats. The emergent marsh and forested wetlands are further divided as seen in **Table 3**, and further described in **Appendix A, Map Inventory - Summary Report.**

The most predominant wetlands type is forested wetland comprising over 75% of the wetland community. The most abundant species in the forested wetland is red maple. Understory species include such tall, bushy shrubs as blueberry, northern arrowwood, and winterberry. Ground level species include skunk cabbage, cinnamon and sensitive fern. Typical coniferous species include: hemlock, white pine and Atlantic white cedar. These have been classified as a subset of the forested wetlands in **Table 3** and **Map 3, Wetlands**, from the Watershed Map Inventory.

The second most abundant type of wetland is the emergent marsh that comprises only 10% of the wetlands. The emergent marsh, usually characterized by very poorly drained soils, includes such species as: cattail, rushes, water lilies and a variety of sedges.

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1 These figures vary with the previous calculation for wetlands in the Geology and Soils Section of this report, in part, because different definitions for wetlands have been employed depending upon which method for wetland delineation has been used. For purposes of this wetlands discussion, the definition is based upon a modified version of the US Fish and Wildlife Service Wetland Classification System. Using the Soil Conservation Service definition of hydric soils, almost half of the watershed (46%) can be considered wetland (see previous discussion on soils). The wetlands of both Rye and Portsmouth have been mapped individually using the modified US Fish and Wildlife Service method -- Rye's through the Coastal Wetlands Mapping project sponsored by the New Hampshire Office of State Planning in 1986 and Portsmouth through its Wetland Delineation and Mapping Project in 1985.

United States Soil Conservation Service/Wetland Definition

Wetland Soils - Poorly and very poorly drained mineral and organic soils with the water table at or near the ground surface for seven or more months of the year.

United States Fish and Wildlife Service/Wetland Definition

Wetlands - are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface of the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Table 3 Acreages of the various wetland cover types identified within the Berry's Brook watershed.

Wetland Type	Acres	Percent of Total	
Forested Wetlands			
Deciduous	935	69.7%	
Coniferous	59.6	4.4%	
Atlantic White Cedar	8.3	0.6%	
Dead	5.8	1.4%	
			76.1%
Scrub/Shrub	118	8.8%	
Emergent Marsh			
Wet Meadow	22	1.6%	
Shallow	86	6.4%	
Deep	13	1.0%	
			9.0%
Open Water	23	1.7%	
High Salt Marsh	59	4.4%	
Panne	7.3	0.5%	
Mud Flats	4.7	0.3%	
Total	**1,341.7 acres**		**100%**

Sources: Coastal Wetlands Mapping Program, Normandeau Associates, Inc., NHOSP, 1986
Portsmouth Wetland Delineation and Mapping Project, IEP, Inc., 1985.

The Portsmouth Wetland Mapping Project identified 14 individual wetlands within the Portsmouth portion of the watershed. Of these 14 wetlands, it was determined that two -- BB-3 and BB-7 -- were suitable candidates to be designated as Prime Wetlands under NH RSA 482-A:15. BB-3 is a large system south of Lang Road and BB-7 is a large system north of Lang Road and east of Lafayette Road. The mapping project also identified these two (2) wetlands and a third -- BB-1 -- as three of the five most threatened in the City, because of nearby development or inappropriate land-use practices, such as inadequate treatment of runoff and erosion. The Berry's Brook Watershed Map Inventory identified another prime wetland candidate that was originally classified as a Packers Bog wetland -- PB-3. This wetland is actually within the Berry's Brook watershed and appears to be hydrologically connected with BB-1 and BB-2. Consequently, it would appear that this total system -- located to the west of Lafayette Road in the Coach Road area -- is not only valuable because of its prime wetland qualities, but also because it is one of the most threatened.

The Rye Coastal Wetlands Mapping Program, identified eleven (11) individual wetlands within the watershed. Of these, six (6) fulfill the definition of Prime Wetlands under New Hampshire law -- BE012 and BE014 through BE018.

The Watershed's wetlands (in Rye) are "in good condition and represent natural resources whose integrity should be preserved and protected." (Wright-Pierce, 1982). The Wright-Pierce report did not consider the wetlands in the Portsmouth and Greenland portion of the Watershed. While it appears that the wetland resources in much of the Watershed are in "good condition", there have been some significant direct impacts to wetland resources since 1982, eg. the Woodlands in Portsmouth. The major impacts have been associated with developments along Lafayette Road and subdivision developments along Washington and Wallis Roads. This type of development has degraded the quality of some of the Watershed's wetlands and needs to be more rigorously regulated in the future in order to better protect these resources.

Vegetation

The Watershed's natural forest vegetation consists of a variety of deciduous and coniferous species. The majority of these are associated with the wetland environment that constitutes a significant portion of the Watershed. Much of the Watershed is comprised of stands of deciduous forest consisting of primarily red maple (Acer rubrum). There are also scattered stands of white birch. Significant forest stands are located in: (1) the headwaters area, and (2) a large area that straddles the east-west border between Rye and Portsmouth, including an area referred to as the Parsonage Woods. These woods also contain other species, including white pine (Pinus strobus), hemlock (Tsuga canadensis), spruce (Picea rubens), and beech (Fagus grandifolia). (Reynolds, 1978).

Another large forested area adjacent to the brook begins at Lang Road and runs to Bellyhack Bog. Interconnected with this forest area is a stand that runs easterly across a Rye conservation commission parcel and town-owned parcel adjacent to the Rye Elementary School and then south through the Liberty Commons area across the Rand Lumber property to an area called Tahltan Woods. These tracts include lowland forests consisting of such species as red maple, red elm (Ulmus serotina) and some black birch (Betula lenta) and upland woodlands characterized by white pine, red spruce (Picea rubens), hemlock, beech, sugar maple (Acer saccharum), and yellow birch (Betula lutea). (Reynolds, 1978). These tracts are all second growth forests.

The Bellyhack Bog area is an extensively vegetated marsh that has a variety of plant species from emergent marsh to deciduous and coniferous forest species to a significant scrub/shrub wetland that includes tall and compact shrubs and tree saplings, such as speckled alder (Alnus rugusa), pepper bush (Clethra alnifolia) and red-osier dogwood (Cornus stolonifera).

The final segment of the Watershed is the area between Sagamore Road and the bridge at Pioneer Road. In addition to a complete array of saltwater marsh plants, the estuary area contains various forest species between Brackett and Sagamore Roads. After crossing Sagamore Road, Berry's Brook flows through an extensive hemlock (Tsuga canadensis) ravine forest before entering the marsh to the west of Brackett Road. This hemlock forest contains many mature old trees, and is very dense and shaded in character. Mixed in with the hemlocks are numerous white pine (Pinus strobus) trees. At the point where the stream leaves the hemlock forest and begins to enter the marsh estuary, numerous transitional species grow. Some of these include Atlantic white cedar (Chamaecyparis thyoides), white oak (Quercus bicolor), tupelo (Nyssa sylvatica), red cedar (Juniperus virginiana) and bayberry (Myrica pennsylvatica). (Reynolds, 1978).

The salt marsh area begins approximately half way between Sagamore and Brackett Roads and continues to the Pioneer Road bridge. It is dominated by salt tolerant species such as low cord grass (Spartina alterniflora) in the intertidal zone, salt hay grass (Spartina patens), and high marsh species including spike grass (Distichlis spicata) and blackgrass (Juncus gerardii).

As part of the vegetative cover mapping (see **Map 3, Wetlands**) for the original Watershed mapping project, Atlantic white cedar stands were specifically identified because of their inherent value and scarcity. These locations were taken from maps that were based upon field work conducted by Clotilde Straus between 1972 and 1975. Four (4) individual stands are located near Lafayette Road where Berry's Brook crosses at the Rye - Portsmouth boundary. Another stand has been identified off Lafayette Road in Portsmouth near one of the tributaries of Berry's Brook. Through easements, acquisition and regulation several stands in the Portsmouth area have been protected.

The New Hampshire Natural Heritage Inventory has listed the following rare plants known to be found within the boundaries of Portsmouth, Rye and Greenland and which are likely to occur in Berry's Brook watershed. Future field reconnaissance and studies should confirm the presence or absence of these species, since some may no longer exist (Straus, 1992).

- Chamaecyparis thyoides (Atlantic White Cedar)
- Salicornia begelowi (Dwarf Glasswort)
- Iris Prismatica (Slender Blue Flag)
- Agalinis maritima (Salt-marsh Gerardia)
- Melampyrum lineare var. latifolium (Cow-wheat)
- Malaxis unifolia (Green Adder's-mouth)
- Campanula uliginosa (Greater Marsh-bellflower)
- Equisetum variegatum (Variegated Horsetail)

The Watershed is rich in its diversity of natural vegetation, much of which is an integral part of the Watershed's wetland ecosystem. Many of these species are "threatened or rare" and have been subject to impacts from previous developments, such as those cited in the preceding wetlands section. These resources need to be protected in order to sustain the integrity of the vegetative and wetland environment of the Watershed.

Fish and Wildlife

The mix of fresh and salt water environments in Berry's Brook provide a rich habitat for a variety of fish and wildlife. Sea run brown trout are found in the brook from the estuary up to Bellyhack Bog. The New Hampshire Fish and Game Department annually stocks this stream with up to 7,000 anadromous fish. Other trout are also found in the brook, including rainbow and brook trout. These species are not stocked.

The Fish and Game Department has initiated an angler survey program to obtain better data on the amount and size of brown trout caught or taken from the brook to monitor the success of the stocking program. Survey cards are placed in a box on Brackett Road where the brook crosses. In addition, there are oyster beds from the estuary up to the area near Brackett Road, although all beds have been closed for the past five years.

The Fish and Game Department also keeps trapping records by town and city throughout the state. Based on an analysis of these records, there appears to be a diversity of wildlife in the watershed area. However, this conclusion is based upon interpretation of the data by municipality, not for the Watershed. Based upon these records, populations of beaver, otter, mink, muskrat, racoon, fisher, weasel, gray fox and red fox are likely to be found in the watershed. Furthermore, the towns of Rye, Greenland and North Hampton have the highest density of deer of any communities in the state. This density is due in part to the milder climates of the Seacoast area and relatively light hunting pressure as well as the diversity of habitat, such as is found in the watershed. Because the deer habitat is so extensive on a year round basis, the State Fish and Game Department has not identified specific deer wintering yards. However, it is common for deer to winter during periods of deep snow in coniferous -- especially hemlock -- stands. There are several of these in the Watershed. See the Watershed Map Inventory **Map 3, Wetlands and Vegetative Cover.**

There is also a variety of song, shore and migratory birds, waterfowl and ground nesting birds in the Watershed. The migratory birds and the combination of wetlands and upland habitats provide food and cover. The variety of birds is also the result of the large undisturbed acreage available in the watershed. Critical habitat size for the species typically found in the Watershed is between 500 - 1,000 acres.

The Audubon Society of New Hampshire has identified a number of threatened and endangered wildlife species of known or potential occurrence in the Watershed. Endangered species include: banded bog skimmer, shortnose sturgeon, common tern, upland sandpiper, bald eagle, peregrine falcon, sedge wren and Henslow's sparrow. Threatened species include: least tern, arctic tern, roseate tern, Cooper's hawk, northern harrier, osprey, common night hawk and purple martin. Species of special concern include: American brook lamprey, Jefferson salamander, Blandings turtle, least bittern, red-shouldered hawk, eastern screech owl, vesper sparrow and New England cottontail.

The New Hampshire Natural Heritage Inventory has listed the Orchard Oriole (Icterus spurius) as a rare animal species known to be found within the boundaries of Portsmouth, Rye and Greenland and which is likely to occur in Berry's Brook watershed. The complete list of species and explanations are found in **Appendix C, Rare, Threatened and Endangered Species.**

Dr. Clotilde Straus, Portsmouth City Arborist, has also conducted field studies in the Watershed for rare and valuable plant species. The results of this work are included in **Appendix D.**

Analysis of Land Use Regulations

Rye

The land that is still vacant or open in the Watershed in Rye is generally zoned either as Single Residence or General Residence. Both districts require at least 44,000 square foot lots with a coverage of no more than 30%. The Single Residence District is somewhat more restrictive requiring a deeper front yard (40 feet compared to General Residence of 30 feet). The General Residence allows 2 - family dwellings as long as the frontage and depth are at least 200 feet and the lot area is 88,000 sf.

Along Washington and Wallis Roads there are several small Business and Commercial zones. These districts require 44,000 square foot lots. In the Business District lot coverage cannot be more than 40%. In the Commercial District lot coverage can be no more than 75%. There is also a Historic District along Wallis Road in the Rye Center area. There is a significant Commercial District along both sides of Lafayette Road which encompasses property that could be developed for commercial use.

Regulations directly concerned with natural resource management and protection include the Wetlands and Flood Hazard Overlay Districts. The Wetlands District, based upon Soil Conservation Service poorly and very poorly drained soil categories, encourages conservation and protection of the town's wetland resources allowing only such uses as forestry, agriculture and passive recreation. Permanent structures are generally not permitted. In addition, there is a 100-foot buffer from tidal marshes, perennial streams and freshwater marshes that prohibits dredging and filling, septic systems and permanent structures. The ordinance also is very restrictive in terms of forest management and tree cutting.

The Town has also implemented a Flood Hazard District that corresponds with the FIRM 100-year flood plain. These regulations in effect allow development in flood plains as long as certain building standards are met.

The Town's Land Development (subdivision) Regulations, adopted in 1988, contain "Standards of the Preservation of Natural Features and the Environment" that encourage protection of wetlands, woodlands, historic resources, open areas for recreation, and groundwater protection. In addition, the regulations require adherence to the design practices for erosion and sediment control as outlined in the Soil Conservation Service's *Erosion and Sediment Control Design Handbook for Developing Areas of New Hampshire* (1981). Furthermore, the Planning Board may request "minimum lot size by soil classification", a provision that requires High Intensity Soils Mapping for a proposed subdivision. Minimum lot size based on this mapping is intended to ensure no degradation to water quality from septic systems. The Planning Board recently adopted the updated model soil-based lot size regulations published by NH DES (1991). In some instances, poorly drained (wetland) soils may be used as part of the lot size calculation.

This provision is a change from former regulations that did not allow any wetland soils to be used in a minimum lot size calculations.

In short, it would appear that Rye's Zoning Ordinance and Land Development Regulations are generally adequate to protect the Watershed from inappropriate development. Some updating of standards to minimize environmental impact from development should be considered; otherwise, the challenge for the town is to ensure that the regulations are properly enforced.

Portsmouth

Land within the City of Portsmouth portion of the Watershed that is still available for development includes land zoned for residential, commercial and industrial land use (see Watershed Map Inventory, **Map 2, Municipal Zoning**). In the northwestern portion of the watershed (generally in the area of the Woodlands development), there is available land in the SR I and II Districts. Along the eastern border with Rye, in addition to the SR I district there is also land available in the Rural Residential District. In addition, there is land available in the Commercial and Mobile Home District east of Lafayette Road and south of Hillcrest Estates to the Rye border. There is also vacant land west of Lafayette Road in the Coach Road area that is within the Industrial and Rural Districts.

The Single Residence (SR) I and II Districts and rural districts generally permit single family homes and accessory uses. The following table presents lot size and cover requirements for each of these districts:

District	Minimum Lot Lot Size	Maximum Building Coverage (%)	Minimum Open Space (%)
SR I	1 Acre	10	50
SR II	20,000 sf	20	40
Rural	5 Acres	5	75

The Industrial District permits a variety of business and institutional uses. It requires a 2-acre minimum lot size with a maximum building coverage of 50% and a minimum open space of 20%.

Two city-owned lots comprising 54 acres between the Beechstone and Springbrook developments constitute a Conservation District. The Conservation District permits only tree farms and forestry; wildlife refuges; parks and play grounds; and nature trails and horse riding areas.

The City has adopted a Floodplain Development Ordinance as part of the Zoning Ordinance that applies to all lands within the special flood hazard area as indicated on the FIRM maps -- 100-year flood plain. These ordinances regulate development in floodplain areas to ensure that additional flooding does not result and that the structure is properly sited and constructed to be flood proof.

Portsmouth does not have a natural resources overlay district, such as a wetland ordinance, although a draft ordinance is currently being developed.

Portsmouth's subdivision regulations for residential development may require natural feature protection; buffer strips of at least 50 feet around surface waters, wetlands or other natural features; and park dedication. The regulations provide for a plan for "minimizing soil erosion and sedimentation during construction and operation of the proposed development". These regulations provide general guidelines for the plan, but do not, at present, reference any design handbooks or manuals as a guide to developers for generally accepted practices to minimize impacts from storm runoff, erosion and sedimentation.

Portsmouth has also developed a rigorous set of Site Review Regulations for all developments except small commercial, industrial or residential activities, i.e., less than five (5) dwelling units. These regulations are set up as a community impact analysis for traffic, utilities, schools, fire, site drainage, noise, flood hazards, and natural features. There are also standards for pedestrian circulation and screening and landscaping. This approach to regulating development is generally commendable, although it appears as though the standards for protection of natural features are rather weak since impacts are to be avoided "whenever possible". There are no specific standards to be met.

These standards and regulations are administered, in the first instance, at a minimum, by the Site Review Technical Advisory Committee, comprised of representatives of all City Departments concerned with development. The Chairman of the Conservation Commission sits as a voting member of the Committee. The TAC makes recommendations as to conditions contingent on approval to the Planning Board which, as a rule, follows them.

Portsmouth's land development regulations need to be significantly improved in the area of natural resource protection, especially standards for stormwater management, erosion and sediment control, and wetland protection. It should be noted that, at the time this Management Plan is being written, the Zoning Ordinances and Site Review Regulations are in the process of revision and it can be expected that many matters now unwritten will be addressed and codified.

Greenland

Within the Berry's Brook Watershed land is only zoned Residential. In this district the minimum lot size is 60,000 square feet of which at least 45,000 square feet must be contiguous non-wetland soil. Wetland soils are defined as poorly and very poorly drained soils, as determined by using high intensity soils mapping. There must also be a minimum lot frontage of 200 feet and minimum setback of 30 feet.

The subdivision regulations contain a provision to minimize soil erosion and to require developers to provide an erosion and/or sedimentation control plan. Any erosion control plan required by the state shall be made available to the Planning Board. The town also has stringent standards for septic systems. In addition to meeting state standards, the town requires vertical distances from the bottom of each leach field to be:

	Vertical Distance
Seasonal High Water Table	4 feet
Hard Pan Layer	4 feet
Bedrock	8 feet
(6 feet with community or municipal water supply)	

In addition, the town requires 18 inches of natural permeable soil above seasonal high water table for leachfields and four feet of natural soil above bedrock.

Greenland's Site Plan Review Regulations are rather perfunctory and provide little or no standards for development.

Because of its large lot zoning that requires large areas of non-wetland soil and stringent septic system regulations, Greenland's land use regulations are generally protective of water quality in the watershed. However, the large lots may have significant negative impact on other watershed resources, such as wildlife habitat. The town has no natural resource protection overlay districts, such as for wetlands, that might provide greater overall watershed resource protection.

THREATS TO WATERSHED RESOURCES

Existing and Potential Threats to Watershed Resources

There are a number of existing and potential threats to the quality of surface waters, wetlands and wildlife habitat within the Berry's Brook Watershed. In general, these pollution sources are considered to be nonpoint-source pollutants. Examples of sources that may affect the Watershed include:

- o Runoff from streets and parking lots, that may contain bacteria, heavy metals, hydrocarbons, sediments and suspended solids;
- o Stormwater runoff that may contain pesticides, herbicides and fertilizers;
- o Inappropriate road salting and storage practices, such as spreading large quantities of salt unnecessarily or not covering salt storage piles;
- o Soil erosion and sedimentation from improperly controlled construction practices;
- o Leaking underground storage tanks;
- o Failing septic systems;
- o Direct application of mosquito - control chemicals, and
- o Impacts from marine-related activities.

Some of these threats have been documented for the Watershed while others are suspected and may need further investigation.

In 1991, the Rockingham Regional Planning Commission conducted a pollution source mapping project that included Portsmouth, Rye and Greenland. The report was limited to the following types of threats: mining, storm drains, combined sewer overflow, sludge/seepage disposal, salt storage piles, snow dumps and pesticide application sites. Therefore the listing below should not be considered a complete list. In the Berry's Brook watershed only storm drains were identified as threats. The potential threats identified in this report are as follows:

Location	Type of Threat
Rye Junior High School Washington Road	Storm Drains, Drain into Wetlands
Breakfast Hill Common Washington Road/Route 1	Storm Drain
Beechstone Apartments Lang Road/Lafayette Road	Storm Drain, Drains into Wetlands

Location	Type of Threat
White Birch Plaza	Storm Drain
Lafayette Road/Heritage Avenue	
Southgate Plaza	Storm Drain, drains into wetland area
Lafayette Road	across Lafayette Road

Source: Pollution Source Identification, RPC Region, Phase I, 1992.

The junior high school and Breakfast Hill Common are considered to be minor or insignificant threats to the water quality of the Watershed. They are relatively small in area and are not adjacent to a permanent surface water tributary to Berry's Brook.

Other threats to the Watershed's resources were identified by Council members. These include some of the above in addition to:

- Ralph's Truck Sales at the intersection of Lafayette Road and Lang Road for storage of potentially hazardous materials.

- Hillcrest Estates Mobile Home Park on Lafayette Road. This park is adjacent to a wetland area which is a candidate for Prime Wetlands (BB-3) designation as identified in the Portsmouth Wetland Mapping project. There has been incremental encroachment into wetland areas as the park has expanded.

- Beechstone Apartments, Spring Brook Condominiums and the Woodlands. The Beechstone Apartments are prevented by agreement with the City to expand towards Berry's Brook. However, the Springbrook Condominiums have available land for expansion. These developments have encroached upon a Prime Wetland candidate (BB-7). The Beechstone Apartments and the Cedars Condominiums were among several sites that were field investigated in the spring of 1993. At the Beechstone, it was observed that at least one parking lot stormwater drain discharges directly into a wetland area. This type of situation could be mitigated through a minimal change to the stormwater runoff design that provides for a small detention area to trap sediments. Similarly at the Cedars, there is at least one area where stormwater from a parking area discharges directly into one of the large detention ponds without being filtered through a vegetative buffer. As a result, sediment has collected in the near shore waters of the pond. Current practices, such as those observed at the Beechstone and Cedars can pose a cumulative threat to the Watershed's resources. Further observation and analysis of existing stormwater management and erosion and sediment control practices should be considered.

- The Coach Road area west of Lafayette Road near the Rye boundary is a potentially serious threat to the Watershed's resources because the area is zoned for industrial uses. As noted in the wetlands section, this area has a rich diversity of wetland wildlife and forest resources, such as upland hemlocks and Atlantic white cedars. The wetland area is a Prime Wetland candidate BB-1 that is associated with both BB-2 and the wetland that has been identified in the Packers Bog Watershed as PB-3 -- also a potential Prime Wetland.

- Habitat fragmentation - the rapid and dense development within certain portions of the Watershed, especially along the Lafayette Road corridor has resulted in loss of valuable wildlife habitat. This development has had an impact on the Watershed's resources by reducing the land area that provides food, nesting and breeding habitat and travel corridors for wildlife.

- The Coakley Landfill Superfund Site in North Hampton is just outside the topographic boundary of the Watershed. It is currently under investigation as a Superfund Site. In 1988, a remedial investigation and feasibility study was conducted that identified contamination at the landfill and the fact that contaminants including volatile organic compounds (VOC's), heavy metals and nitrates were migrating to the northwest of the site. This area includes wetlands at the headwaters of Berry's Brook in the Breakfast Hill area in Greenland. At present there are monitoring wells at the northwest, southwest and Route 1 portions of the site that have been sampled on a periodic basis. In 1989, representatives from NOAA investigated the Breakfast Hill wetland areas and were not concerned about the potential impact. The EPA has recommended that the landfill be capped and that a program to pump and treat the groundwater for up to 10 years be implemented. At present, consultants for the PRP's (Potentially Responsible Parties) are conducting investigations of the site. The consultants will document results of the studies and provide recommendations for remediation in a report to be completed in the fall of 1993.

To date there appears to be no definable impact to the water quality of Berry's Brook. The existing release of contaminated waste is being addressed through the Superfund remediation process. However, the Council should continue to monitor the progress of the remediation program. A final "feasibility study and proposed plan for remediation" is due to be made public by late fall of 1993. The Council should be prepared to respond to this report.

- The former Rye Landfill - is located within the Watershed near the headwaters just west of Lafayette Road and south of Breakfast Hill Road. It is an approximately 6-acre site that was closed in 1986 and capped in 1987 with six inches of loam and a clay cap. There are eight (8) monitoring wells of which three are wet. The wells have been monitored regularly, since the facility was closed.

All water quality parameters are below EPA guidelines for contamination. This site does not appear to pose a threat to the water quality of Berry's Brook nor the sensitive natural resources of the Watershed.

In addition, there are several areas within the Watershed that are subject to development that pose potentially serious impacts to the Watershed because of large size and/or nearness to Berry's Brook or its contiguous wetlands. These include:

1. The headwaters area west of Lafayette Road, that includes both residential and commercial zones; in Greenland (where much of the land is owned by Seawall and Ciborowski) and in Portsmouth (where much of the land is owned by Ciborowski).

2. Two areas in the southern portion of the Watershed east of Lafayette Road, including one in Rye (owned by Ciborowski) and one in Portsmouth between the town boundary and the Hillcrest Mobile Home Park.

3. A residential area in the southeast portion of the watershed in Rye adjacent to Washington Road near the Webster Nursing Home.

4. Several residentially-zoned areas off Lang Road in both Rye and Porstmouth, also including a portion of the Rand property.

5. A residentially zoned area in Portsmouth that includes the Cavaretta property.

6. Two large residentially-zoned parcels on either side of Brackett Road in the lower portion of the Watershed.

These areas are categorized as Developable Lands on the **Watershed Management Plan Map** that is part of this report.

WATERSHED BUILD-OUT ANALYSIS

Watershed Build-Out Analysis

A build-out analysis is a useful technique to determine the potential number of new residential dwelling units and maximum commercial/industrial square footage that can be built in a given area, such as a municipality or watershed. By using a parcel map, property owner information, an existing land use/land cover map, and a municipal zoning map and ordinances, the amount of developable land can generally be determined. However, the accuracy of this analysis is based to a great extent on the accuracy of the data that is available.

The build out analysis for Berry's Brook Watershed included portions of three municipalities--Greenland, Portsmouth and Rye. The following maps were used from the Watershed Map Inventory: the Parcel Map, the Zoning Map and the Hydric Soil coverage from the Soil Map. The only other information that was required was land use/land cover. Since there was no recent mapping of this information, the Portsmouth Planning Department conducted a windshield survey that was verified by Watershed Council members. Therefore, while most of the Map Inventory information in this analysis is reasonably accurate, the land cover information should be considered in light of the manner in which it was prepared.

By combining the above maps into a composite map, the gross areas of available land was determined. This determination was based upon the following methodology:

1. All areas of very poorly drained soils and known critical resource areas, such as Atlantic white cedar stands, were eliminated from consideration.

2. Areas that were relatively small and/or not accessible to roadways were generally discarded on the assumption that they would be unlikely to be developed. For example, there is a small portion of the Trefethen property in Rye on the Portsmouth boundary that was not considered developable, because it is cut off from access by a significant amount of very poorly drained soils.

3. All publicly owned parcels were eliminated from consideration.

For the remaining potentially developable areas the following procedure was used to determine the amount of available acreage.

1. The area of each potentially developable area was calculated.

2. For each area, approximately 15% of the total acreage was deducted to account for any critical on-site resources, such as wetlands, and interior subdivision roadways.

3. Using the Watershed zoning map, the remaining acreage of each undeveloped area was categorized as residential or commercial/industrial and density calculations were prepared for each. This resulted in either potential new residential units or potential commercial/industrial square footage for each area. These individual areas were then aggregated for each community and totalled for the Watershed as shown in **Table 4.**

Table 4 - Potential Watershed Build Out

	Residential Units	Acres	Commercial/Industrial Space(sf)	Acres
Greenland	100	150+	NA	NA
Portsmouth	290*	175	220,000	265
Rye	350	410	1,300,000	95
Total	**740**	**735**	**1,520,000**	**360**

* Includes 100 mobile home units.

In spite of the fact that much of the Watershed is developed and that much of the watershed is classified as very poorly drained soils, there is still a significant potential for additional residential and commercial/industrial growth. These numbers only serve to indicate the relative potential for future growth since the analysis relies upon existing generalized land use data. In addition, these numbers may be modified downward, since poorly drained soils in Rye, included in its Wetland Overlay District, were not totally eliminated from consideration.

ACTION PLAN

Watershed Goal and Policies

Goal

Protect the unique natural inland and coastal resources of the Berry's Brook - Bellyhack Bog drainage basin and the Berry's Brook - Little Harbor estuary within an inter-municipal management framework that allows for appropriate development and recreational use.

Policies

1. Protect and enhance the quality of surface and ground water resources within the Berry's Brook Watershed through sound land use policies, regulatory enforcement, public education, and proper infrastructure maintenance and improvements.

2. Protect open spaces that have significant scenic, recreational, wetland, water, wildlife, fishery, and/or rare and endangered species value through acquisition, easement, or some other means.

3. Promote appropriate public access and recreational opportunities within designated portions of the Berry's Brook Watershed.

4. Preserve and protect critical fish and shellfish resources, wildlife habitat and migration corridors, and rare and endangered species through proper management and regulation.

5. Identify and protect environmentally sensitive natural resource areas including rivers and streams, shorelands, the estuary, coastal and inland wetlands, floodplains, and aquifer recharge areas.

6. Direct new development away from environmentally sensitive areas through proper land use regulation.

7. Minimize the negative impacts of existing and proposed development on surrounding natural, scenic, open space, and passive recreational resources.

Watershed Management Strategies

While much of the Berry's Brook Watershed is developed, significant land remains available for development. In addition, there is a potential for redevelopment of some existing uses, especially the commercial uses along Lafayette Road. The watershed management strategies presented below address impacts from existing and future development activities, as well as provide opportunities for public use of the Watershed's natural resources.

These strategies can be broken down into two general categories--regulatory and non-regulatory. Regulatory strategies that are suitable for the Watershed include:

- zoning;
- subdivision regulations;
- site plan review regulations;
- wetlands and groundwater protection;
- erosion and sediment control;
- stormwater management;
- wastewater management; and
- hazardous materials management.

The first four strategies listed above deal primarily with controlling future land uses within the Watershed, while the remaining four deal with controlling potential sources of pollution from both existing and future land uses.

Non-regulatory strategies for the Watershed include:

- land acquisition,
- conservation easements,
- current use taxation,
- transfer of development rights, and
- public education and information.

The implementation of a mix of these management strategies is critical to the long-term protection of the Watershed's water and wetland resources. To the extent possible, these strategies should be addressed and implemented as a fully integrated package in order to provide the highest level of protection and management of the Watershed's resources.

A number of these strategies are consistent with the goals of existing and updated master plans. For example, Portsmouth has recommended the adoption of a wetland ordinance in furtherance of its Master Plan goal to "continue to protect the function of natural resources through innovative zoning techniques." In addition, Rye and Portsmouth have protected open space and critical natural resource areas through acquisition, e.g. the Adams property along Berry's Brook, and conservation easements, e.g. the areas surrounding the Woodlands Development. Thus, the strategies presented here are meant to reinforce, and expand upon, some of the activities that the Watershed communities have already begun.

As a part of the Action Plan for the Watershed, **a Watershed Management Plan Map** was prepared that identified various management areas including, Protected Resource Areas, such as high salt marsh and publicly owned lands; Resource Management Areas, such as poorly drained soils and parcels with high resource value; Public Access Areas; and Developable Lands. Many of the recommended management strategies that follow are included graphically on this map.

Regulatory Strategies

Zoning

Issue: Regulatory protection for the Watershed's resources is fragmented among three communities--Greenland, Portsmouth, and Rye. While there is state jurisdiction through a permit process over certain activities in wetlands (NH RSA 482-A) and significant alteration of terrain (NH RSA 485A:17), the primary control for development is at the local level. Each community has varying degrees of control over activities that might impact the Watershed's natural resources and quality of the water in Berry's Brook. Rye is the only community to have a natural resource protection zone -- a Wetlands Ordinance and a Conservation District that includes the salt marshes adjacent to the lower end of Seavey Creek adjacent to the Watershed. Portsmouth has several Conservation Districts in the watershed and several Rural Districts that require large lot zoning (5-acre lots). Portsmouth is also currently considering the adoption of a wetlands district. Greenland relies only on large lot zoning--60,000sf--as a means to protect watershed resources.

Discussion: Zoning regulates the use and density of land development by establishing minimum building lot sizes, maximum lot coverages, and setback distances from property boundaries, streets, and sensitive resource areas (i.e., estuaries, wetlands, streams, or other water bodies). Controlling future land use is clearly an important element of protecting the Watershed's sensitive natural resources and the quality of Berry's Brook. Although there is no established minimum lot size which assures the protection of water quality, it is generally accepted that lot sizes based upon the potential impact to critical natural resources, when coupled with appropriate site development guidelines, provide better water quality protection.

While there has been a reliance on large lots, i.e., greater than one acre, as a means to protect natural resources, a more suitable approach is to ensure that the overall density within a given area be compatible with the ability of the environment to sustain given types of development. This approach can usually be accomplished through a more flexible zoning technique, such as cluster or open space zoning. In essence, this option allows higher density on land within a large parcel that can accommodate such an increase, while providing areas of open space where the land is more sensitive. The overall density of the parcel remains the same as the underlying zone. In addition, any such changes to the zoning density should be accompanied by appropriate coverage and setback requirements to ensure protection of any adjacent sensitive resource areas. When zoning regulations are designed in a manner which considers the land's capacity to attenuate nutrients and other pollutants, flexible zoning can be one of the most effective tools available to a community to preserve critical natural resources.

In addition, there are a number of options for protection of specific natural resources through the use of overlay districts that in effect overlay the existing underlying zone while affording additional protection to a particular resource. Commonly adopted overlay zones include: watersheds, wetlands, slopes, and shorelands. Rye has already adopted a Wetland Ordinance. The New Hampshire Office of State Planning has prepared a *Model Shoreland Protection Ordinance* (1993) for use by local communities.

Recommendations:

1. Base any future zoning changes upon the capacity of the Watershed's land and water resources to accommodate development.

    a. Cluster/Open Space Development

    Each of the communities in the Watershed should adopt a cluster or open space development option where the overall residential lot densities are equal to, or greater than, 40,000 square feet. If adopted, the original residential zone setback dimensions, etc. could remain the same.

    b. Increased Lot Size

    Portsmouth should consider rezoning the SR II zone that is within Berry's Brook Watershed to SR I, thus making the minimum lot size 40,000 square feet. Where site conditions dictate and/or where sewer is available, density may be increased through the cluster option.

2. Adopt and implement a Watershed Protection District for the protection of the Berry's Brook/Little Harbor Watershed. This district would establish specific land use controls for residential and nonresidential areas within the watershed. The overlay district would be established as a Watershed Protection District provision within local zoning ordinances, under the authority of NH RSA 674:21.

   An ordinance of this kind may:

   - Define the boundaries of the District to include all land draining to Berry's Brook to the greatest extent possible. For regulatory purposes, the district boundaries should be easily identifiable, or legally defined, landmarks, such as roads or town boundaries.

   - Permit, only by special exception, any non-residential land use which involves the usage or storage of hazardous materials, herbicides, pesticides, or fertilizers.

   - Consider the development and implementation of a resource-based land use allocation model for the Watershed that is based on the assimilative capacity of Berry's Brook. For example, see *Phosphorous Control in Lake Watersheds: A Technical Guide to Evaluating New Development*, Maine DEP, 1989 or *Model Subdivision Regulations for Soil-Base Lot Size*, NHDES and Rockingham County Conservation District, June 1991.

   - Include provisions for shoreland protection that use the *Model Shoreland Protection Ordinance* prepared by the NH Office of State Planning, January, 1993 as a source document. Within a defined shoreland area consider the prohibition of certain commercial uses--such as gas stations that are currently permitted in Rye's commercial district--which may cause significant impact to the Brook. The **Watershed Management Plan Map** includes a 250-foot buffer zone around the Berry's Brook and its tributaries to identify those areas where such provisions may be appropriate.

Subdivision/Site Plan Review Regulations

Issue: Portsmouth's subdivision and site plan review regulations generally lack specific standards for protection of the Watershed's sensitive natural resources. Greenland's subdivision regulations have strict standards for septic systems, but lack specific standards for protection of the Watershed's resources. Greenland's site plan review regulations provide minimal standards for development. Rye's subdivision and site plan review regulations are generally appropriate for managing development in the Watershed, but the guidance document cited for managing erosion and sedimentation from new development is outdated. Furthermore, in some instances planning boards have approved plans with conditions for open space and conservation areas, but these conditions have not been legally recorded as part of the deed in the county registry of deeds.

Discussion: Subdivision regulations constitute an important means of local control over the quality of proposed multiple lot/commercial-industrial developments in each of the Watershed communities. These regulations establish:

- o provisions for the local review of preliminary and final subdivision plans; and;
- o design standards for subdivisions.

Within these regulations, standards for erosion and sediment control, stormwater management and open space set asides may be established to protect sensitive Watershed resources. Further discussion of some of these standards follow this section.

Recommendations:

1. Revise each community's subdivision/site plan review regulations to incorporate the following provisions:

   - o specify that an Environmental Impact Review (EIR) may be required, and
   - o require a claim of "no adverse phosphorous, nitrogen, or coliform impacts to Berry's Brook". To substantiate this claim, the regulating board may conduct a technical review by a consultant of its choice.

These provisions should apply to any proposed subdivisions greater than five acres or site plans for a commercial/industrial use greater than 50,000 square feet of gross floor area (Portsmouth' Site Review Regulations already generally conform to these threshold criteria)

2. Revise each community's subdivision and site plan regulations to incorporate standards for erosion and sediment control and stormwater management, as outlined in subsequent sections.

3. Consider the adoption of a regulation that requires a cutting plan for any cutting/ logging activity within the Watershed that directly impacts 40,000 square feet or more, whether for purposes of timber sale or new development.

4. Each community's subdivision and site plan review regulations should provide for the option of conducting a technical review at the expense of the applicant for any proposed activity that might have an adverse impact on the sensitive resources, such as critical wetlands, of the Watershed. Such a review should be conducted by a recognized authority, such as a certified civil engineer, certified soil scientist, certified wetland scientist or expert natural scientist.

5. Ensure that any conditions of subdivision or site plan approval, that set aside property for open space or conservation, be legally recorded as part of the deed at the Rockingham County Registry of Deeds.

Wetlands Protection

Issue: Wetlands, both tidal and fresh water, are resources that provide many valuable functions, including the removal of sediments, nutrients, and other potential pollutants from stormwater runoff and other overland flows to Berry's Brook. In addition, the wetlands of the Watershed provide: 1) flood control, 2) habitat for fin fish, shellfish, and a variety of wildlife, 3) communities of rare, endangered and threatened species and 4) potential recharge areas for ground water supplies. Past development in certain areas of the Watershed, particularly along Lafayette Road, have had a negative impact on the Watershed's wetland resources. For example, the Woodlands residential development has encroached directly into a potential Prime Wetland area, BB-7. The protection of wetlands within the Berry's Brook Watershed is critical to protecting the Brook and other sensitive resources within the watershed.

Discussion: Wetlands are currently regulated at both the federal level (Section 404 of the Clean Water Act) and the state level through RSA 482-A. The New Hampshire statute was designed to preserve the critical natural functions of wetlands as outlined above.

At the federal level, the Army Corps of Engineer (ACOE) manages the wetlands program for permitting any dredging or filling of wetlands. Through an agreement with the ACOE, the state Wetlands Board administers both the federal and state programs to permit any dredging or filling of wetlands up to three (3) acres in size. Any state approved project is subject to a 21-day waiting period for an ACOE review, comment or intervention, if appropriate. The Conservation Commissions in Greenland, Rye and Portsmouth are empowered through state statute to comment on, and set conditions on, development proposals which may significantly impair critical wetlands functions.

As part of the New Hampshire wetlands law there is also a local option that provides for the identification of Prime Wetlands (RSA 482-A:15). The aim of this provision is to establish criteria for municipalities to select wetlands of significant value that are worthy of extra protection because of their uniqueness, quality, fragility and/or unspoiled character. The law also provides guidance as to the special consideration that needs to be taken by the local Conservation Commission and the state Wetlands Board.

At the local level, only Rye has implemented a wetland ordinance that specifies permitted and non-permitted uses and the exclusion of any wetlands as part of lot size calculations for minimum lot size. In addition, minimum lot size may be further adjusted based upon the provision in Rye's Subdivision Regulations that requires High Intensity Soil Mapping.

Although Greenland has no wetlands overlay district, there is large lot zoning in the watershed and strict regulation for septic system installation. In addition, although wetlands may be included in minimum lot size calculation, more than one (1) acre must be non-wetland soil.

Portsmouth does not have a wetland overlay district, although a draft ordinance is currently being developed. In addition, Portsmouth's subdivision and site plan review regulations have only minimal language to encourage protection of this resource.

Recommendations:

1. The City of Portsmouth should adopt a wetlands ordinance, as well as additional provisions in its subdivision and site plan review regulations to protect wetland resources.

2. The Town of Greenland should adopt a Wetlands Ordinance based upon hydric soils maps from the SCS. In addition, consideration should be given to allowances for smaller lot sizes in the residential zone as long as there is no negative impact on the watershed's wetland resources. This can be accomplished through a density bonus provision, cluster ordinance and/or provisions for an Environmental Impact Review in the subdivision regulations, as recommended previously in this report.

3. Portsmouth and Rye should consider adopting as Prime Wetlands those wetlands already identified in the Wetland Inventory Section of this plan and previous mapping studies, pursuant to NH RSA 482-A:15. In Portsmouth these would include wetlands BB-3, BB-7, PB-3. In Rye these would include wetlands BE012 and BE014 through BE018.

Erosion and Sediment Control

Issue: Sedimentation associated with the off-site transport of sediment during construction activities, as well as from existing uses with large impervious surfaces, may be one of many principal threats to water quality in Berry's Brook.

Discussion: The implementation of soil erosion and sediment controls is site-specific, and numerous factors contribute to determining the level of complexity necessary for a given control plan. The topography, size of disturbed area, volume and direction of runoff, soil characteristics, vegetative cover, and length and steepness of slope are all important factors in the site's susceptibility to soil erosion. In turn, these factors determine the type of control measures which should be implemented. In general, the goals of erosion and sediment controls during construction and development are to:

- keep disturbed areas small;
- stabilize and protect disturbed areas as soon as possible;
- keep stormwater runoff velocities low;
- protect disturbed areas from stormwater runoff; and
- retain sediments within the corridor or site area.

While the subdivision regulations in each of the watershed communities require sediment and erosion control, only Rye specifically identifies guidelines (*Erosion and Sediment Control Design Handbook for Developing Areas in New Hampshire*, SCS, 1981) to be followed by the site developer. By naming a specific document or methodology, a community may lose some of the desired flexibility to keep current with the required practices and compliance standards as new technologies or information become available. For example, the handbook cited above was updated in 1992. One alternative to resolve this issue is to add language which allows for the use of other documented and accepted erosion and sediment control practices or guidelines. On the other hand, the community should keep abreast of commonly accepted, updated guidance documents that are suitable for reference in its land use regulations.

Compliance standards may either take the form of engineering or design standards or performance standards. Engineering standards consist of specific control mechanisms that must be included in the proposed development plans (e.g., hay bales, silt fences, sediment basins, sod waterways, etc.) for a given site. Environmental performance standards, on the other hand, are an alternative to engineering standards. Performance standards are designed to take into account the natural characteristics of the land for both erosion potential as well as runoff retention capabilities.

For further discussion of erosion and sediment control standards, see **Appendix E.**

Recommendations:

1. Each Watershed community should reinforce, and or update, existing local sediment and erosion control provisions of the subdivision regulations to include specific recommendations for minimum sediment and erosion control measures for all sites disturbed during construction. Specify a guidance document that developers should follow, or document specific requirements within the regulations. Appropriate guidance documents include the *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, August, 1992[2] or Schueler's *Practical Manual for the Design of Best Management Practices*. The requirements set forth in the regulations, including those in any referenced guidance document, should be at least as restrictive as those outlined in the NPDES general permits for construction activities.

2. Adopt specific provisions requiring routine inspection and maintenance of erosion and sediment control practices. Inspection and maintenance within the jurisdiction of the community may require further training for existing staff or hiring additional staff. Maintenance of erosion control facilities located on private property should be required through site plan approval as a responsibility of the landowner. The community may want to inspect these devices on a periodic basis.

3. Portsmouth and Greenland should revise their subdivision and site plan regulations to reference a preferred guidance document (see Recommendation #1 above) or set of guidelines which must be adhered to, or to specifically outline sediment and erosion control compliance standards for new development. Rye should update their regulation to reference the revised 1992 SCS document.

Stormwater Management

Issue: Stormwater discharges to Berry's Brook contribute suspended sediments, nutrients, bacteria, heavy metals, petroleum hydrocarbons, and other pollutants which may degrade water quality, and impair wildlife, fisheries, and human uses. There are a number of drains in the watershed identified in the Existing and Potential Threats section of the inventory that may be contributing contaminated discharge to the Brook.

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[2] This document contains a model erosion and sediment control regulation that is currently under review. The model regulation is scheduled to be re-issued in 1993.

Discussion: The management or control of stormwater runoff may include source control (reducing the generation and transport of pollutants) as well as treatment (the removal of pollutants prior to discharge to the receiving resource). Traditionally, stormwater control measures and any regulation of stormwater runoff associated with development activities has focused on flood control (e.g., controlling peak runoff rates, etc.). However, more recently, attention has broadened to include water quality considerations.

Stormwater Management for New Development

Control of runoff from new development is most commonly accomplished through subdivision regulations. Stormwater regulations may dictate that new development must follow accepted engineering design practices, performance standards, or both.

Performance requirements or standards set an expected level of performance for the stormwater treatment system, while allowing for flexibility in the actual types and sequences of treatment devices. An example of a performance standard is the use of a treatment criteria. Recent guidance issued by the US EPA and the National Oceanic and Atmospheric Administration (NOAA) for the control of nonpoint source pollutants within the coastal zone include the following treatment criteria: "require new development projects to reduce the average annual loadings of total suspended solids (TSS) from the site by 80% or demonstrate no greater than pre-development loads." (See *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, USEPA, 1993). Similar approaches for establishing treatment criteria have been recommended in some states (e.g., Rhode Island which recommends 85% reduction in TSS for sensitive resources or watersheds).

The premise for TSS treatment criteria is that a large proportion of pollutants found in urban runoff are associated with particulate material. Therefore, if one removes a substantial portion of the suspended solids, other pollutants will also be removed. The developer must demonstrate that the proposed stormwater treatment design will achieve the desired removal efficiency. This is most commonly done through the use of standard design criteria or predictive hydrologic-based water quality models. There are several models or guidance documents (e.g., *P8 Urban Catchment Model*, Schueler's *Practical Manual for the Design of Best Management Practices,* and *A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone,* 1992) which could be used by the reviewing agencies to determine if the proposed design would be expected to provide the desired results.

Stormwater Management for Existing Sources

While regulation of development may minimize impacts of runoff from new development, such regulations do not provide a means for controlling pollutant discharges from currently developed areas, including roadways. Mechanisms to control existing discharges may be of particular importance in watershed areas which are almost entirely developed. Control of existing sources must be implemented by the communities rather than specific land owners, and may include:

- o enhanced maintenance activities, e.g., street sweeping and catch basin cleaning;
- o reduced salting and sanding, leaf pick-up and composting;
- o retrofitting of catch basins with more effective structures for pollutant attenuation, e.g., catch basins with sumps and oil/grease separators, triple chambered basins, leaching catch basins;
- o modifying discharge points, e.g., flow dissipaters (rip rap), vegetated swales, check dams; and
- o public education regarding fertilizer/pesticide use, hazardous materials disposal, etc.

Recommendations:

1. Institute a street sweeping policy for public impervious surfaces, including roads and parking lots, on a bi-annual basis in the Watershed to reduce sediment and nutrient loads to Berry's Brook and its tributaries. These sweepings should occur during the autumn after leaf-fall and in the spring immediately after snow melt.
2. Institute a similar policy for cleaning catch basins on the same schedule as street sweeping.
3. Include provisions in the Rye and Portsmouth site plan regulations that require Best Management Practices for new development based upon accepted manuals as noted in the above discussion. For example, as a condition of site plan approval, require parking lot sweeping on a regular basis, such as monthly or more frequently as dictated by individual site conditions.
4. Conduct an inventory of existing stormwater management designs, devices and practices within the watershed. Determine how effective these practices are in maintaining water quality in the Watershed.

5. As part of this inventory, conduct stormwater sampling and dry weather observations of the storm drains in the watershed, especially the high density residential (Beechstone, Spring Brook, and Woodlands) and commercial uses along Lafayette Road. Any dry weather discharge may indicate a cross connection or illegal discharge and should be further investigated.

6. Where the above inventory of stormwater practices indicates that there is a resultant adverse impact on the sensitive resources of the Watershed, (for example, the erosion of the banks of the detention pond at Springbrook Condominium) consider a policy to retrofit or modify the discharges from storm drains or impervious surfaces that discharge directly into Berry's Brook or its tributaries or contiguous wetlands.

7. Modify subdivision and site plan regulations for proposed residential subdivision of 5 acres or greater and proposed commercial and industrial uses of greater than 50,000 square feet to incorporate total suspended solids (TSS) treatment criteria of either 85% reduction after construction is completed or no greater than pre-development loadings.

Wastewater Management

Issue: Septic systems which are functioning improperly or are poorly maintained can be sources of nitrates, phosphorus, pathogenic bacteria, and a variety of inorganic hazardous materials. Although there is currently no evidence that failed systems are contributing pollutants to the water resources of the watershed, the Watershed Protection Council should consider ways to determine if this is a problem.

Discussion: While septic systems can be effective in removing organic matter and bacteria, they function correctly only if the system is properly sited, used and maintained. Lots adjacent to waterways and water bodies are often inappropriate for individual septic systems, with septic system failure frequently associated with water quality problems. The overloading of solids to the system can cause clogging. When this occurs, the system requires rehabilitation, which is commonly done with the use of strong acids or organic solvents. Such treatment can seriously degrade the water quality of adjacent water resources. In addition, hydraulic overload caused by large volume use is a common cause of leach field failure (EPA, 1993).

Soil types and topography play a significant role in the function of septic systems. Tightly bound soils such as clay provide poor infiltration. On the other hand, gravel is a poor filter because wastewater drains too rapidly for treatment to occur. Likewise, on steep slopes inadequate filtering occurs due to rapid flow, or surface break out may occur due to a lack of soil penetration. Additional causes of ineffective sewage treatment include:

- improper maintenance of septic systems, such as failure to pump out frequently enough;
- the use of detergents containing phosphates which increase phosphorus loading in the water supply; and
- the flushing of household hazardous materials down drains or toilets which can introduce toxins into ground and surface water bodies.

Aging septic systems require scheduled monitoring to detect signs of system failure and scheduled cleaning to avoid seepage levels which compromise the system's effectiveness at removing contaminants from wastewater. NH RSA 147 and 485-A of the Water Supply and Pollution Control Code require owners of properties which have septic systems or other on-site wastewater disposal systems to keep such systems in proper operational condition at all times. The purpose of NH RSA 147 and 485-A is to provide minimum standards for the protection of human health and the environment in circumstances where septic systems or other individual subsurface wastewater disposal systems are used. These standards may not be sufficient to protect human health and the environment in environmentally sensitive areas.

Recommendations:

In general, these recommendations apply to areas within the watershed that are unsewered, i.e. portions of Rye and Greenland.

1. Adopt and implement as part of a health ordinance a provision to regulate subsurface disposal systems using the *Model Health Ordinance to Regulate Subsurface Disposal Systems and Establish Local Enforcement Procedures* prepared by the NH Office of State Planning, December, 1992 as a source document.

2. As a part of the health ordinance, establish a mandatory septic system inspection and maintenance program through supplementary health regulations that require both cleaning and inspection of all septic systems within 250 feet of Berry's Brook or its permanent tributaries. See 250 foot buffer on **Watershed Management Plan Map.** For example, septic systems within the watershed could be required to be pumped out every two years with a receipt for such pump out provided to the building inspector or included in the property tax bill. This policy may be waived if a homeowner can prove that the septic system does not require such action by providing written notification to the building inspector from a certified septic waste hauler. Inspections/pump outs could also be triggered when there is an application for a building permit that includes the addition of a bedroom to a residential unit.

3. Educate the public regarding the importance of proper use and maintenance of septic systems (Refer to the subsequent section on public education strategies).

4. Encourage/require connection to Portsmouth municipal sewer system, where possible, especially the commercial properties in Rye along Lafayette Road.

5. Consider additional requirements that would be incorporated into the supplemental regulations for properties in unsewered portions of the Watershed, such as:

   - o requiring a 100-foot setback distance from Berry's Brook, its tributaries or adjacent wetlands for any portion of a septic system or leaching chamber;
   - o prohibiting the use of chemical septic tank cleaners and/or chemical additives;
   - o requiring septic system design that is sufficient to accommodate discharge from washing machines, dishwashers and garbage disposals (for example, a requirement for a separate leaching system);
   - o amending the building code to require use of low-flow plumbing fixtures to prevent hydraulic overload of leaching systems; and
   - o requiring ground water monitoring annually for the life of the system for any new system designed for greater than 2,000 gallons per day flow or for new clusters of systems designed for greater than 2,000 gallons per day cumulative flow. Such monitoring should test for nutrients (i.e. phosphorous and nitrogen) and bacteria.

Non-Regulatory Management Strategies

Issue: The city of Portsmouth and the town of Rye have a number of parcels within the watershed that are under public ownership (e.g. the Adams property in Rye). In addition, the planning boards in each community have required specific conditions that set aside areas for conservation as part of subdivision or site plan approval (e.g. the rear portion of the Beechstone Apartments subdivision). These conditions typically establish restrictions to limit development adjacent to Berry's Brook. Furthermore, a number of parcels in the watershed are under the state's Current Use program. Although each of these strategies for maintaining open space has value for protecting the watershed's resources, there are additional actions that might be considered.

Discussion: Non-regulatory management strategies usually entail the acquisition and public ownership of, or the placement of restrictions on selected parcels of land within the watershed by the respective communities. Although land acquisition is the most effective and certain means of protecting Berry's Brook and other environmentally sensitive areas in the watershed from adverse impacts of development, it is also the most costly. Additional information regarding alternative mechanisms for securing or restricting development rights are provided in **Appendix G**. Open space protection techniques include land acquisition, purchase of development rights, conservation easements, transfer of development rights, land set asides as part of subdivision development, and preferential tax policies such as the current use assessment program.

Recommendations:

1. Identify sites and properties to be targeted for purchase or alternative development restriction mechanisms, including conservation easements or current use taxation. Approach appropriate property owners to determine their willingness to sell, place restrictions/easements on portions of their property or enter the current use program. Priority should be given to selecting properties in the Watershed which:

   - o include or border Berry's Brook or its permanent tributaries;
   - o include or border wetlands contiguous to the Brook or its permanent tributaries;
   - o exhibit erosion-prone conditions (e.g.: erodible soils, steep slopes, and clear-cut areas);
   - o contain significant natural features (e.g. rare/threatened species habitat, unique wetland or upland habitat, etc.);
   - o are reasonably accessible from town or state roads; and/or
   - o when purchased, will discourage direct public access to Berry's Brook unless it is a designated site for public access.

2. Obtain conservation easements as part of the development approval process for parcels and large lots located within critical areas of the Watershed. Ensure that such restrictions or easements are not only a condition of subdivision or site plan approval, but are also recorded with the property deed as a deed restriction. For example while there are legal site review agreements for setting aside conservation areas in the Ceders and Beechstone apartment development, it is not clear that these agreements were recorded with the county Registry of Deeds at the time of plan recording.

3. Consider the implementation of a TDR system for protecting critical resource areas within the Watershed. The implementation of a TDR system is potentially a very effective watershed protection strategy, but can become a complicated and lengthy process, and should therefore be pursued as a second priority to the current use incentive, easement restriction, and land acquisition alternatives.

4. Establish a Community Land Trust for the purpose of obtaining key parcels within the Watershed.

The **Watershed Management Plan Map** identifies parcels by number within the Watershed that have high resource value that may be suitable for protection through one of the non-regulatory recommendations above. There are three (3) such properties in Greenland, one (1) in Portsmouth and four (4) in Rye.

Public Education and Participation

Issue: Land use regulations or public health strategies may be effective at controlling sources of water pollution on a large scale throughout the watershed, but do little to influence the habits of each resident or business owner within the watershed. Informing residents and business owners of the role they can play in protecting Berry's Brook and critical watershed resources will complement regulatory strategies by addressing watershed protection on a lot by lot basis.

Discussion: Public education and participation may take many forms, including:

- public meetings, Awareness Days or workshops,
- newsletters or fliers;
- posting of the watershed boundaries and stream crossings;
- forming neighborhood groups;
- developing and/or encouraging educational programs and curricula in public schools that relate to natural resources protection and watershed management;
- developing community educational programs for adults; and
- providing information through the media.

The most effective form of public education depends upon the target group and the objectives of the public education program. The target group for such a program is all of the Watershed's residents and businesses as well as state and local land use regulatory boards. The objectives should be:

- to notify the public and governmental decision-makers of the need for protection of the Watershed;
- to identify and explain the issues that threaten the Watershed;
- to explain ways in which the target group can participate in watershed protection on an individual basis;
- to instill a sense of responsibility for, and interest in, protecting the Watershed; and;
- to establish institutions which will sustain and build on the initial efforts to protect the Watershed.

Recommendations:

1. Expand the role of the Watershed Council to hold regular informational neighborhood meetings, and encourage residents and business owners to practice environmentally sound habits through a broad-based public education program.

2. Participate in the public review, comment and decision-making process for proposed projects within or affecting the watershed.

3. Develop and implement a broad-based public education program that might include:

    - periodic newsletters to watershed residents and business that discuss watershed issues and problems;
    - fact sheets, such as those provided by the UNH Cooperative Extension Service on specific watershed issues, such as proper installation, cleaning and maintenance of septic systems (See **Appendix F** for a sample);
    - encouraging the use of low flow plumbing fixtures to reduce hydraulic flow to septic systems;
    - informative news releases that deal with specific timely issues or a project that might be undertaken by the Watershed Council;
    - the development and implementation of a science curriculum within the public school system that includes a section on watershed management;
    - self-guided, low maintenance, outside laboratory(ies) or field study area(s) for students and the public; and
    - the implementation of Berry's Brook Watershed Day with programs and events that focus on the opportunities for public enjoyment of the Watershed and the ecological values of the Watershed's sensitive natural resources.

4. Implement a "Watershed Watch" group to conduct periodic water quality sampling, perhaps in association with the Great Bay Watch or through the River Watch program based in Vermont that works with groups like the Watershed Council. Such a program could be conducted at minimal expense initially by sampling for such parameters as temperature, dissolved oxygen, pH, conductivity, salinity, and turbidity. Sampling should occur in the following six locations along Berry's Brook which are identified on the **Watershed Management Plan Map**:

   - o Lafayette Road crossing in Rye;
   - o Lang Road crossing in Portsmouth;
   - o Rye Elementary School property;
   - o Sagamore Road crossing in Rye;
   - o Brackett Road in Rye; and
   - o Pioneer Road in Rye.

5. Develop links with such institutions as the University of New Hampshire (School of Natural Resources or Department of Civil Engineering) or the Jackson Lab to encourage further research and monitoring of the Watershed's natural resources;

6. Identify and implement opportunities for controlled public access to the Watershed. Immediate opportunities include:

   - o rehabilitating the Rye Elementary School Nature Trail in conjunction with the development of an appropriate curriculum as recommended above;
   - o acquiring and developing an access point where Berry's Brook crosses Brackett Road;
   - o providing a trail link between the town right-of-way on Berry's Brook Lane and the Seavey Acres Trail that begins at Pioneer Road; and
   - o working with the NHDOT to improve the safety of, and provide a bike lane along, Pioneer Road between Foye's Corner and Odiorne State Park. This project would provide a link to the existing bike trail at the Park and along Route 1A.

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REFERENCES

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APPENDIX A

MAP INVENTORY - SUMMARY REPORT

Berry's Brook Watershed

INTRODUCTION

IEP, Inc. of Portsmouth, NH was retained by the Berry's Brook Watershed Council during April 1991 to produce resource inventory maps which would assist the local communities in assessing the natural resources and existing land use patterns within this important resource area. The Berry's Brook Watershed Council, which oversaw the project, is made up of residents and other representatives from the Portsmouth and Rye areas who are concerned with future development in and around this watershed. Both the Audubon Society of New Hampshire and the New Hampshire Natural Heritage Inventory cite the Berry's Brook Watershed as an area which provides important fish and wildlife habitat above and beyond its potential value as habitat for threatened and endangered species. Appendix A includes correspondence from these organizations citing plant and animal species which are threatened endangered or of special concern and which are known to occupy the area.

Production of these resource inventory maps is the first step in understanding the unique features of the watershed and how this important area may be wisely managed in the future. The following maps, all at a scale of 1" = 600', were produced as part of this study:

Watershed Base Map
Zoning Map for the Towns of Portsmouth, Rye and Greenland
Wetland boundary and vegetative cover type map
Soil map, classified by drainage characteristics
Topographic map
Utility map including water and sewer lines
Property ownership map
Aquifer map.

This report briefly describes the production of the eight resource maps and the criteria used in their development. All maps produced as part of the project were prepared utilizing IEP's ARC/INFO geographic information system. Funding for this project was provided by a Coastal Zone Management Grant and by matching funds from both the Town of Rye and the City of Portsmouth.

BASE MAP

The Berry's Brook Watershed consists of a 3,801 acre area straddling the communities of Rye, Portsmouth, Greenland and North Hampton (Table 1.). The watershed begins in the Breakfast Hill area of Greenland and North Hampton and extends in a north-

Table 1. Acreages and percentages of Berry's Brook watershed within the four seacoast communities of Rockingham County in southern New Hampshire.

Community	Acres	Percent of Total
Rye	2117	55.7%
Portsmouth	1362	35.8%
Greenland	310	8.2%
North Hampton	12	00.3%
Total	3,801	100.0%

easterly direction along the Portsmouth/Rye border before ending just below the Route 1A/Pioneer Road bridge. At this point waters from the brook mix with water from Seavey Creek before discharging into the Sagamore river and then the Atlantic Ocean.

The base map was prepared by delineating the limits of the watershed on U.S.G.S 7.5 minute series topographic quadrangle maps. Once delineated, the watershed boundary was digitized into IEP's GIS system. All GIS digital planimetric data produced during the Town of Rye's parcel mapping project was obtained and used in conjunction with Portsmouth's planimetric maps to produce the base map. The base map not only delineates the limits of the watershed and the location of Berry's Brook, but also depicts the road system through the watershed area. Finally, approximate locations of Seavey's Mills I and II are also shown on the Base map.

This remaining seven (7) maps were overlaid on the base map to accurately outline the limits of the study area.

ZONING MAP

A zoning map was produced showing the current zoning districts across the entire watershed. Nine zoning classes had been identified for the 4 municipalities. Table 2 summarizes the various acreages of each district as depicted on the map.

Table 2. Zoning districts and acreages within Berry's Brook watershed as identified from zoning maps for the four seacoast communities

Zoning District	Acres	Percent of Total
Residential	2773.6	73.0%
Business	209.6	5.5%
Commercial	182.1	4.8%
Historic	19.3	0.1%
Apartment	130.3	3.5%
Industrial	61.2	1.7%
Mobile Home Park	159.0	4.3%
Conservation Land	56.1	1.5%
Rural	210.7	5.6%

WETLAND MAP

Wetlands were identified utilizing past wetland delineation studies completed for both the City of Portsmouth and the Town of Rye. IEP, Inc. completed a wetland delineation study in Portsmouth in 1985 in which the major wetland areas were identified, cover mapped based on vegetation type and delineated on the City's tax maps. Normandeau Associates Inc. completed a wetland delineation study in 1986 of the NH seacoast towns (excluding Portsmouth). Wetlands were delineated on ortho-photos for each town during that study. Based on these past efforts, approximately 35% of the watershed or 1,342 acres of wetland were delineated within the 3,802 acre watershed (Table 3).

Both communities had their wetland delineation information available as planimetric, digitized data so that a composite cover map could be produced showing all the major wetland systems in the watershed. Utilizing 1989 1" = 600' color aerial photos available from the Town of Rye, previously delineated wetland boundaries were evaluated and cover mapped utilizing a modified version of the U.S. Fish and Wildlife Service wetland classification system* . This classification system, which characterizes each wetland based on the dominant vegetation type present, is the methodology utilized by the U.S. Fish and Wildlife Service for their National Wetland Inventory (NWI) maps. The classification of wetland types utilized in this study is similar to the Fish and Wildlife Service's method but is simpler and more readable. In general, the predominance of certain plant communities determines the type of wetland present. The vegetative cover type into which any wetland may fall is based on a minimum coverage of 30%, assessed visually, beginning with the forest layer strata and progressively working through the

* Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. United States Department of the Interior, Fish and Wildlife Service .

Table 1. Acreages of the various wetland cover types identified within the Berry's Brook watershed .

Wetland Type	Acres	Percent of Total
Wooded Swamp		
Deciduous	935	69.7%
Coniferous	59.6	4.4%
Atlantic White Cedar	8.3	0.6%
Dead	5.8	0.4%
Scrub/Shrub	118	8.8%
Emergent Marsh		
Wet Meadow	22	1.6%
Shallow	86	6.4%
Deep	13	1.0%
Open Water	23	1.7%
High Salt Marsh	59	4.4%
Panne	7.3	0.5%
Mud Flats	4.7	0.3%
Total	1,341.7 acres	

shrub layer, the herbaceous layer and finally the unvegetated layer. One or several of the following wetland classes and sub-classes may be present within the borders of any particular cover class. Since the level of detail is limited to the 1"= 600' scale of the final map.

The following wetland types or classes were used to describe each wetland as it was identified. Each description briefly characterizes the major features of each wetland and the vegetative species likely to be encountered. Acreages for each wetland type are also found on Table 3.

Forested Wetland. This class applies to wetlands dominated by trees which are taller than 20 feet and have an average diameter breast height (dbh) greater than 6". This class may also be described as a wooded swamp. By far the most abundant species comprising this habitat is red maple (Acer rubrum). Understory development is often quite pronounced, with abundant tall and bushy shrubs such as high-bush blueberry (Vaccinium corymbosum), northern arrowwood (Viburnum recognitum) and winterberry (Ilex verticillata). Typical species at the ground layer include skunk cabbage (Symplocarpus foetidus), cinnamon and sensitive fern (Osmunda cinnamomea and Onoclea sensibilis, respectively), royal fern (Osmunda regalis), and sphagnum moss (Sphagnum spp.). Wooded swamps are typically seasonally flooded with the water table at or near the ground surface during much of the year. Soil conditions range from well-decomposed very poorly drained organics to poorly drained mineral soils.

Any one of four subclasses are included in the description of the forested wetland cover class. These subclasses are:

Forested Wetland Deciduous dominated by deciduous tree species such as red maple which lose their leaves annually.

Forested Wetland Coniferous dominated by evergreen tree species which may include any or all of the following species: hemlock (Tsuga canadensis), white pine (Pinus strobus) and Atlantic white cedar (Chamaecyparis thyoides).

Forested Wetland Coniferous (Atlantic white cedar) includes those wooded wetlands in which known sightings of Atlantic white cedar, an uncommon tree species in New Hampshire, have been documented.

Forested Wetland Dead dominated by dead standing timber, usually the consequence of past or persistent beaver activity. Areas classified under this category do not preclude the likelihood that a well developed shrub or herbaceous understory may have develop subsequent to inundation.

Scrub/Shrub Wetland. This wetland type is dominated by woody species less than 20 feet tall and with a dbh less than 6". This wetland class may include tree saplings, tall shrubs, and compact shrubs. The woody species listed above are frequently found in shrub swamps as well as speckled alder (Alnus rugosa), red-osier dogwood (Cornus stolonifera), willows (Salix spp.), leatherleaf (Chamaedaphne calyculata), pepperbush (Clethra alnifolia), sweet gale (Myrica gale), and buttonbush (Cephalanthus occidentalis). As in forested wetlands, soil conditions may range from well decomposed very poorly drained organics to poorly drained mineral soils.

Emergent Marsh refers to those plant communities dominated by herbaceous plant species. Standing water usually persists in these wetlands most of the time during the growing season. As a consequence, very poorly drained soils usually dominate this wetland class. This class can be further subdivided into three subclasses based on the average depth of standing water. All wetlands classified in this category are considered freshwater systems.

Emergent Marsh Shallow This community is distinguished as a shallow fresh marsh, as opposed to the deep marsh, by having an average water depth less than six inches during the growing season. This community is usually dominated by robust or narrow-leaved emergents, such as cattail (Typha spp.), bur-reeds (Sparganium spp.), rushes (Juncus spp.), woolgrass (Scirpus cyperinus), and a variety of sedges (Carex spp.).

Emergent Marsh Deep This subclass applies to wetland with an average water depth between six inches and three feet during the growing season. Plant species composition may be similar to that listed for shallow marshes, however, pickerel weed (Pontedaria cordata) and floating-leaved aquatic vegetation such as water lilies (Nymphaea spp. and Nuphar spp.) may be common.

Emergent Marsh Meadow This wetland is considered a variety of marsh with little standing water but still dominated by herbaceous plants. Species typically comprising this habitat include a variety of sedges and rushes, sensitive fern, iris (Iris spp.), and various manna grass (Glyceria spp.). Wet meadow wetlands are more often dominated by poorly drained soils, and are often a consequence of wetlands that are constantly mowed or grazed.

High Salt Marsh Typical New England salt marsh is dominated by salt tolerant plants collectively called halophytes. These marsh areas are the dominant wetland type occurring behind barrier beaches and at the mouths of coastal rivers in highly saline waters. Two vegetation zones are evident within the salt marsh: the low marsh and the high marsh. The low marsh consists of a single species, salt marsh cord grass (Spartina alterniflora), growing in the inter tidal zone, those areas subject to the daily high and low tides in and along tidal creeks and channels. The high marsh areas are typically dominated by Spartina patens (salt hay grass), those large areas of level marsh generally located behind or immediately upslope of the channels. High marsh is more diverse and usually includes several other species such as spike grass (Distichlis spicata), black grass (Juncus gerardii), glassworts (Salicornia spp.), arrow grasses (Triglochin spp.) sea blites (Suaeda spp.) and sea lavenders (Limonium spp.) These areas are usually only inundated during the higher spring tides. While both habitat types occur within the lower levels of the watershed, only the high marsh areas were cover mapped. Low marsh is prevalent along the tidal channels, but the cover type was to small to delineate at the scale of the maps.

Panne are depressions or ponds within the high marsh areas. These areas retain salt water for longer periods than the rest of the marsh, and evaporation concentrates the salt creating an extremely harsh environment. Despite the harsh conditions, pannes are often very important for wildlife by providing additional feeding areas.

Mud Flats are those unvegetated flats typically exposed during the low period of the daily tidal cycle. Mud flats are an extremely important habitat type for a number of shore and wading birds as well as for numerous crustaceans.

Open Water Open water is a permanently flooded or intermittently exposed habitat type. It may also be comprised of an aquatic bed with a variety of submerged aquatic plant species and/or possess an unconsolidated bottom of mud, sand, gravel or cobbles. Most areas included in this system are freshwater, however, open water areas adjacent to tidal wetlands (salt marsh) are saline.

The final wetland map was produced following development and editing of a series of draft maps. The initial draft map clearly displayed inconsistent location of Berry's Brook between the most recent Rye planimetric data and the digitized wetland maps provided by the New Hampshire Granite GIS. The Watershed Protection Council requested that IEP move the wetland boundary lines to fit the Rye base map, thereby resolving this inconsistency. It is understood that the accuracy of the wetland delineations was decreased following this procedure.

SOIL MAP

Soils serve as an excellent indicator of the long term moisture regime of an area, and therefore may either supplement or replace vegetative analysis or aid in determination of wetlands in disturbed or transitional plant communities. Soils which are considered to be wetland (or hydric) soils are those which contain morphological evidence of wetness. Such evidence includes organic horizons of thick dark gray or black surface horizons, gleyed soils below the A horizon, iron and manganese concretions (mottling) within 12 inches of the surface, and evidence of ponding or flooding.

The Soil Conservation Service (SCS) uses drainage class as one way to classify soils. Table 4 summarizes the acreages of the various drainages classes and land use patterns as described by SCS for the Berry's Brook watershed area.

Hydric (or wetland) soils fall into the general categories of poorly drained and very poorly drained. It is not uncommon for communities to consider areas with soils classified as poorly or very poorly drained to be wetlands. Utilizing the SCS Soil Survey of Rockingham County, New Hampshire (unpublished) a modified soil map was produced of the watershed based on drainage class. Soil series names as defined by SCS were classified into their appropriate drainage class for creation of the soil map.

Table 4. Acreages and percentages of the Berry's Brook watershed according to land use and drainage class based on the Soil Conservation Service Soil Survey of Rockingham County, NH.

Land Use/Drainage Class	Acres	Percent of Total
Urban Land	429	11.3%
Gravel Pit	43	1.1%
Open Water	26	0.7%
Excessively Drained	558	14.7%
Well Drained	932	24.5%
Moderately Well Drained	59	1.6%
Poorly Drained	1161	30.5%
Water Muck and Peat (Very Poorly Drained)	524	13.8%
Tidal Marsh (Very Poorly Drained)	70	1.8%
Total	3,802 acres	

Topographic Map

Topographic information was digitized from 7 1/2 minute quadrangles for the entire watershed. FEMA topographic information (5' contour interval) was also digitized, but was discarded because only a small portion of the study (the extreme northeast corner) was available.

In addition to displaying contours, slope information was color-coded and overlaid on topographic data. Slope was derived from SCS soils classifications. In general, SCS slope data was very consistent with contour data. One anomaly is present in the northeastern area of the watershed, adjacent to Bellyhack Bog, where a small area of moderate slope is located. As the slope of this area should be very low, it is expected that SCS data may be erroneous.

Utility Map

This map includes utility information, displayed as color-coded lines running along streets. All water and sewer maps/information was requested from Rye Planning and Portsmouth Public Works Departments. The Utility maps displays all data provided to IEP by these Departments at the scale of 1" = 600'.

Property Ownership Map

The property ownership map was produced by merging parcel maps from Portsmouth, Rye and Greenland. Initial digitizing revealed significant overlap of the community's parcel maps along borders. This problem was resolved by slightly modifying the parcel lines of Portsmouth and Greenland to fit those of the more accurate Rye parcel maps. All parcel maps were registered to the New Hampshire State Plane Coordinate System.

Aquifer Map

Aquifer data was obtained from an unpublished groundwater survey produced by U.S.G.S., the most recent aquifer information available for the Berry's Brook Watershed area. IEP was permitted to re-draft all mapped information from this study, including the location of stratified drift, marine and till deposits. Additional information concerning this study may be obtained from Mr. Peter Steckle at U.S.G.S. in Bow, New Hampshire.

APPENDIX B

WATER QUALITY

HISTORY

Source. 1990, 197:6, eff. June 26, 1990.

485-A:7-c Issuance of Certificates.

I. Upon satisfactory completion by an applicant of the established requirements, the division shall issue to the applicant a suitable certificate designating the applicant's competency. The certificate shall indicate the level of operation for which the operator is qualified. The certificate shall remain in effect for 2 years from the date of issuance.

II. Certificates shall be renewed biennially and shall be accompanied by a $50 renewal fee, which shall be deposited pursuant to RSA 485-A:7-a, II.

III. Certificates may be issued, upon payment of the $50 fee, without examination, for a comparable classification to any person actively seeking employment in New Hampshire who holds a certificate issued by the appropriate certification agency of any federal, state, interstate, territorial, or other jurisdiction if, in the judgment of the committee, the certification requirements of the jurisdiction granting such certification do not conflict with the division's rules and are not less stringent than rules adopted under this subdivision. The fee shall be deposited pursuant to RSA 485-A:7-a, II.

HISTORY

Source. 1990, 197:6, eff. June 26, 1990.

485-A:7-d Revocation. The division may suspend or revoke the certificate of an operator under rules adopted pursuant to RSA 485-A:6.

HISTORY

Source. 1990, 197:6, eff. June 26, 1990.

Classification of Waters

485-A:8 Standards for Classification of Surface Waters of the State. It shall be the overall goal that all surface waters attain and maintain specified standards of water quality to achieve the purposes of the legislative classification. For purposes of classification there shall be 2 classes or grades of surface waters as follows:

I. Class A waters shall be of the highest quality and shall contain not more than either a geometric mean based on at least 3 samples obtained over a 60-day period of 47 Escherichia coli per 100 milliliters, or greater than 153 Escherichia coli per 100 milliliters in any one sample; and for designated beach areas shall contain not more than a geometric

mean based on at least 3 samples obtained over a 60-day period of 47 Escherichia coli per 100 milliliters, or 88 Escherichia coli per 100 milliliters in any one sample; unless naturally occurring. There shall be no discharge of any sewage or wastes into waters of this classification. The waters of this classification shall be considered as being potentially acceptable for water supply uses after adequate treatment.

II. Class B waters shall be of the second highest quality and shall have no objectionable physical characteristics, shall contain a dissolved oxygen content of at least 75 percent of saturation, and shall contain not more than either a geometric mean based on at least 3 samples obtained over a 60-day period of 126 Escherichia coli per 100 milliliters, or greater than 406 Escherichia coli per 100 milliliters in any one sample; and for designated beach areas shall contain not more than a geometric mean based on at least 3 samples obtained over a 60-day period of 47 Escherichia coli per 100 milliliters, or 88 Escherichia coli per 100 milliliters in any one sample; unless naturally occurring. There shall be no disposal of sewage or waste into said waters except those which have received adequate treatment to prevent the lowering of the biological, physical, chemical or bacteriological characteristics below those given above, nor shall such disposal of sewage or waste be inimical to aquatic life or to the maintenance of aquatic life in said receiving waters. The pH range for said waters shall be 6.5 to 8.0 except when due to natural causes. Any stream temperature increase associated with the discharge of treated sewage, waste or cooling water, water diversions, or releases shall not be such as to appreciably interfere with the uses assigned to this class. The waters of this classification shall be considered as being acceptable for fishing, swimming and other recreational purposes and, after adequate treatment, for use as water supplies. Where it is demonstrated to the satisfaction of the division that the class B criteria cannot reasonably be met in certain surface waters at all times as a result of combined sewer overflow events, temporary partial use areas shall be established by rules adopted under RSA 485-A:6, XI-c, which meet, as a minimum, the standards specified in paragraph III. Notwithstanding the foregoing, a temporary partial use area subject to the minimum standards specified in paragraph III shall be established for those surface waters which receive effluent from an existing municipal wastewater treatment facility and which are subject to extremely low flows and low dilution as specified in paragraph III.

III. The waters in temporary partial use areas established under paragraph II shall be free from slick, odors, turbidity, sludge deposits, and surface-floating solids of unreasonable kind or quantity, shall con-

tain not less than 5 parts per million of dissolved oxygen; shall have a hydrogen ion concentration within the range of pH 6.0 to 9.0 except when due to natural causes; and shall be free from chemicals and other materials and conditions inimical to aquatic life or the maintenance of aquatic life. These criteria shall apply during combined sewer overflow discharges and up to 3 days following cessation of said discharge. These criteria shall also apply for a period of up to 21 consecutive days, to surface waters which receive effluent from an existing municipal wastewater treatment facility when the flow in those surface waters falls below 25 cubic feet per second (cfs) and when those waters are subject to a dilution factor of not greater than 2.5. At all other times the standards and uses specified in paragraph II shall apply.

IV. Notwithstanding anything contained in this chapter, the division in submitting classifications relating to interstate waters to the New England Interstate Water Pollution Control Commission for review and approval, as provided for under the terms of Article V of the compact whereby the interstate commission was created by RSA 484, shall submit such classifications in accordance with the standards of water quality as currently adopted by said interstate water pollution control commission provided, however, that the standards for any classification thus submitted for review and approval shall not be less than, nor exceed the standards of the classification duly adopted by the General Court as provided for in RSA 485-A:9 or 10.

V. Tidal waters utilized for swimming purposes shall contain not more than either a geometric mean based on at least 3 samples obtained over a 60-day period of 35 enterococci per 100 milliliters, or 104 enterococci per 100 milliliters in any one sample, unless naturally occurring. Those tidal waters used for growing or taking of shellfish for human consumption shall, in addition to the foregoing requirements, be in accordance with the criteria recommended under the National Shellfish Program Manual of Operation, United States Department of Food and Drug Administration.

VI. Notwithstanding anything contained in this chapter, the division shall have the authority to adopt such stream classification criteria as may be issued from time to time by the federal Environmental Protection Agency or its successor agency insofar as said criteria may relate to the water uses specified in RSA 485-A:8, I and II, provided, however, that the criteria thus issued shall not result in standards that are less than nor exceed the standards of the classification duly enacted by the general court as provided for in RSA 485-A:9 or 485-A:10.

VII. All tests and sampling for the purposes of examination of waters shall be performed and carried out in a reasonable manner and whenever practicable, in accordance with the commonly accepted scientific method as selected by the division. The waters in each classification shall satisfy all the provisions of all lower classifications. The minimum treatment for the lowest classification shall be as follows:

(a) For sewage, secondary treatment and disinfection as necessary to comply with water quality standards.

(b) For industrial wastes and combined sewer overflows, such treatment as the division shall determine. Appeal from any such determination shall be in the manner provided for in RSA 21-O:7, IV.

VIII. In prescribing minimum treatment provisions for thermal wastes discharged to interstate waters, the division shall adhere to the water quality requirements and recommendations of the New Hampshire fish and game department, the New England Interstate Water Pollution Control Commission, or the United States Environmental Protection Agency, whichever requirements and recommendations provide the most effective level of thermal pollution control.

IX. Subject to the provisions of RSA 485-A:13, I(a), the fish and game department may use rotenone or similar compounds in the conduct of its program to reclaim the public waters of the state for game fishing.

HISTORY

Source. 1989, 339:1. 1991, 371:3–5, eff. Aug. 31, 1991.

Amendments—1991. Added the first sentence of the introductory paragraph.

Paragraph I: Rewrote the first sentence and substituted "adequate treatment" for "disinfection" following "after" in third sentence.

Paragraph II: Rewrote the first sentence, inserted "biological" preceding "physical" and substituted "aquatic" for "fish" preceding "life" in two places in the second sentence, inserted "water diversions, or releases" following "cooling water" in the fourth sentence, substituted "fishing, swimming" for "bathing" following "acceptable for" in the fifth sentence, and added the sixth and seventh sentences.

Paragraph III: Amended generally.

Paragraph V: Amended generally.

Paragraph VI: Substituted "I and II" for "I, II, and III" following "RSA 485-A:8" and "485-A:10" for "10" following "RSA 485-A:9".

Paragraph VII: Amended generally.

Revision note. Substituted "RSA 485-A: 8, I, II, and III" for "RSA 485-A:3, I, II, and III" in the first sentence of par. VI to correct an error in the reference.

ANNOTATIONS

1. Debt limitation

Legislature has recognized imperative necessity for prevention of water pollution under this section by providing that cost shall not be subject to ordinary limitations upon public debt. State v. Goffstown (1956) 100 NH 131, 121 A2d 317. (Decided under prior law.)

APPENDIX C

RARE, THREATENED, AND ENDANGERED SPECIES

Audubon Society of New Hampshire
Audubon House • 3 Silk Farm Road • P.O. Box 528-B
Concord, NH 03302-0516 • (603) 224-9909 • Fax No. (603) 226-0902

MAY 15

14 May 1991

Steven W. Ellsworth
IEP, Inc.
39 Bow Street
P.O. Box 1136
Portsmouth, NH 03801

Dear Mr. Ellsworth;

Enclosed are a summary of information regarding rare, threatened, and endangered wildlife in the Berry's Brook watershed in Greenland, Portsmouth, and Rye, NH and an invoice for services.

The Berry's Brook watershed provides significant wildlife habitat above and beyond its potential value to threatened and endangered species. The New Hampshire coast is a major travel route for migratory birds, and the watershed includes a diverse assemblage of wetland and upland habitats which provide essential food and cover for a wide assortment of migrants. The study area likely supports a rich breeding fauna, and many overwintering species. Because of this area's coastal location and habitat diversity, seasonal field surveys to document wildlife use of the watershed are strongly recommended, especially if significant habitat alterations are being considered.

If I can be of further assistance, please don't hesitate to contact me.

Sincerely,

Carol R. Foss

Carol R. Foss
Wildlife Department

Enclosures

printed on recycled paper

Threatened and Endangered Wildlife
of Known or Potential Occurrence in the
Berry's Brook Watershed, Greenland, Portsmouth, and Rye, NH

Endangered Species

Banded bog skimmer: May inhabit bogs and sedge meadows in the coastal plain. Appropriate habitat likely to exist in study area; field surveys should be undertaken during May flight periods.

Shortnose sturgeon: May occur in estuarine waters along New Hampshire coast. Could possibly occur in brackish section of Berry Stream.

Pied-billed grebe: Nests locally throughout the state in deep freshwater marshes with extensive beds of emergent vegetation. Potential habitat may occur within the watershed, and wetlands within the study area should be checked for suitability. If suitable habitat exists, field surveys should be conducted during the breeding season.

Common tern: Nested for many years on islands in Back Channel of Little Harbor, but not in 1990. Individuals may forage in brackish marshes of watershed.

Upland sandpiper: Currently the state's only known nesting population occurs on Pease Air Force Base in Portsmouth/Newington. Spring migrants have been seen in Rye and Greenland during the past 2 decades. While nesting is unlikely to occur within the study area, these birds may forage in the watershed during migration.

Bald eagle: Wintering population occurs annually at Great Bay. Migrants and transients move along the coast, and sightings have occurred in Rye, Portsmouth, and Greenland during the past decade. Eagles traveling the coast may forage in the watershed, especially in its extensive wetlands where waterfowl are likely to congregate.

Peregrine falcon: Occurs as migrant along coast. Sightings reported from Portsmouth and Rye during past decade. Migrants may hunt over the extensive wetlands of the watershed.

Sedge wren: Nests locally in freshwater marshes and wet meadows throughout N.H. Suitable habitat likely to occur in study area; field surveys should be conducted during breeding season.

Henslow's sparrow: May nest in wet meadows and moist weedy fields south of the White Mountains. Suitable habitat may exist in study area; field surveys should be conducted during breeding season.

Threatened Species

Least tern: May occur as migrant in brackish portion of study area.

Arctic tern: May occur as migrant in brackish portion of study area.

Roseate tern: May occur as migrant in brackish portion of study area.

Cooper's hawk: Nests in deciduous and mixed woods in scattered locations throughout New Hampshire. Field surveys necessary to determine presence. Records exist from Portsmouth, Rye, and Greenland during last 25 years.

Northern harrier: Occurs in large marshes and open fields during all seasons. Migrant and potential breeder on New Hampshire coast. Undoubtedly uses marshes of study area during migration. Many records from Portsmouth, Rye and Greenland during last 25 years. Nesting within study area possible, but no evidence reported.

Osprey: Occurs in vicinity of large coastal or fresh water bodies. Common migrant along New Hampshire coast. Single pair has nested in Durham since 1989. Undoubtedly occurs in study area during migration. As coastal breeding population gradually expands, study area likely provides suitable nesting habitat.

Common nighthawk: Nests on flat rooftops in downtown Portsmouth in some years. May forage over study area during spring and fall migrations and possibly during breeding season.

Purple martin: New Hampshire breeding population depends completely on martin houses for nest sites. Historically nested in such houses provided along the coast and foraged over salt marshes. Study area provides suitable habitat. Availability of occupied or unoccupied martin houses nearby is unknown. Likely occurs in study area at least as migrant.

Threatened and Endangered Wildlife

not expected to occur in the

Berry's Brook watershed, Greenland, Portsmouth, and Rye, NH

Endangered Species

- dwarf wedge mussel
- swollen wedge mussel
- frosted elfin butterfly
- karner blue butterfly
- Persius dusky wing skipper
- Sunapee trout
- timber rattlesnake
- piping plover
- golden eagle
- loggerhead shrike
- Canada lynx
- small-footed bat

Threatened Species

- pine pinion moth
- pine barrens zanclognatha moth
- cobblestone tiger beetle
- common loon
- pine marten

Species of Special Concern
expected to occur in the
Berry's Brook watershed, Greenland, Portsmouth, and Rye, NH

Species	Habitat
American brook lamprey	Streams with muddy bottoms
Marbled salamander	Sandy, gravelly areas in deciduous woods
Jefferson salamander	Damp shady woods, swamps, wet meadows, lakeshores
Slimy salamander	Moist wooded hillsides and ravines
Spotted turtle	Bogs, marshy pastures, small wooded streams
Eastern box turtle	Open woods, pastures, wet meadows
Blandings turtle	Shallow lakes, ponds, marshes, streams with soft bottom and abundant vegetation
Eastern hognose snake	Open woodlands with sandy soils
Least bittern	Deep marshes with tall emergent vegetation
Black-crowned night heron	Nest in trees or shrubs near wetlands or shorelines; forage in marshes, along shores
Red-shouldered hawk	Swampy woods with tall, mature trees for nesting
Sora	Deep marshes with abundant emergent vegetation
Common moorhen	Ponds and deep marshes with emergent vegetation
Eastern screech owl	Small woodlots, open woodlands, suburban shade trees
Long-eared owl	Woodlands adjacent to open lands
Whip-poor-will	Dry open woods
Golden-winged warbler	Brushy overgrown fields, hillside thickets
Vesper sparrow	Dry open fields
Grasshopper sparrow	Dry grasslands
New England cottontail	Dense bushy woodlands

Helpline TDD Relay
225-4033
1-800-992-3312

NEW HAMPSHIRE
NATURAL HERITAGE
INVENTORY

June 3, 1991

Steven Ellsworth
Senior Wetland Scientist
39 Bow Street
P.O. Box 1136
Portsmouth, NH 03801

-5

Dear Mr. Ellsworth:

Thank you for consulting the New Hampshire Natural Heritage Inventory regarding the presence of rare plants, animals, and noteworthy natural communities (hereafter referred to as "elements") in your study area.

The New Hampshire Natural Heritage Inventory, a program within the Department of Resources and Economic Development, collects and analyzes data on the status, location, and distribution of rare or declining native plant and animal species and exemplary natural communities in the state. Using our data base and map information system, the NHNHI also reviews private and public projects with regard to impacts on these species and communities.

Enclosed is a list of the elements known from within the boundaries of Portsmouth, Rye and Town of Greenland site; any of these elements may occur in the area under consideration. The list consists of four columns: state rank, global rank, scientific name, and common name. An explanation of the ranking system is attached.

ELEMENTS	RANK	STATUS
Icterus spurius (Orchard Oriole)	S2, G5	
Salicornia bigelovii (Dwarf Glasswort)	S2, G5Q	ST
Chamaecyparis thyoides (Atlantic White Cedar)	S2	
Iris prismatica (Slender Blue Flag)	S2, G4, G5	ST
Agalinis maritima (Salt-marsh Gerardia)	S2, G5	ST
Melampyrum lineare var. latifolium (Cow-wheat)	SHQ, G5T5	
Malaxis unifolia (Green Adder's-mouth)	S2, G5	ST
Campanula uliginosa (Greater Marsh-bellflower)	S1, G5	
Equisetum variegatum (Variegated Horsetail)	S2, G5	
SNE Acidic Seepage Swamp		
SNE Basin Swamp		

Please note, this information on environmental elements is not the result of comprehensive field surveys. For this reason, the New Hampshire Natural Heritage Inventory cannot provide a

definitive statement on the presence, absence, or status of species or natural communities in the area under consideration. It should also be noted that more data on this area may become available in the future as the inventory expands with ongoing fieldwork and research.

We request information on what you plan to do with this information; if a project is involved or if you are collecting the information for planning. Given the several rare elements in your area we are concerned with impact.

The fee for this review is $50.00. An invoice will be forthcoming from the business office of the Department of Resources and Economic Development.

Sincerely,

Sherry Godlewski

Sherry Godlewski
Natural Heritage Intern

THE RANKING SYSTEM DEVELOPED BY THE NATURE CONSERVANCY AND USED BY ALL STATE NATURAL HERITAGE PROGRAMS FOR "ELEMENTS" OF NATURAL DIVERSITY (RARE SPECIES AND EXEMPLARY NATURAL COMMUNITIES)

Each element is assigned a single global rank by specialists under the guidance of the national Science Department of The Nature Conservancy. State ranks within each state, in which the element occurs, are assigned by the state Heritage Program and will vary from state to state.

GLOBAL ELEMENT RANKS:

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor of its biology making it especially vulnerable to extinction. [Critically endangered throughout range.]

G2 = Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of other factors demonstrably making it very vulnerable to extinction throughout its range. [Endangered throughout range.]

G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single state, a physiographic region) or because of other factors making it vulnerable to extinction throughout its range; in terms of occurrences, in the range of 21 to 100. [Threatened throughout range].

G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

GA = Accidental in North America (not part of the established biota, usually a species of bird).

GE = An exotic species established in North America (e.g., Japanese Honeysuckle).

GH = Of historical occurrence throughout its range, i.e. formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Ivory-billed Woodpecker).

The New Hampshire Natural Heritage Inventory does not inventory GA or GE species.

APPENDIX D

STRAUS FIELD STUDIES

Preliminary Notes on Rare and Uncommon Plants of the Berry's Brook Watershed
1972-1992
C.M. Straus

Note: These preliminary notes pertain to nine areas which have been delineated on the attached map. These areas will be studied in a more in-depth manner in future field trips.

Area 1	From Lafayette Road to Breakfast Hill	*See additional notes*
Area 2	Breakfast Hill to Portsmouth-Rye town line west of Lafayette Road	*Chamaecyparis thyoides Habenaria psycodes
Area 3	Portsmouth-Rye border east of Lafayette Road	*Chamaecyparis thyoides
Area 4	Lang Road, southerly side	*Chamaecyparis thyoides Equisetum fluviatilis
Area 5	Lang Road, northerly side (Beechshone's Conservation area and City of Portsmouth Conservation area).	*Chamaecyparis thyoides Lobelia cardinalis Habenaria psycodes
Area 6	Lafayette Road back woods in rear of residential developments (Colonial Pines, Cedar Boulevard, Spring Brook, The Woodlands, Elwyn Park)	*Chamaecyparis thyoides Sassafras albidum Nyssa sylvatica Habenaria psycodes ❖Typha glauca *Polygonum robustius ◆Myosotis laxa
Area 7	"Bellyhack Bog" at Sagamore Road crossing.	*Chamaecyparis thyoides *Campanula uliginosa
Area 8	Sagamore Road to Brackett Road crossing. *See Additional Notes*	Zanichellia palustris *Scirpus robustus *Eleocharis halophila Sassafras albidum Nyssa sylvatica
Area 9	The esturary, from Brackett Road to Seavey Creek. *See Additional Notes*	*Salicornia Bigelowi *Agalinis (Gerardia) maritima

* Denotes rare and/or endangered NH listing (Note: Chamaecyparis thyoides probably delisted from rare and endangered is still a species of "special concern".

❖ Denotes species not previously recorded in New Hampshire.

◆ Denotes species not previously recorded in Rockingham County.

Flora of Berry's Brook Watershed

Area 1

Local name or location	Dominant vegetation type	Rare or locally uncommon species
Berry's Brook headwaters (partially north of Lafayette Road) and flood plain (southeast of Lafayette Road)	• Cedar swamps • mixed coniferous deciduous forest, white pine, hemlock, swamp maple, white birch, yellow birch, willow species • low woods • shrub swamp • shallow marsh • deep marsh	**Trees** Atlantic White Cedar (Chamaecyparis thyoides) Red Spruce (Picea rubens) Black Gum, Tupelo (Nyssa sylvatica) Sassafras (Sassafras albidum) **Shrubs** Spicebush (Lindera benzoin) Mountain Holly (Nemopanthus mucronata) Sweet Pepperbush (Clethra alnifolia) Ground Hemlock (Taxus canadensis) **Herbaceous Plants** Grape Fern (Botrychium dissectum) Small Purple Fringed Orchids (Habenaria psycodes) Cardinal Flower (Lobelia cardinalis) Knotweed, Smartweed (Polygonum robustius) Forget-me-not (Myosotis laxa)

Flora of Berry's Brook Watershed

Saltmarsh & Marsh Border between Brackett Road & the Natural Dam Marking the Extreme Reach of the Tide
May 26, 1991
Clotilde M. Straus

Area 8

UPPER MARSH AND MARSH BORDER

Grasses
Spartina patens
Hierochloe odorata
Puccinellia maritima
Distichlis spicata
Panicum virgatum

Sedges
Scirpus americanus
Scirpus maritimus
Carex stricta
Carex annectens
Carex scoparius

Rushes
Juncus Gerardi
Juncus effusus
Juncus filiformis

Cattails
Typha angustifolia

Ferns
Thelypteris palustris
Osmunda cinnamomea
Onoclea sensibilis

Forbs (Herbaceous plants with showy flowers)
Solidago sempervirens
Potentilla simplex
Convolvulus sepium
Iris versicolor
Aster novibelgii

Shrubs
Rosa carolina *(Rose Family)*
Aronia melanocarpa *(Rose Family)*
Spiraea latifolia *(Rose Family)*
Amelanchier laevis *(Rose Family)*
Ilex verticillata
Myrica pensylvanica
Gaylussacia baccata
Vaccinium corymbosum
Toxicodendron radicans

Trees
Quercus alba
Quercus borealis
Nyssa sylvatica
Sassafras albidum
Juniperus virginana

MID-MARSH

Spartina patens
Panicum virgatum
*Scirpus robustus
*Eleocharis halophila
Triglochin martima
Potentilla Anserina

*rare and endangered listing

Flora of Berry's Brook Watershed

Area 9

SEAVEY CREEK

Low Marsh
Dominated by Spartina alterniflora

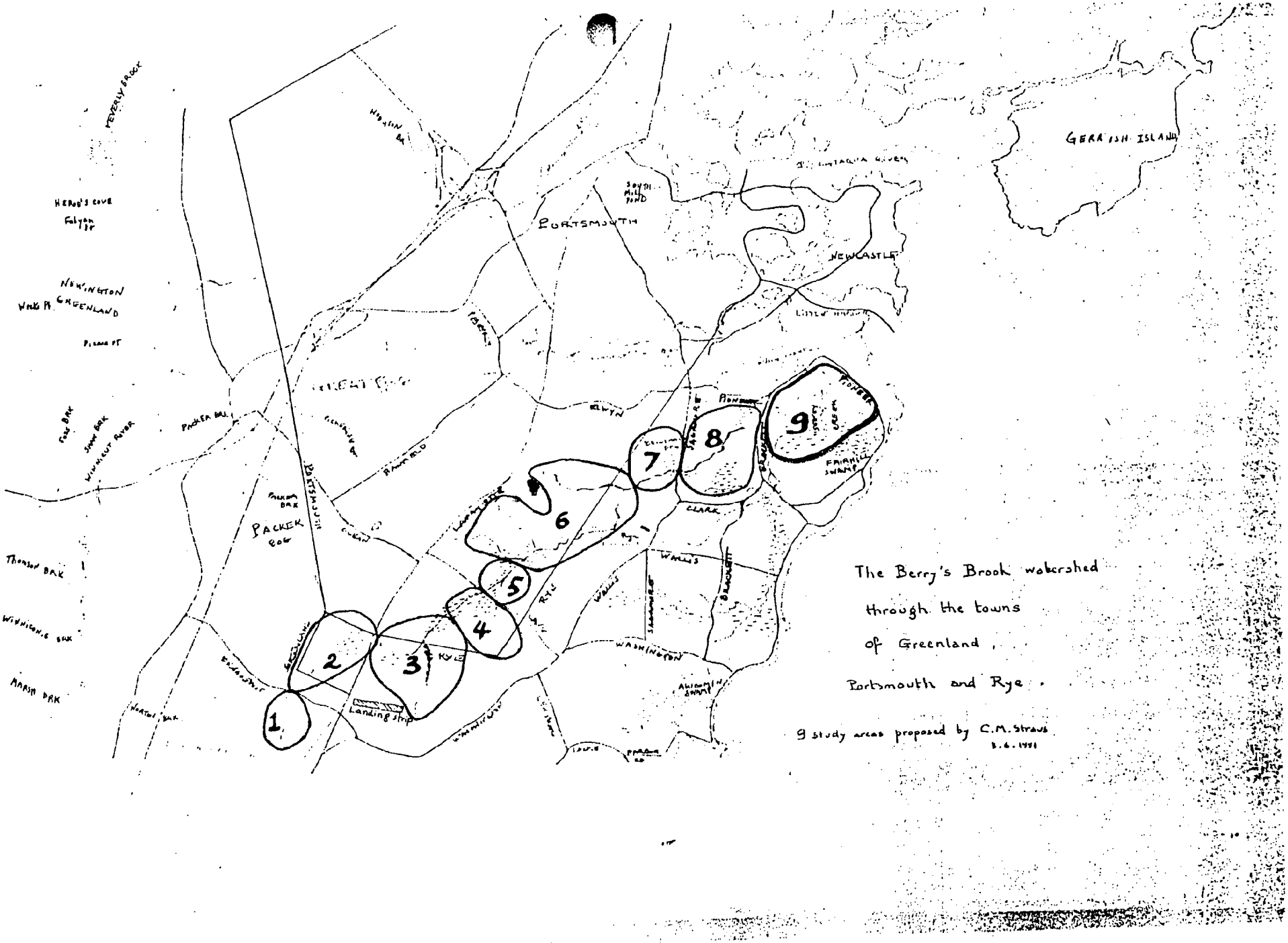
Mid Marsh
Dominated by Spartina patens

Pannes

* Gerardia (Agalinis) maritima
* Salcornia Bigelowi
Salicornia europea

* Rare and Endangered Listing.

See *Floristic Study and Plant Communities of Odiorne Point*, C.M. Straus, *Exploring Odiorne Point*, 1992, page 158. List of plants of Odiorne Plant Section 12 (North Shore Saltmarsh) applies to this section of Berry's Brook Watershed.



The Berry's Brook watershed through the towns of Greenland, Portsmouth and Rye.

9 study areas proposed by C.M. Straub 8.6.1991

APPENDIX E

EROSION AND SEDIMENT CONTROL STANDARDS

Erosion and Sediment Control Standards

Engineering Standards

Engineering standards consist of specific control mechanisms that must be included in the proposed development plans (e.g., hay bales, silt fences, sediment basins, sod waterways, etc.) for a given site. Use of these standards is based on the assumption that if certain specified techniques are employed, then a satisfactory level of protection will be achieved. However, in some cases engineering standards may not provide control measures which are appropriate for a specific situation, and may tend to discourage innovation to meet the specific needs of the given project. The use of these standards are advantageous from the developers' perspective, as compliance with the exact standards tends to assure plan approval. Review boards may view design standards as less complicated to review and enforce. Examples of engineering design standards include:

- o the area of a site to be left exposed at any given time will be kept to a minimum;
- o the appropriate use of diversion ditches, berms, hay bale/silt fence barriers, and other erosion and sedimentation controls; and
- o the immediate seeding or sodding of a disturbed site with indigenous grasses and covering replanted areas with mulch, jute netting or organic fiber erosion control blankets, where appropriate.

Environmental Performance Standards

Environmental performance standards are an alternative to engineering standards. Performance standards are designed to take into account the natural characteristics of the land for both erosion potential as well as runoff retention capabilities. To develop this type of regulation, the community identifies the natural erosion and sedimentation parameters that are closely associated with public health or water quality. For example, these parameters could be in the form of pounds of soil loss per acre, or solids loadings (total suspended or turbidity) to receiving waters. The community establishes the standards and parameters desired, and any development of the land in the area must be completed in such a way as to not compromise that level. This method allows for innovative control design and the tailoring of control measures to specific site conditions. Examples of environmental performance standards include:

- o a permit by exception will be required for the clear cutting of over 10,000 square feet of any area;
- o site work will not increase turbidity in any receiving waters (e.g., wetlands, streams, or ephemeral tributaries, etc.); and

o site work will not increase suspended solids in any receiving waters.

Erosion and sediment control measures are currently required for all construction activities involving the disturbance of more than 100,000 square feet under RSA 485-A:17,I. Such construction activities require a permit under the Site Alteration program that is administered through the New Hampshire Department of Environmental Services. The NH Office of State Planning *Model Shoreland Regulations* recommends a reduction of this limit to 50,000 square feet based upon the Comprehensive Shoreland Protection Act (RSA 483-B).

Erosion and sediment control measures are also required for all construction activities involving the disturbance of more than 5 acres of land under the National Pollutant Discharge Elimination System (NPDES). Such construction activities require a permit under the NPDES program. For most sites in New Hampshire this a general permit. The general permit requires a submittal of an NPDES Notice of Intent (NOI) to EPA. The permittee is also required to submit a copy of the NOI to the regulating authorities if the project is subject to any state or local approved sediment and erosion control plan. The general permit specifies that certain sediment/erosion control measures are to be implemented. As part of the general permit conditions the site operator or developer must also prepare and implement a Stormwater Pollution Prevention Plan (SWPP). This plan must detail the sediment/erosion control measures to be implemented, and identify who is responsible for implementation, inspection, and maintenance. In addition, the general permit requires weekly inspections of all control measures, as well as within 24 hours of large rain events. Inspection reports must be kept as part of the SWPP, and action must be taken to correct any problems which occur. This federal permit program now ensures that sediment and erosion control measures will be implemented for most significant development projects. An added benefit of the federal regulations is that the state or EPA have the ability to take appropriate enforcement action if the permit conditions are not met. For the most part developers have been preparing erosion and sediment control and stormwater management plans to satisfy local and state regulations that generally meet the federal requirements.

Stormwater Management

The management or control of stormwater runoff may include source control (reducing the generation and transport of pollutants) as well as treatment (the removal of pollutants prior to discharge to the receiving resource). Traditionally, stormwater control measures and any regulation of stormwater runoff associated with development activities has focused on flood control (e.g., controlling peak runoff rates, etc.). However, more recently, attention has broadened to include water quality considerations.

Stormwater Management for New Development

Control of runoff from new development is most commonly accomplished through subdivision regulations. As with sediment and erosion control measures, the regulations may dictate that new development must follow accepted engineering design practices, performance standards, or both.

Design criteria place requirements on the site developer to design stormwater systems according to a set of fixed specifications. Such criteria often explicitly or implicitly specify a certain type of treatment device which would be uniformly required on all sites. This type of approach generally restricts innovations on the part of the developer, and does not consider varying site characteristics which may not be conducive to the required treatment practice. The use of such specifications does not consider the assimilative or carrying capacity of the receiving water resource.

Examples of design specifications include requirements for 48 hours detention or other specific detention time for site runoff for a given size storm. A 24 to 48 hour detention time provides a fairly high level of particulate pollutant removal. The removal of dissolved and very fine particulate matter may vary considerably with such design specifications depending upon the specific design of the pond and the presence or absence of aquatic vegetation. Another example of a design specification for water quality treatment is to require the treatment (traditionally through infiltration) of the "first flush" or first 1/2 inch of runoff from the site.

Performance requirements or standards set an expected level of performance for the stormwater treatment system, while allowing for flexibility in the actual types and sequences of treatment devices. An example of a performance standard is the use of a treatment criteria. Recent guidance issued by the US EPA and the National Oceanic and Atmospheric Administration (NOAA) for the control of nonpoint source pollutants within the coastal zone require new development projects to reduce the average annual loadings of total suspended solids (TSS) from the site by 80% or demonstrate no greater than pre-development loads. (See *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, USEPA, 1992). Similar approaches for establishing treatment criteria have been recommended in some states (e.g., Rhode Island which recommends 85% reduction in TSS for sensitive resources or watersheds). The premise for TSS treatment criteria is that a large proportion of pollutants found in urban runoff are associated with particulate material. Therefore, if one removes a substantial portion of the suspended solids, other pollutants will also be removed. The developer must demonstrate that the proposed stormwater treatment design will achieve the desired removal efficiency. This is most commonly done through the use of standard design criteria or predictive hydrologic-based water quality models. There are several models or guidance documents (e.g., *P8 Urban Catchment Model*, Schueler's *Practical Manual for the Design of Best Management Practices,* and *A Current Assessment of Urban Best Management Practices: Techniques for Reducing Nonpoint Source Pollution in the Coastal Zone,* 1992) which could be used by the reviewing agencies to determine if the proposed design would be expected to provide the desired results.

Other performance based approaches include establishing numeric or qualitative discharge limits which must be documented by monitoring. Numeric limits are extremely difficult to develop and should be based upon both the receiving water assimilative capacity as well as technologically achievable levels. Numeric limits are not practical for application at the local level in most cases. On the other hand, it is difficult to demonstrate compliance with qualitative criteria.

Stormwater Management for Existing Sources

While regulation of development may minimize impacts of runoff from new development, such regulations do not provide a means for controlling pollutant discharges from currently developed areas, including roadways. Mechanisms to control existing discharges may be of particular importance in watershed areas which are largely developed. Control of existing sources must be implemented by the communities rather than specific land owners, and may include:

- o enhanced maintenance activities, e.g., street sweeping and catch basin cleaning; reduced salting and sanding, leaf pick-up and composting;
- o retrofitting of catch basins with more effective structures for pollutant attenuation, e.g., catch basins with sumps and oil/grease separators, triple chambered basins, leaching catch basins;
- o modifying discharge points, e.g., flow dissipaters (rip rap), vegetated swales, check dams; and
- o public education regarding fertilizer/pesticide use, hazardous materials disposal, etc.

Finnemore (1982) suggests that each round of sweeping removes about 30% of the total solids from roads. However, actual percent removal is largely dependent on the street surface conditions. Sartor and Gaboury (1984), however, state that in order to achieve a 30% removal (or a 30% reduction in the amount of material potentially reaching the Brook), the street sweeping interval should be two times the time span between rain events. For this region, in order to achieve 30% reduction in sediments, street sweeping would need to be conducted about 3-4 times per week.

Catch basins may be designed to trap sediments carried in stormwater runoff, but if not properly maintained, they tend to act more as sources than as sinks of pollution (Huber, 1986). Sediments collected in the basins after one storm may be resuspended and carried out of the basin by the first flush of stormwater through the storm sewer from the next storm. At a minimum, quarterly inspection and maintenance is considered sufficient.

Efforts to reduce the amount of salt and sand use for winter deicing can reduce the amount of material discharged to adjacent streams. Alternative de-icing materials used in place of salt may also be used to reduce sodium inputs to the receiving waters. However, alternative deicing materials tend to be more costly.

APPENDIX F

SAMPLE EDUCATIONAL FACT SHEET

The Lake Washington Project Lake & Watershed Management Educational Series

Water Conservation
Preventing Septic Systems Failure

Fact Sheet No. 7 August 1991

Septic systems are a common type of individual sewage disposal system (ISDS). Septic systems receive and treat wastewater from your home, removing solid wastes by settling in the septic tank, and removing pollutants from the liquid wastes as wastewater passes through the leach field and into the surrounding soils. Septic tanks, if sized and maintained properly with pump-outs every 2 - 5 years will function indefinitely. The leach field, however, has a limited lifespan, which is determined by the load of wastewater on the field, relative to its size (expressed as gallons per square foot of leach area per day) and the characteristics of the surrounding soil.

The long-term discharge of wastewater to the soils below the leach field may clog the soils (or affect the soil permeability), and over time will affect the way wastewater infiltrates into the soils. In addition, long-term wastewater loading will eventually exhaust the phosphorus binding capacity of the soils. Therefore, as septic systems out-last their effective lifespan, they are likely to contribute larger and larger quantities of nutrients and bacteria to areas downgradient of the leach field. Septic systems located near the shorelines of lakes or ponds have a great potential to contribute to the problem of eutrophication.

Septic systems are designed (or "sized") to treat a fixed amount (or load) of wastewater. On average, systems are designed to have a capacity to treat 60 - 75 gallons of wastewater per person per household. Therefore, a household with three bedrooms and 2 persons per bedroom needs a system designed to treat from 360 - 450 gallons of wastewater daily. A system which has a design capacity that is less than the amount of wastewater it is actually receiving is termed an "under-sized system". Many septic systems located along the shorelines of lakes and ponds are under-sized. This has frequently occurred when, over the years, summer camps and cottages (designed for infrequent and seasonal use) have been converted to year round homes, without appropriate modifications to or replacement of the original septic system.

"Overloading a septic system will eventually lead to system failure and costly repairs and replacement."

Overloading of a system occurs when more wastewater is discharged into the ISDS than the system was designed to handle. Overloading of the septic system will cause incomplete settling of solid wastes, and flooding and clogging of the leach field. Eventually, this will lead to system failure and costly repairs and replacement. Overloading may occur when a system is under-sized, or simply when leaks result in a continual discharge of water to the system. For example, one leaking faucet can waste from 300 to 4,000 gallons of water per month and a leaking toilet may waste more than 50 gallons of water per day[1].

[1] - from Earth Day 1990 Action Guide, New Age Journal. 1990

APPENDIX G

NON-REGULATORY LAND MANAGEMENT STRATEGIES

NON-REGULATORY LAND MANAGMENET STRATEGIES

Land Acquisition

This strategy requires the outright purchase of selected property within the watershed by one of the three municipalities or some other land holding entity such as the state or federal government or a private group, such as the Nature Conservancy, the Society for the Protection of New Hampshire's Forests or a community land trust. These groups purchase parcels of land, or the development rights of a parcel in order to permanently protect the property for open space. Private or non-profit entities have one advantage in that the difference between the sale price and fair market value may be taken as a federal tax deduction. In addition, land trusts may act more quickly and discreetly than a public entity and provide a suitable alternative to government ownership. On the other hand, a government entity may use the value of the property as match for subsequent federal grants that may be used to enhance or improve the open space.

Although land acquisition is the most direct and effective way to protect watershed resources, it can also be very costly. Therefore, the option should be pursued on a selective basis that complements other protective measures as part of the overall watershed protection plan by targeting only the most critical parcels for purchase.

Current Use Taxation

Towns can encourage property owners to protect land as open space by educating them about the advantages of the state's current use law (NHRSA 79-A). Qualifying parcels (such as wetlands, floodplains, farmlands and woodlands that are 10 or more acres) are taxed at a rate that reflects their current uses rather than their "highest and best use" which is usually development. The community benefits by protecting key parcels and the landowner benefits through reduction in local property taxes. If the land owner sells the changes the use of the parcel, a financial penalty is imposed.

Conservation Easements

Another technique for land protection is conservation easements, which allow a municipality to protect resource areas without outright purchase. The easement is a legal agreement between the land owner and a municipality to keep a parcel undeveloped for a specified period of time, preferably in perpetuity. The agreement specifies the types of uses allowed and becomes part of the property deed. The landowner benefits by paying lower property taxes (through the current use program) and receiving a federal tax deduction for the value of property lost (if the owner is not paid for the easement). The town benefits by having land protected from development.

Transfer of Development Rights (TDRs)

Transfer of development rights is a land use management mechanism that literally provides for transferring development rights from one parcel of land to another parcel of land. This strategy is based upon the desire of a community to allow more intense development in specified areas while providing open space protection in other areas.

TDRs are based on the assumption that the various rights associated with land ownership can be separated and used, or sold, individually. A property owner in any one of the watershed communities could, under a TDR program, separate his or her residential development rights from other property rights (such as agricultural use) and sell only the development rights.

In implementing a TDR program, the watershed communities would identify those areas where development would be encouraged (referred to as receiving zones, since these areas would receive additional development rights from lands identified for open space) and other areas where protection of open space (referred to as sending zones, since these areas would send additional rights to receiving zones) would be encouraged. Under a TDR system, a property owner in the area to be protected could sell his or her "development rights" to a prospective developer/property owner. The purchaser of the development rights would be able, under zoning guidelines, to use these rights to increase the development density on the "receiving" property. The TDR system should be supported by an updated master plan and supportive municipal zoning. Watershed communities could use TDRs in order to preserve undeveloped properties in the watershed as open space.

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