

**ROYAL RIVER WATERSHED: A WATER QUALITY
MANAGEMENT PLAN**



**CUMBERLAND COUNTY SOIL AND WATER CONSERVATION DISTRICT
MARCH, 1998**

A NOTE TO THE READER FROM THE PROJECT MANAGER

I was asked recently by an elementary school in the Royal River Watershed to spend part of a day describing to third grade students what a "watershed" is. After spending some time explaining what makes up a watershed to the students, I asked them to show me what they thought a watershed would look like if they were to paint a portrait of themselves into their watershed. Their portraits turned out to be delightful and imaginative. Some children drew their houses and yards while others drew nature scenes along a river or lake. But every portrait included what I feel is the most vital part of any watershed - **people**. Certainly watersheds consist of much more than just the people that live there, but at this point on the Geological Time Line - people are the most dominant presence. Only people can work together to protect and preserve the environment so that these third graders' children and their grandchildren can, in turn, paint themselves into impressive portraits of their watershed.

I would like to dedicate this report and project to the people of the Royal River Watershed.

- Forrest Bell

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This project was funded by a grant from the United States Environmental Protection Agency through the Clean Water Act, Section 104(b)(3). The contents of this document do not necessarily reflect the views and policies of the EPA, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

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Katherine Groves

ACKNOWLEDGMENTS

The Royal River Watershed Project and this report would not have been possible without the assistance of many individuals, groups and agencies. We would like to recognize and thank the following contributors:

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Project sponsors/partners and their roles

- **Cumberland County Soil and Water Conservation District (CCSWCD)** is the main sponsor of the Royal River Watershed 104(b)(3) Planning Project. The CCSWCD is responsible for carrying out the objectives of the grant and completing the Royal River Watershed Management Plan.
- **United States Environmental Protection Agency (US EPA)** is the provider of funds for the Royal River Watershed 104(b)(3) Planning Project and is responsible for overseeing the timely and effective completion of the project.
- **United States Department of Agriculture Natural Resources Conservation Service (USDA NRCS)** is a close partner of the CCSWCD and provided guidance, technical assistance, and coordination assistance for the watershed project. The USDA NRCS initiated a PL 83-566 Small Watershed Planning Project in the Royal River Watershed.
- **Casco Bay Estuary Project (CBEP)** provided guidance, Geographic Information System (GIS) mapping, technical assistance, and coordination assistance for the watershed project.

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I. INTRODUCTION

In February of 1994, the Cumberland County Soil and Water Conservation District (SWCD) held a public forum to identify the environmental concerns of Royal River Watershed residents and to form a consensus of watershed resource issues. Later these problems, concerns, and issues were reviewed and prioritized by the project sponsors and technical advisors.

The results of this meeting (**See Appendix A for a complete listing**) initiated a planning project for the Royal River Watershed. The United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) received and approved a request from the Cumberland County Soil and Water Conservation District to sponsor a Public Law 83-566 Small Watershed Project in this region. In addition, a Clean Water Act 104(b)(3) grant was issued by the United States Environmental Protection Agency (US EPA) to aid in the assessment of the Royal River Watershed and to develop this water quality management report.

During the next two years (1995-96), the Royal River Watershed Planning Project was launched with the help of several individuals, groups, and agencies. The project was overseen by two groups - a technical steering team and a watershed advisory committee. (**Appendix B gives a detailed breakdown of the structure of the project**). These two groups donated much of their time to assessing the watershed and assisting the project sponsor - the Cumberland County SWCD - to provide outreach and education to the citizens of the watershed. A mission statement was developed to help guide the project.

MISSION STATEMENT

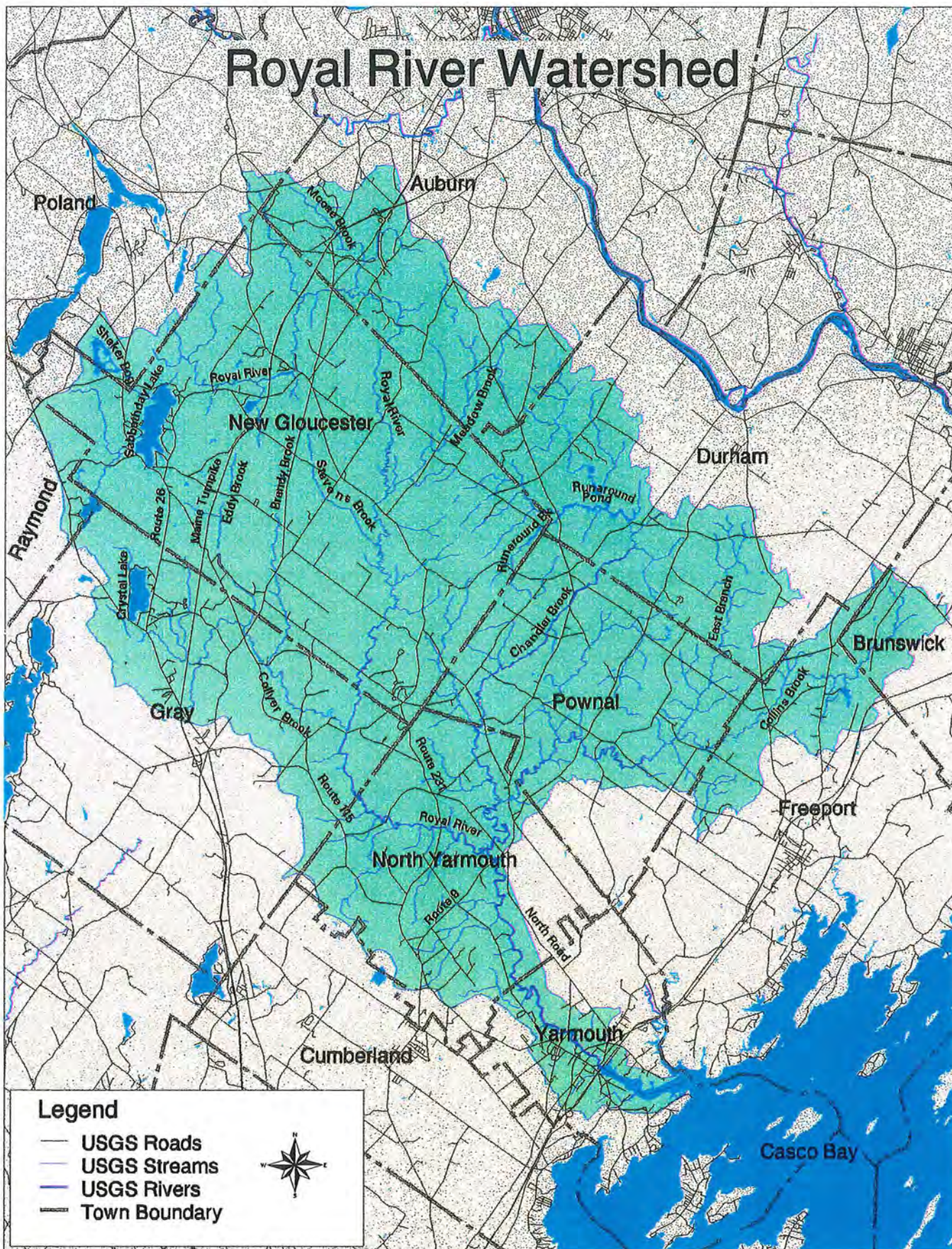
The mission of the Royal River Watershed Project is to develop a long-term water quality management plan to protect and enhance the river and its watershed so that future generations can benefit from the full potential of the natural resources.

In the winter of 1996, it became evident that the PL 83-566 process was not going to be advantageous for the Royal River Watershed. Federal funding under the program was drastically cut, and the project committees decided to focus efforts on completing the Royal River Water Quality Management Plan. While goals of the project were streamlined to fit with the objectives of this water quality management plan, the mission of the groups and agencies remains the same.

The Royal River Water Quality Management Plan is designed for the residents of the watershed so that they can work together to improve, restore, and protect surface waters and groundwater in the Royal River Watershed. In addition to assessing and describing the present state of water quality in the Royal River Watershed, this management plan offers suggestions on how to provide long and short term protection of surface waters and groundwater. In particular, the plan recommends ways to restore and enhance indigenous and resident fisheries and other aquatic life in the surface waters of the watershed, and increase opportunities for human enjoyment of surface waters through water quality protection and improvements.

Note: The Royal River Water Quality Management Plan includes technical terms that many people may be unfamiliar with. Some of these terms are included in a Glossary, which begins on page 31.

Royal River Watershed



Legend

-  USGS Roads
-  USGS Streams
-  USGS Rivers
-  Town Boundary

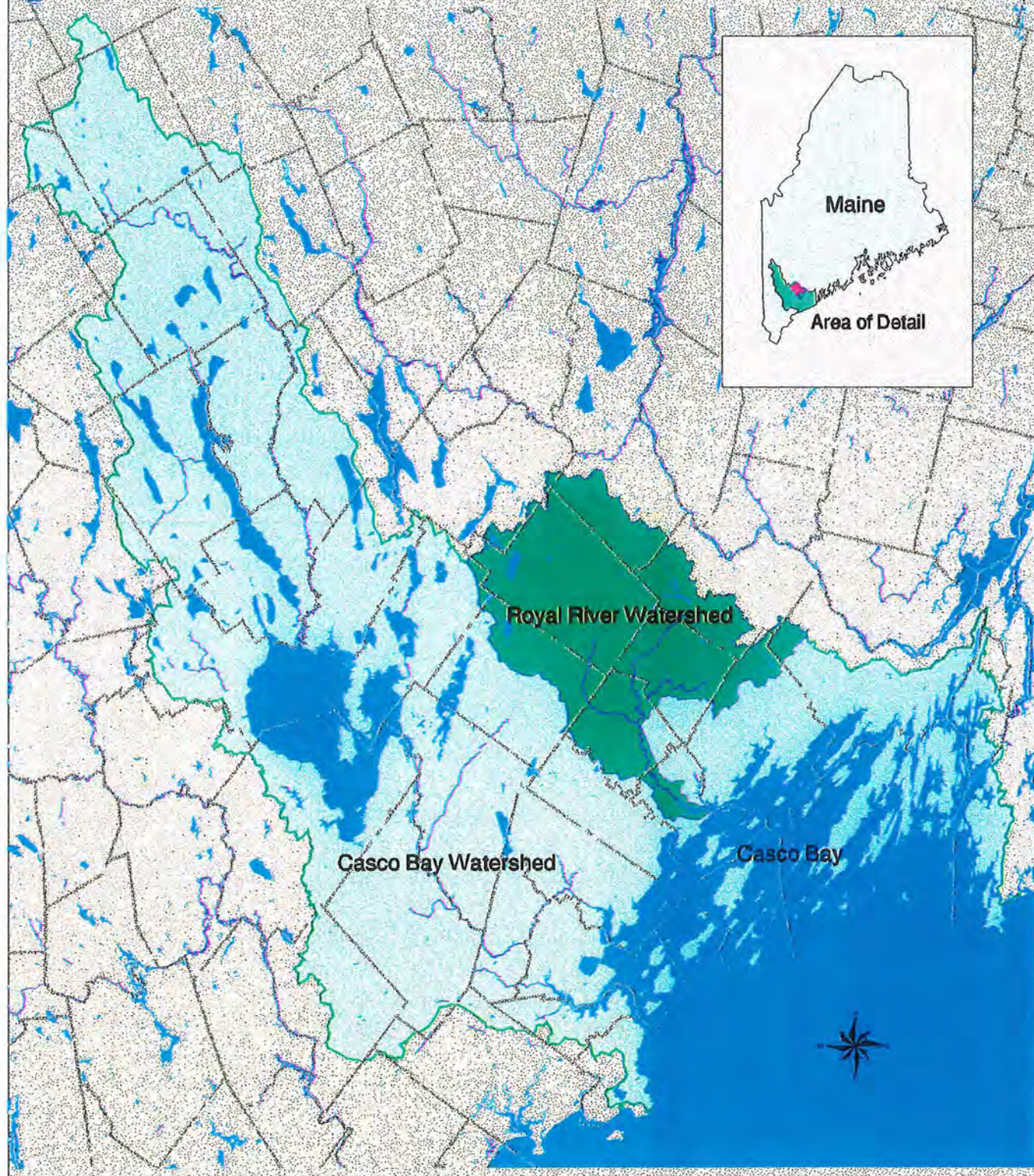


Scale 1:167,000

Data Sources:
Maine Office of GIS
State House Station #125
Augusta, ME 04333

SEP-11-1007

Casco Bay and Royal River Watersheds



Scale 1:187,000

Data Sources:
Maine Office of GIS
State House Station #125
Augusta, ME 04333

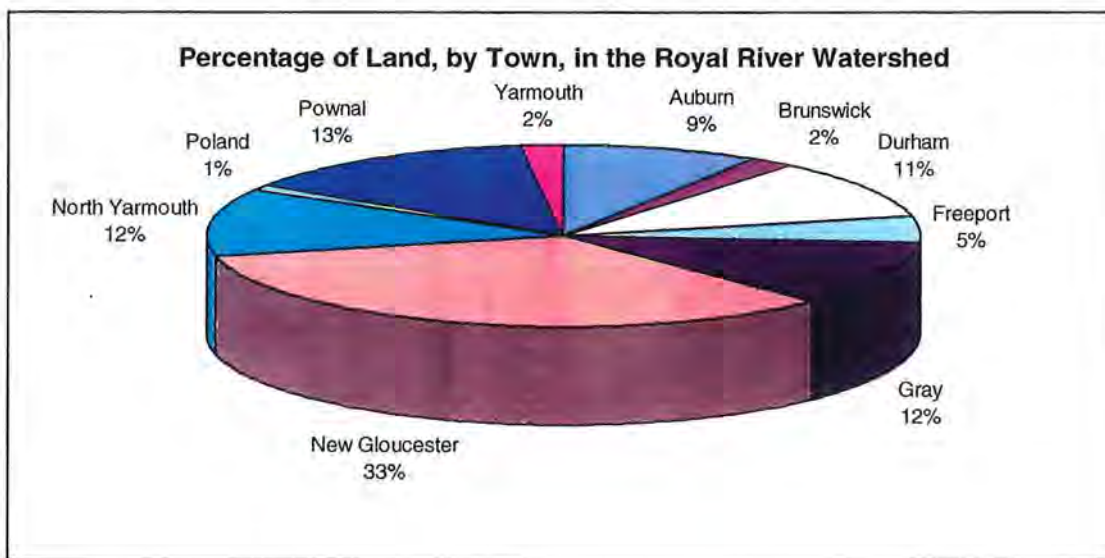
SEP-10-1097

II. WATERSHED DESCRIPTION

General Description

The Royal River Watershed, which is drained by the Royal River, Chandler Brook and their tributaries, is one of five major watersheds that constitute the larger Casco Bay Watershed in southern Maine. The Royal River enters the tidal waters of Casco Bay in the town of Yarmouth. The 150 square mile watershed is located in the towns of Auburn, Durham, and Poland in Androscoggin County and the towns of Brunswick, Cumberland, Freeport, Gray, New Gloucester, North Yarmouth, Pownal, Raymond, and Yarmouth in Cumberland County. Although there are no exact figures available for the exact population of the watershed, about five percent (62,500) of the total Maine population of 1.25 million live in the towns that contain land area within the Royal River Watershed. The following graph illustrates the amount of land area in each of these towns that make up the watershed. Raymond and Cumberland are not depicted on the chart because their land area in the watershed constitutes less than 1 percent.

Percentage of land, by town, in the Royal River Watershed



Natural Features

According to the Casco Bay Land Use Inventory (USDA NRCS, 1995), this watershed is located in the Coastal Lowland region which is characterized by rolling hills with small changes in elevation. The topography in some areas of the watershed is very irregular with many narrow valleys and very steep slopes. Stratified metamorphic rocks, which are rocks that have been greatly altered from their previous condition by heat and pressure, are found along the coast. Soils that have been deposited by glacial melt water, called glacial outwash, and ice-contact stratified drift which include kames, terraces, eskers, and deltas, are found in the areas where relief is low. The coastal zone is commonly covered by marine silts and clays.

The majority of the land within the Royal River Watershed can be categorized as having gentle to moderate slopes. Generally speaking the flat, gently sloping and moderately sloping areas are usually well suited for development. It should be noted, however, that flat lands are sometimes difficult to drain, depending on the type of soil present, and would require extensive stormwater management infrastructure to develop. There are areas of very steep slopes (greater than 25%) in

isolated areas on the hills of each community. The greatest area of steep land is found in Pownal on Bradbury Mountain (a frequently visited State Park) and Tryon Mountain.

The watershed boundary includes several water features. Among them are Crystal Lake, Notched Pond, Runaround Pond, Sabbathday Lake, and Shaker Bog in the northwest; Florida Lake as well as tributaries and main stems of Chandler Brook in the northeast; and the tributaries and main stem of the Royal River draining from the northwest to the southeast. Collyer Brook, Brandy Brook, Thoits Brook, the East Branch, Collins Brook, Deer Brook and Toddy Brook are some of the more notable streams in the watershed. These tributaries, including Chandler Brook, contribute 86% of the water flow to the Royal River. The average daily flow of the river at Yarmouth according to the US Geological Survey is 273 cubic feet per second.

Land use in the watershed according to the Casco Bay Watershed Land Use Inventory (USDA NRCS, 1995) is approximately 60% forested, 27% developed, and 6% farmed. The remaining 7% of the watershed is comprised of ponds, rivers, streams, and wetlands.

Fish and Wildlife

The Maine Department of Inland Fish and Wildlife has documented that the Royal River Watershed supports a variety of fresh water, marine, anadromous, and catadromous fisheries. Anadromous fish in the watershed include *Alewife*, *Smelt*, *Shad*, and possibly *Salmon*. Game fish in the watershed include *Brown and Brook Trout*, *Perch*, *Pickrel*, *Smallmouth and Largemouth Bass*, and *Striped Bass and Bluefish in the tidal waters*. Other species of fish include the *Golden Shiner*, *Common Shiner*, *Northern Redbelly Dace*, *Blacknose Dace*, *Creek Chub*, *Lake Chub*, *Fallfish*, *Nine Spine Stickleback*, *White Sucker*, *Hornpout (brown bullhead)* *Pumpkinseed Sunfish*, and the *American Eel*, a *catadromous fish*.

The watershed supports a trout habitat in the northern and western areas of the watershed. There are wild Brown Trout in the Collyer Brook drainage area. These streams include Brandy Brook, Eddy Brook, Cole Brook, Hatchery Brook, Mill Brook and Libby Brook. Many of the tributaries that enter the Royal River and the lower stem of the Royal River below Gray are marginal trout streams. According to John Boland, Regional Biologist for Maine Inland Fish and Wildlife, this is because of the warmer water temperatures and suspended sediments from both natural and human induced erosion. The lakes in the northwestern part of the watershed (Sabbathday Lake, Crystal Lake, and Notched Pond) all support an abundant cold water fishery (predominantly brook and brown trout) and are stocked by Maine Inland Fish and Wildlife; Runaround Pond in Durham is not stocked but contains pickerel and golden shiners. According to the Maine Department of Human Services, a fish consumption advisory has been posted for the all inland waters in Maine including the Royal River Watershed (**Please see Appendix C**).

The Royal River Watershed does contain some productive clam flats that are harvested for commercial and recreational purposes. The south shore of the Royal River estuary in Yarmouth has approximately 22.5 acres of productive soft-shell clam flats with an estimated average yield of 45 bushels per acre. The north shore of this estuary has approximately 37 acres with an estimated average yield of 183 bushels per acre. By contrast, the Yarmouth side of Cousins River, which is rated Class SB, is far more productive with only 13 acres of clam flats producing an estimated average yield of 230 bushels per acre.

Wildlife in the watershed is abundant and, according to the Maine Department of Inland Fish and Wildlife (IF&W), includes some species that are listed as endangered and threatened in Maine.

Maine Endangered Species

Roseate Tern (coastal)
Grasshopper Sparrow
Box Turtle

Maine Threatened Species

Bald Eagle
Spotted Turtle

Several animals use the Royal River Watershed as their habitat including the *Black Bear, Beaver, Bobcat, Eastern Chipmunk, Eastern Cottontail, Coyote, White-tailed Deer, Fisher, Gray Fox, Red Fox, Snowshoe Hare, Mink, Moose, Muskrat, Opossum, River Otter, Porcupine, Raccoon, Flying Squirrel, Gray Squirrel, Red Squirrel, Striped Skunk, Woodchuck, Wood Ducks, Black Ducks, Great Blue Heron, Grouse, and Woodcock.*

Other Features

There are three dams on the main stem of the Royal River. Two dams are located in Yarmouth, and another in New Gloucester. Both of the dams in Yarmouth currently provide fish passage while the New Gloucester dam does not, and according to Maine Inland Fish and Wildlife - does not need, a fish passageway. There are three other dams in the watershed (that do not provide for fish passage) including one in North Yarmouth at the Yarmouth Reservoir, one in North Pownal on Chandler Brook, and one near the source of Chandler Brook at Runaround Pond in Durham. None of the three dams on the mainstem of the Royal River or its major tributaries are subject to a Federal Energy Regulatory Commission (FERC) license. However, owners of the Sparhawk Dam, which is located on Bridge Street in Yarmouth, applied for and received an exemption from FERC licensing in 1985. The "exemption", notwithstanding the name, requires the dam to be operated in compliance with terms and conditions determined appropriate by federal and state fish and wildlife agencies to prevent loss of or damage to fish and wildlife resources in the river.

The U.S. Army Corps of Engineers reports that alterations to the Royal River estuary channel have been made since 1883. Since that time, the river has been dredged and a channel widened by the Corps in 1967, 1976, 1985, 1986, and most recently in 1995-96 (**Please see Appendix F** for a summary of the most recent dredging project). This action creates a channel 80 feet wide and with an average depth of eight feet at mean low tide.

According to the USDA Natural Resources Conservation Service, The predominant soils in the watershed are the Paxton-Woodbridge-Hollis association (deep, well drained and moderately well drained, nearly level to strongly sloping moderately coarse textured soils) and the Scantic-Buxton-Windsor association (deep, poorly drained to moderately well drained, level to moderately sloping, medium textured soils). Through the assessment of the Royal River Projects' Technical Teams, soil erosion has been identified as a significant problem in the watershed. The watershed contains soils which, for the most part, are vulnerable to water induced erosion. Soil erosion is the wearing away of soil by the gradual detachment of soil and rock fragments by water, wind, ice, and other mechanical and chemical forces. Human activities can greatly speed this detachment. The Cumberland County SWCD and NRCS have conducted soil erosion surveys (CCSWCD/NRCS: September, 1995) on the main stem of the Royal River and on all roadways. Further discussion on soil erosion in the watershed appears in the forthcoming chapters.

The majority of the water supplies in the watershed come from private wells with the exception of the areas serviced by three water districts: the Yarmouth Water District which serves the towns of Yarmouth and North Yarmouth, the Lewiston/Auburn Water District which serves the City of Auburn and the Portland Water District serves a portion of the town of Gray. Likewise, a

majority of the homes and businesses in the watershed have private septic systems. Only parts of Freeport, Yarmouth, and Auburn have public sewer systems.

Recreation

The Royal River is one of the prime canoeing rivers in the southern part of Maine. There are numerous access points and road crossings to put a canoe into the water. From New Gloucester, the River winds with a good current through wetland areas. There are some areas in the northern segment of the river, however, where the gradient is too steep and water levels are usually too low for travel. The most popular stretch of river for canoeists is the ten mile stretch between Yarmouth and North Yarmouth. Other popular areas for boating are the lower segment of Chandler Brook and all of the lakes and ponds in the watershed.

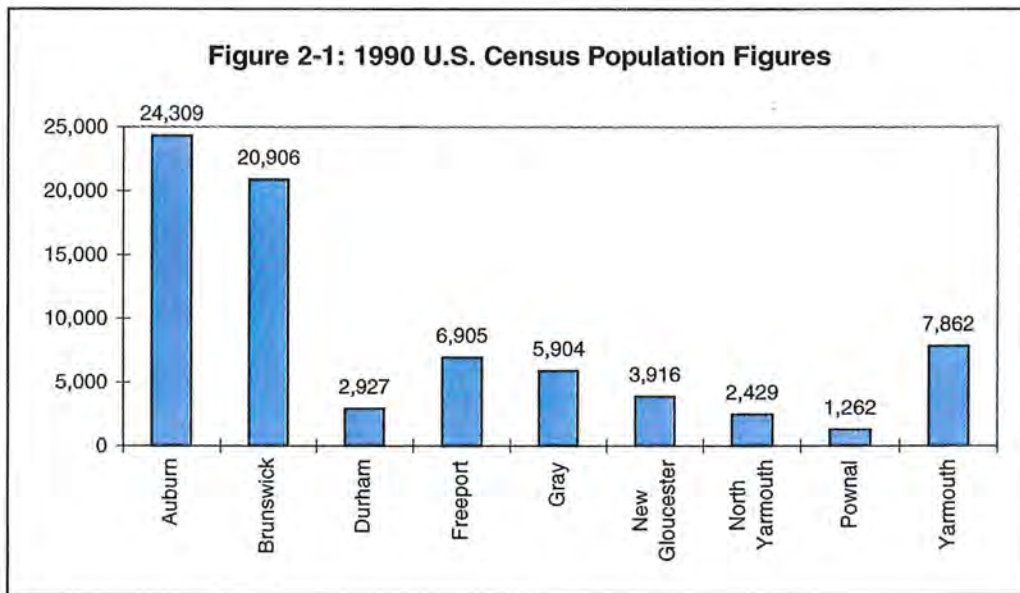
Fishing has long been a popular form of recreation in the Royal River Watershed. Other important forms of recreation in the watershed include swimming, picnicking and hiking in the spring, summer, and early fall. The late fall and winter months provide opportunities for ice skating and cross country skiing on the frozen Royal River, while a significant amount of snowmobiling and hunting takes place in the more remote sections of the watershed.

The Royal River and its watershed is also used as a teaching facility. The natural setting in an accessible location of the Royal River affords educators an opportunity to educate students on various environmental features. In addition, many groups and agencies have developed educational programs in the watershed. **Please see Appendix G** for summaries of some of these programs.

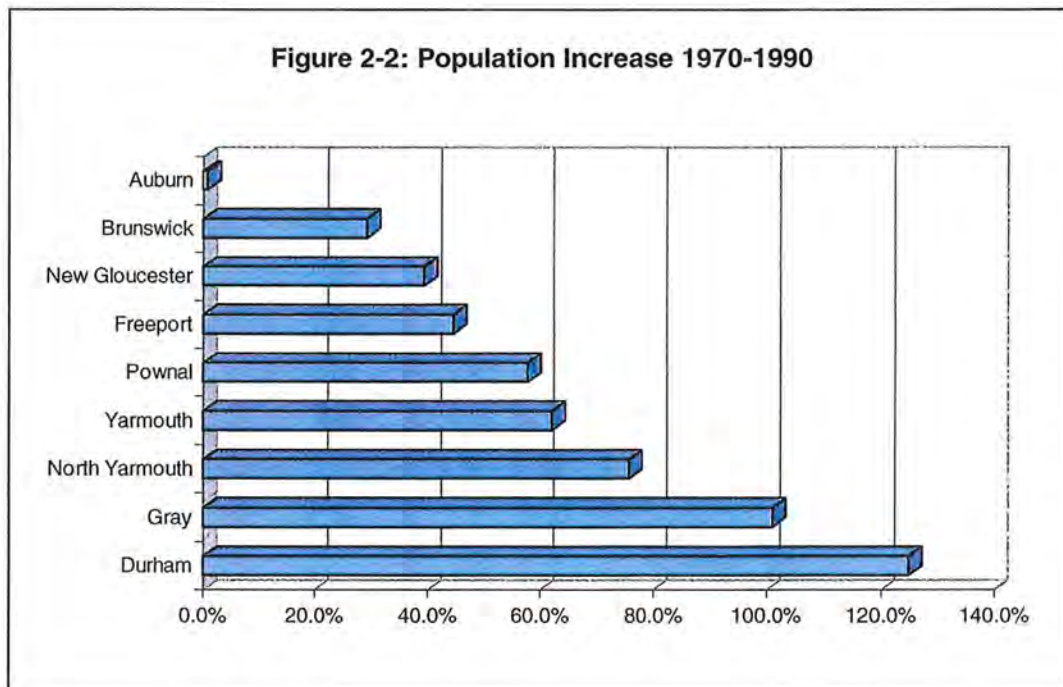
The recreational and educational opportunities in the Royal River Watershed are reason enough to work to improve and protect the water quality in the region. The following chapters will help explain what can and should be done in the short and long term to address water quality concerns.

Population/Housing Unit Growth

One of the reasons that attention has been drawn to the Royal River Watershed is the potential for increased development to impact the watershed. With an increase in housing units comes an increase in impervious surfaces which are, any surfaces altered in such a way that stormwater cannot penetrate into the ground. The increase in impervious surfaces increases the volume of polluted stormwater runoff in a watershed which can have a negative impact on water quality (increased polluted runoff, raising stream temperatures, flooding) if not properly managed. *Please note that the population figures in Figure 2-1 are for the entire town's population.* The population figures for Auburn, Brunswick, and Freeport would be much lower due to the fact that the areas of the town in the Royal River Watershed do not include the business districts which contain the greatest population. Unfortunately, demographic data in Maine is not currently figured for watershed boundaries.



The population and housing growth rate of the area has steadily increased over the past twenty years. According to the 1990 U.S. Census, population increases in Royal River watershed towns from 1970 - 1990 have ranged from increases of 0.7% to 124.8%. The following graph, Figure 2-2, depicts the percent change in population for the nine towns with the most land area in the watershed.

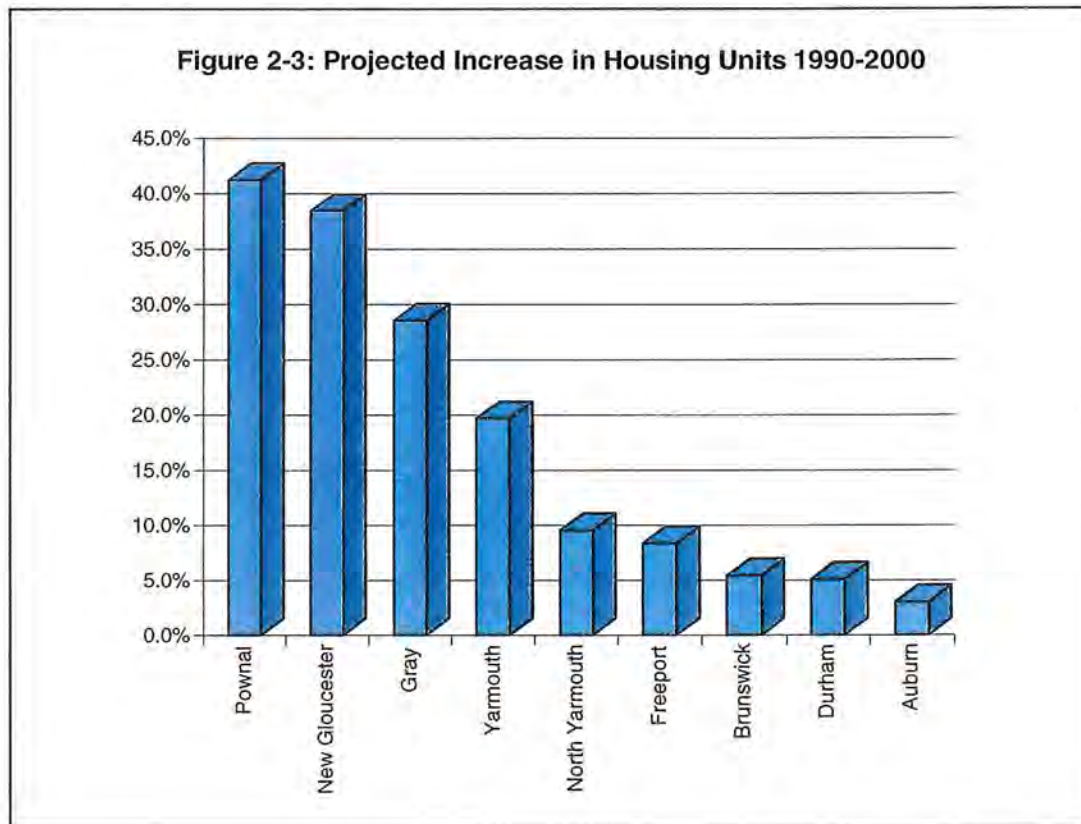


The primary driver of population growth in the Royal River Watershed is the economic opportunity offered in southern Maine. When a region experiences economic expansion, population growth generally follows. Economic expansion has certainly been a factor in the

growth of southern Maine communities since total employment has increased rapidly during the past twenty years.

Another factor which has influenced growth in the watershed is the immigration of people from surrounding communities where land and housing costs are higher. Royal River Watershed communities recognize that they serve as “bedroom” communities for Greater Portland, Lewiston-Auburn, Augusta, and Brunswick’s employment opportunities.

The US Census Summary on Population and Housing Characteristics also projects that many of the Royal River Watershed communities will experience a significant housing increase during the present decade (1990-2000). The projected number of total housing units is derived by dividing the population projection for the year 2000 by the number of persons per housing unit from the 1990 Census. It should be noted that this figure may be somewhat conservative since the trend has been for decreasing household size. If this trend continues and the 2000 projections remain the same there would be more housing units. The following graph, Figure 2-3, illustrates this projected increase.



The towns of Pownal and New Gloucester are both projected to have a housing unit increase of 40% during this decade. This is a concern because the land area of these two towns constitute nearly 50% of the land area of the Royal River Watershed. It is important to consider the effects that increased population can have on water quality. In general, more human activity means more pressure on the ecosystem. Municipalities in the Royal River Watershed need to work together to carefully manage and regulate human activities. Recommendations for ways to work together appear in the next few chapters. Certainly one important factor for municipalities to track is

present and future trends of population and housing unit growth. **Appendix D** lists some of the water quality concerns that municipalities have in the Royal River Watershed.

Impacts to water quality from increasing development has been an important focus for many local and state groups and agencies in Maine. The Maine Department of Environmental Protection (A Developer's Guide to the Maine Stormwater Management Law, July 1997) illustrates the effect that human activities have on watersheds in Maine:

Unfortunately many of Maine's waterbodies are in danger. Activities in areas draining to Maine's watersheds alter waterflow, add pollutants, and damage habitat. A decline in water quality results in business losses from decreased tourism, property damage, and decreasing coldwater fish populations. In addition, the value of shorefront property declines, affecting the local tax base. This results in higher taxes for residents and businesses alike. Once prosperous regions of the state have suffered tremendous economic losses due to the degradation of valuable waterbodies.

The process leading to degradation starts when rainwater or water from snow melt flows over disturbed areas, paved or graveled sites, roads, lawns, and agricultural fields. This "stormwater" picks up eroding soil, residue from gas and oil, nutrients, heavy metals, bacteria, and pathogens. Unless stormwater receives proper treatment, these pollutants will be deposited in lakes, rivers, and coastal waters. Also, when woods and fields are replaced by impervious areas such as pavement, dirt roads, or buildings, the volume of runoff is substantially increased. Changes in the volume, velocity and timing of flows can cause property damage, erode stream banks, scour stream bottoms, flood property, and harm habitat.

III. WATER QUALITY ISSUES IN THE WATERSHED

Impacts of Water Quality Degradation on Human and Aquatic Life

All life depends on clean water. Biological, economic, and industrial growth are all linked to the availability of clean water. Unfortunately, it has been estimated that by the year 2000, approximately a quarter of the world's fresh water will be contaminated from the effects of human activity. - (Maine DEP: A Citizen's Guide to Lake Watershed Surveys, 1997)

Water is one of the most valuable natural resources on our planet. Preserving the water quality of our oceans, lakes, streams, ponds, estuaries, and aquifers is necessary for the survival of humans, plants, and animals. Protecting our groundwater is essential so that drinking water remains healthy for consumption. Our surface waters are also used as water supplies as well as for many types of recreation including fishing, swimming, and boating. Maintaining healthy levels of water quality in the Royal River Watershed will ensure that its lakes and rivers remain open to these forms of recreation. Many studies have shown that decreasing water quality can adversely affect the economy. Without good water quality, waterfront property values can decline, expensive costs to dredge channels (this has happened in the Royal River Watershed - **Please see Appendix F**) and forms of recreation that are important to the economy can be negatively impacted.

In addition to the human uses that can be affected by water quality, the fisheries and wildlife rely heavily on water quality. Sedimentation from soil erosion has been cited as a main source of pollution affecting the Royal River Watershed. This is not surprising, as sediment from soil erosion is considered the leading contributor to water pollution in our country. The following list (from Watershed Protection Techniques, Volume 12, February 1997) describes some of the impacts that suspended and deposited sediment can have on the aquatic environment.

Impacts of **Suspended** Sediment on the Aquatic Environment

- Abrades and damages fish gills, increasing risk of infection and disease
- Scours periphyton from stream (plants attached to rocks)
- Shifts in fish community toward more sediment tolerant species
- Reduces sight distance for trout, with reduction in feeding efficiency
- Reduces light penetration which causes reduction in plankton and aquatic growth
- Slightly increases stream temperature in the summer
- Suspended sediments are a major carrier of harmful nutrients and metals
- Adversely impacts aquatic insects which are the base of the food chain

Impacts of **Deposited** Sediment on the Aquatic Environment

- Reduces survival rate for fish eggs
- Reduces channel capacity, exacerbating downstream bank erosion and flooding
- Physically smothers benthic aquatic insect community
- Destroys spawning areas
- Increases in sediment oxygen demand can deplete dissolved oxygen (DO) in lakes or streams
- Reduces flood transport capacity under bridges and through culverts

The impacts to the aquatic community can be devastating. Fortunately, in the Royal River watershed work has been done to assess the water quality and identify the sources that are negatively impacting water quality in the watershed.

Water Quality Monitoring in the Royal River Watershed

Although it is difficult to draw a definite conclusion, technical teams organized to contribute knowledge to this Plan have concluded that residential and commercial development, roadways and agriculture appear to be contributing the largest amounts of polluted runoff in the watershed. Water quality monitoring parameters or “vital signs” that have frequently been used to assess the health of the watershed are Dissolved Oxygen (DO), Fecal Coliform Bacteria, Turbidity, and to a lesser extent Macroinvertebrate Identification. The Friends of the Royal River, an active grassroots watershed management and monitoring organization, provided useful descriptions of these monitoring parameters in their Spring, 1996 Newsletter (Excerpts from article written by Mary Holman):

Dissolved Oxygen

The level of DO in a body of water is one of the best indicators of its health and its ability to support aquatic life. The higher the level the better. Seasonal and daily fluctuations in dissolved oxygen can be quite large. Early summer morning measurements of DO show the worst case scenario on the river because warm water holds less oxygen than cold water and because during the dark nighttime hours the aquatic plants are consuming oxygen rather than releasing oxygen into the water as they do through photosynthesis during the daylight hours. For Class B waters (which includes the Royal River), Maine Department of Environmental Protection standards state that the dissolved oxygen levels should not fall below 75% saturation.

Turbidity

Turbidity is the measurement of the amount of light scattered by placing a water sample in a light beam. It is recorded in units called nephelometric units (NU). The turbidity of a sample is proportional to the amount of suspended particulate matter in the water sample. While there is not a turbidity standard for Class B waters, values below 30 NU are preferable although it is not unusual to see values over 100 NU after heavy rainfalls.

Fecal Coliform Bacteria

Fecal Coliform bacteria are found in the digestive tracts of warm-blooded animals. The presence of fecal coliform bacteria in a sample indicates that there has been a recent contamination event but does not necessarily indicate that disease-causing bacteria are present. Bacterial results can be greatly influenced by storm events and all sites often have higher than normal levels of bacteria after heavy rainstorms. The bacterial standards accepted for fresh waters in Maine are for E. coli counts, there are no established standards for fecal coliform counts. The permissible level for fecal coliform bacteria in estuaries (for swimming and drinking only after treatment) is less than 1,000 colonies in 100mL of filtered water and the preferable cutoff is less than 200 colonies in 100mL of filtered water.

Macroinvertebrate Identification

Macroinvertebrates are animals without backbones that live at least part of their lives in water. They include: worms, clams, leeches, crayfish, snails and aquatic insect such as mayflies, caddis flies, dragonflies, and water beetles. The DO, turbidity and fecal coliform tests being done on the water samples each give information on an aspect of the water quality at a particular moment

in time. The varying degrees of sensitivity of macroinvertebrate species able to live in the water is a very important indicator of the overall health of the river.

Water Quality Data

The water quality monitoring results for the Royal River and some of its tributaries have revealed changes in certain sampling locations to levels of dissolved oxygen and fecal coliform bacteria. The results of five years of water quality monitoring conducted by the Friends of the Royal River will be available in 1998. Additional sampling in the watershed has been conducted between 1983 and 1987 by the Maine Department of Environmental Protection.

Map 3 illustrates the sample locations (labeled by distance from the Royal River Estuary) for the Friends of the Royal River while Map 4 illustrates the sampling locations that were undertaken by the Maine Department of Environmental Protection. Please note that site identification numbers were not available and lake and pond sampling sites are not listed on the DEP map. Areas where water quality may be a concern due to the results of monitoring and other factors are outlined in Chapter 4.

The measured turbidity of Royal River sites has been fairly low. However, this does not mean that there are no soil erosion and sedimentation problems in the watershed. The turbidity readings following a significant storm event would be much higher as this is when most soil erosion occurs. Most sites have averaged below 10 NTU for all three years of testing conducted by the Friends of the Royal River. Sites averaging slightly over 10 NTU are usually on tributaries to the Royal River (i.e. Chander Brook, Brandy Brook) or at the confluence of the Royal River and a tributary.

Macroinvertebrate data in the watershed is limited, as sampling of this type was initiated in the watershed just a few years ago. Preliminary reports from the Maine DEP and the Friends of the Royal River suggest that many pollution intolerant species are found in the watershed.

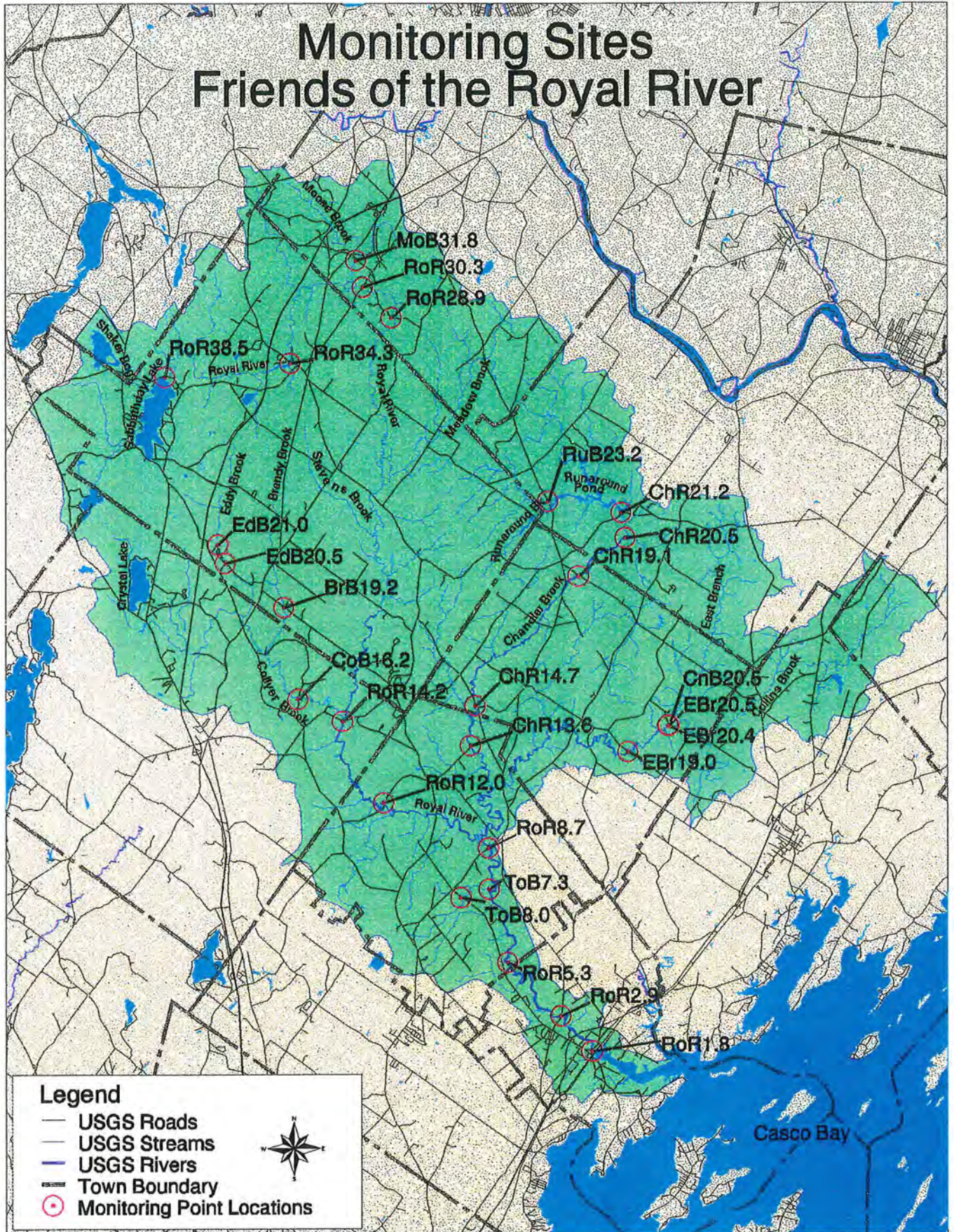
The Maine DEP and the Volunteer Monitoring Program collect data on many of the lakes in the watershed. Trends have shown consistent declines in water quality on some of these lakes largely due to impact from development. Specific information on lakes in the Royal River Watershed appears in Chapter 4.

Sources Impacting Water Quality

Understanding what is affecting the water quality in the Royal River Watershed is crucial if agencies, groups and watershed citizens want to make the necessary changes to prevent degradation of water quality and to maintain healthy aquatic communities. According to studies directed by Royal River technical sub-teams (agency representatives facilitated by the Cumberland County SWCD and USDA Natural Resources Conservation Service), the three main contributors to the degradation of water quality are:

- Soil erosion and sedimentation from roadsides, gravel pits, and streambanks.
- Impacts from development including stormwater runoff and groundwater contamination, and other urban issues
- Agricultural/timber harvesting nonpoint source pollution

Monitoring Sites Friends of the Royal River

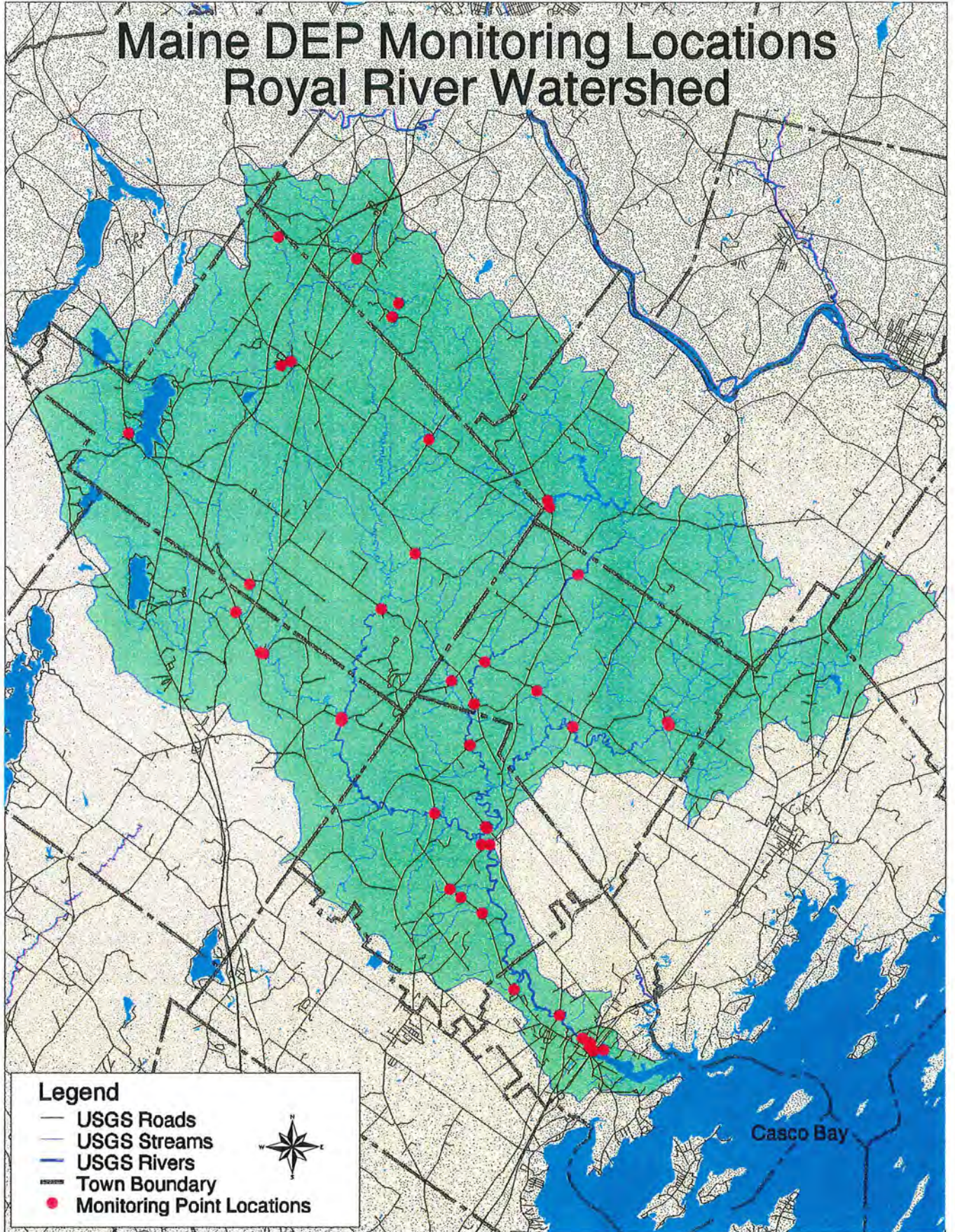


Scale 1:167,000

Data Sources:
Maine Office of GIS
State House Station #125
Augusta, ME 04333
Friends of the Royal River

SEP-11-1997

Maine DEP Monitoring Locations Royal River Watershed



0 1 2 3 4 Miles
0 1 2 3 4 5 6 Kilometers

Scale 1:167,000

Data Sources:
Maine Office of GIS
State House Station #125
Augusta, ME 04333
Maine DEP

SEP-10-1997

Soil Erosion and Sedimentation from Roadsides, Gravel Pits, and Streambanks

The technical sub-team organized by the Cumberland County SWCD and USDA NRCS concluded through field analysis, and consultation with scientists, engineers and local residents that sediment is the single greatest pollutant, by volume, in the Royal River Watershed. The amount of sediment in the rivers and streams of the watershed has impaired several critical wildlife habitats and caused the need for more frequent and expensive dredging in the lower portions of the river. In 1994 the Atlantic Salmon Commission of Maine determined that the Royal River would be unfit for the introduction of Atlantic Salmon to the river due to the excess sediment both naturally occurring and from human impact in the riverbed. No determination was made about the future possibilities of introducing Atlantic Salmon. In addition to this degradation of the Royal River, several brooks and streams in the watershed have been impaired due to roadside runoff, gravel pit runoff, and streambank erosion.

Roadside erosion is well documented in the Royal River Watershed. The CCSWCD conducted a Roadside Erosion Inventory in 1991. This inventory located all significant areas of roadside erosion in the Casco Bay Watershed including 35 "most severe" sites in the Royal River Watershed. This inventory was updated by the CCSWCD during the 1996 Roadside Runoff and Erosion Control Project. This project identified roadside erosion sites at stream and river crossings within the watershed. Over 150 sites were identified as contributing excessive sediment to the Royal River and its tributaries. As previously mentioned, the impacts to aquatic life from these roadside sites can be devastating.

Through field visits, the Cumberland County SWCD and NRCS have determined that clay and gravel pits contribute sediment to the Royal River and its tributaries. Although runoff is sometimes contained within the confines of these pits.

Approximately 60 gravel pits in the Royal River Watershed were located by CCSWCD staff using topographical maps, however, these topographic maps were dated 1979 to 1981 and since then more pits have been developed. The DEP requires a license for gravel pits that are greater than five acres in size. Currently, approximately 27 of the gravel pits within the watershed are licensed with the DEP. The majority of the gravel pits in this watershed are less than five acres; and therefore, little is known about these gravel pit operations.

Naturally and human induced streambank erosion is another source that contributes significant amounts of sediment in the watershed. The CCSWCD and the Natural Resources Conservation Service surveyed the riverbanks of the lower half of the Royal River in 1995. Over 25 major sites were identified and located on a watershed map. About two thirds of these sites appeared to be naturally occurring erosion. The predominance of clay soils in this lower portion of the watershed contributes to the accelerated erosion and sedimentation.

Impacts from Development (Urban Issues)

Human activities in the watershed are typically perceived to have a negative impact on natural resources in general, and water quality specifically. Technical specialists brought together for this project examined the various perceived problems and concerns identified in a public forum.

Although only limited data is available to determine the specific effects that residential and commercial development have on the watershed, there are several potential sources of pollution that could threaten water quality in the Royal River Watershed. These include increased nutrients and pathogens from improperly maintained septic systems and land spreading of sludge and septage, pathogens, nutrients, and toxic substances such as heavy metals from stormwater runoff

and sediment and toxic substances from construction site runoff, landfills, salt storage sites, underground storage tanks, hazardous material spills (**Please see Appendix I for information regarding response to hazardous spills in the watershed**), and litter. It is likely that some of the identified issues do represent a significant threat to water quality in the watershed, if not now, they will in the future. Most of the communities are relatively small and undeveloped at present. As population continues to grow and more development occurs there will be increasing pressure on watershed resources. One of the more significant findings of the preliminary study is the fact that there is a general lack of public understanding and knowledge with respect to the actual and potential effects of development.

Agriculture/Timber Harvesting

According to the Gorham Field Office of the Natural Resources Conservation Service, agricultural nonpoint source pollution is a concern in the Royal River Watershed, even though only 6,635 acres (3.3% of the watershed) are actively being used for agricultural crop production. The major agricultural land uses include hayland for forage and mulch hay production, pastureland for livestock, and cropland. The major market crops grown in the watershed are vegetable truck crops (including potatoes and corn), apples and small fruits. Livestock in the watershed include beef and dairy cattle, as well as sheep.

The Maine Department of Environmental Protection and the Maine Department of Inland Fish and Wildlife have observed that most agricultural contributions to non-point source pollution occur during the fall, winter, and spring when the ground is frozen or saturated, or during major storm events. Potential sources, and/or activities that can contribute to nonpoint source pollution in the Royal River Watershed include livestock wading in streams, barnyard runoff, cropland, hayland, and pastureland eroding into adjacent watercourses, and improperly applied nutrient, pesticide and water management practices.

Forested land is the largest land cover in the watershed, covering approximately 60% of the watershed. According to the U.S. Forest Service, forested land cover is ideal to protect water quality because forests typically contribute the least amount of nonpoint source pollutants per acre of any land cover type. The traditional concept of sustained-yield forestry has focused predominantly on forest stand management for timber harvesting. The emerging concept of forestry focuses on the long-term health and productivity of the forest ecosystem for multiple uses.

Timber harvesting activities, such as the layout of roads and skid trails, location of landings, and crossing of streams and other water bodies, may also contribute to water quality problems in the Royal River Watershed. Soil compaction also poses a problem over some sites when whole tree chipping is implemented.

IV. SITE SPECIFIC WATER QUALITY PROBLEMS AND SOLUTIONS

This chapter is intended to present site specific problems that are known in the watershed as well as presenting potential solutions to treat the problems. In several situations, the Cumberland County SWCD has determined that obtaining more inventory or water quality data may be the best recommendation for that water body. A number of general recommendations that do not necessarily pertain to a given water body appear in Chapter V.

According to the Maine Department of Environmental Protection, all lakes and ponds in the Royal River Watershed are either threatened or not attaining water quality standards.

Sabbathday Lake, Crystal Lake, Lily Pond, Runaround Pond, and Notched Pond are all listed under the Maine DEP posting (Stormwater Law, Chapter 502) of lakes most at risk from new development. The main stem of the Royal River, with the exception of the estuary, does meet its assigned water quality standard of Class B. In fact, all of the tributaries in the watershed are assigned a standard of Class B. Class B is the third highest classification of fresh surface waters not classified as great ponds. For a summary of what the other classifications represent **please see Appendix J.** The following is a summary of the Class B classification as specified by the Maine DEP:

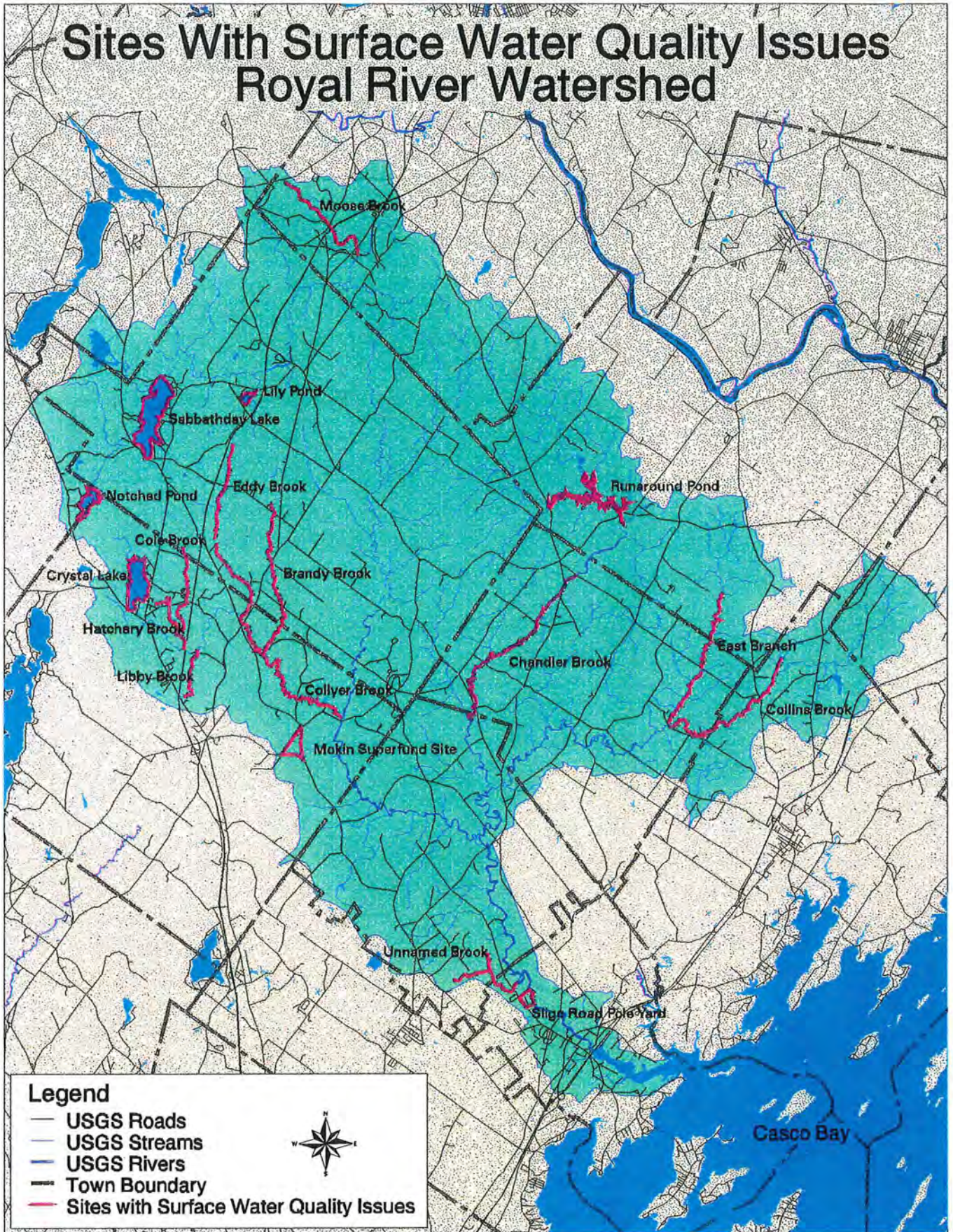
- A. **Class B waters** shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life. The habitat shall be characterized as unimpaired.
- B. The dissolved oxygen content of **Class B waters** shall be not less than 7 parts per million or 75% of saturation, whichever is higher, except that for the period from October 1st to May 14th, in order to ensure spawning and egg incubation of indigenous fish species, the 7-day mean dissolved oxygen concentration shall not be less than 9.5 parts per million and the 1-day minimum dissolved oxygen concentration shall not be less than 8 parts per million in identified fish spawning areas. Between May 15th and September 30th, the number of *Esherichia coli* bacteria of human origin in these waters may not exceed a geometric mean of 64 per 100 milliliters or an instantaneous level of 427 per 100 milliliters.
- C. Discharges to **Class B waters** shall not cause adverse impact to aquatic life in that the receiving waters shall be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community.

Lakes and Ponds

Sabbathday Lake, New Gloucester

Sabbathday Lake was recently downgraded by the Maine DEP because it did not meet dissolved oxygen standards. Sabbathday Lake is characterized by dissolved oxygen depletion in the deepest parts of the lake basin, moderate algal production, but is not at an immediate risk for a phosphorus recycling problem which could lead to an algal bloom. The lake is one of the important recreational facilities of the watershed with numerous fishing, swimming and boating opportunities. The lake is closely monitored by the Sabbathday Lake Association. A complete watershed survey was conducted by watershed citizens, CCSWCD and DEP in 1996. The survey found that state, town, and private roads were the largest contributor of sediments to the lake. (for

Sites With Surface Water Quality Issues Royal River Watershed



Data Sources:
 Maine Office of GIS
 State House Station #125
 Augusta, ME 04333
 Friends of the Royal River

SEP-10-1997

a more detailed summary of the results of the watershed project please see Appendix G). Sabbathday Lake is listed as a “priority” water body by the Maine DEP and is also listed as one of Maine’s lakes most at risk from development pressures.

Management Options: Sabbathday Lake is an important resource and has sufficient data to illustrate a decline in water quality. Additionally, sources of polluted runoff have been documented. The Lake Association and New Gloucester Water Resources Committee should work with the Maine DEP, Cumberland County SWCD, and local groups to implement a water quality restoration project in the watershed. These projects are usually focused on the installation and demonstration of Best Management Practices. Section 319 grants are available through DEP and the US EPA to implement projects of this type. Other ways to address pollution sources include volunteer driven projects, workshops and seeking technical assistance from the Maine DEP and local Soil and Water Conservation Districts.

Runaround Pond, Durham

Runaround Pond is the source of Chandler Brook. Low dissolved oxygen readings have been recorded (by the Maine DEP) for the Pond, including at the outlet, where Chandler Brook begins. Runaround Pond is relatively shallow and does not support a cold water fishery. However, the pond is used for canoeing and there is a small town landing near the outlet of Chandler Brook where fishing and picnicking are popular. There is not an active lake association, but the pond is monitored and the Durham Conservation Commission hopes to focus water quality efforts here in the next several years. With support from the Casco Bay Estuary Project in the form of a mini-grant, the Town of Durham conducted (with the help of a consulting biologist) a watershed survey in 1994 similar to the survey done for Sabbathday Lake. The results of this watershed survey were also similar with roads accounting for nearly 60% of the polluted runoff entering Runaround Pond and its immediate watershed. This report can be obtained by contacting the Town of Durham.

Management Options: Runaround Pond is listed by the Maine DEP as a threatened lake and should continue to be a focus of the Durham Conservation Commission. Local parties should consider opportunities for implementing Best Management Practices including Section 319 Grants through Maine DEP and the US EPA. Local residents should also attempt to organize a lake association to track water quality trends and help educate the public on the importance of water quality.

Crystal Lake (also known as Dry Pond), Gray

According to DEP data, the Lake does not consistently meet dissolved oxygen standards. The lake is characterized by dissolved oxygen depletion at the deepest parts of the lake, moderate algal production, and is considered to be a high risk for phosphorus recycling problem. Crystal Lake is quite densely developed along the shores and, according to Maine Inland Fish and Wildlife, is experiencing a reduction in cold water fisheries. There is no lake association and no watershed survey work has been undertaken in recent years.

Management Options: Because of the potential impact of development in the area, Crystal Lake should be continuously monitored. The formation of a lake association would be beneficial to future preservation and implementation efforts. Undertaking a watershed survey (a qualitative and quantitative process of determining the extent of soil erosion in a watershed and defining the BMPs to be implemented) would be a logical and useful next step.

Notched Pond, Raymond/Gray/New Gloucester

Notched Pond does not consistently meet dissolved oxygen standards. There are indications of dissolved oxygen depletion at the deepest area of the Pond, and moderate algal production according to the Maine DEP. The pond has some shoreline development and there is the potential for future development. There is no lake association and no known watershed surveys have been undertaken in recent years. The pond does support a cold water fishery (trout).

Management Options: As in the case for Crystal Lake, an expanded water quality monitoring program, the formation of a lake association would greatly benefit the future of the Pond. Once a Lake Association is formed, a watershed survey to determine sites contributing polluted runoff would be a logical and useful next step.

Lily Pond, New Gloucester

Lily Pond is not currently developed but there is the potential for future development in the watershed. The pond does support a warm-water fish population of mostly bass and pickerel.

Management Option: Lily Pond is a popular recreation spot and preventing a decline in water quality is necessary to preserve the warm water fishery. Best Management Practices for Roadside Erosion Control should be implemented at a town road crossing near the pond's outlet. The Cumberland County SWCD, Maine DEP and Maine Department of Transportation Local Roads Center can provide technical assistance and training to road crews on implementing BMPs.

Tributaries to Royal River

There are more than 30 tributaries to the Royal River. Monitoring and assessment efforts on some of these smaller streams and brooks was undertaken in the mid 1980s by Maine DEP and has been re-initiated in the past five years by The Friends of the Royal River. The Friends of the Royal River and Maine DEP have both expressed the desire to expand their monitoring programs to assess more of these streams. The following summaries are based on what information is currently available. Many of the streams are not listed because assessment work has not taken place in their watersheds. The management options for the tributaries are inclusive for all of the listed and unlisted streams.

Brandy Brook, Gray/New Gloucester

Dissolved oxygen deficit is the major water quality issue affecting Brandy Brook. This stream, which supports a cold water fishery, has experienced readings below the allowable 75% saturation level for dissolved oxygen. According to CCSWCD roadside data, roadside runoff is contributing sediment to this brook in at least two areas. A stream restoration project has been targeted by several agencies on Brandy Brook for 1998.

Chandler Brook, North Yarmouth/Pownal/Durham

Class B Dissolved oxygen standards are not met mainly due to agricultural activities and roadside runoff in the watershed. The Chandler Brook watershed makes up almost one-third of the entire Royal River watershed. Although Chandler Brook and its tributaries do not support a good cold water fishery, there is certainly the potential for restoring a fishery if demonstration efforts continue. There currently is a Non Point Source (NPS) 319 project in this basin managed by the CCSWCD. The project is demonstrating the use of BMPs (Best Management Practices) in the watershed and will be completed by the winter of 1998.

Cole Brook, Gray

The main factor impairing Cole Brook is erosion and sedimentation. The stream was once a bountiful trout habitat but has suffered from the impacts of runoff from a large agricultural field and to a lesser extent, nearby residential development. Monitoring at this site involves macroinvertebrate sampling (conducted by Maine DEP) as well as fish counts (electrofishing; conducted by Maine Inland Fish and Wildlife). Cole Brook is the site of a NPS 319 restoration project undertaken by CCSWCD, DEP and the Maine Department of Inland Fish & Wildlife to help restore the cold water fishery. Implementation efforts include treating agricultural runoff and erosion at a Gray Plains site near the New Gloucester toll booths and building in-stream habitat structures for trout.

Collyer Brook, Gray

Collyer Brook is, according to Maine Inland Fish and Wildlife, the most popular trout fishing stream in the watershed. There has been concern expressed about high bacteria levels. Complete results will be published in the Friends of the Royal River Five Year Monitoring Report.

East Branch and Collins Brook, Pownal/Freeport

It is known (through field evaluation undertaken by CCSWCD and NRCS) that livestock grazing and roadside runoff are contributing to the possible impairment of these streams.

Eddy Brook, New Gloucester

There has been concern expressed on the discharge of the state fish hatchery in New Gloucester. The discharge consists of fish waste and is being monitored by Maine Inland Fish and Wildlife.

Hatchery Brook, Gray

There has been concern expressed on the discharge of the Dry Mills fish hatchery in Gray. The discharge consists of fish waste and is being monitored by Maine Inland Fish and Wildlife.

Libby Brook, Gray

Although there is no available data for this cold water fishery, Libby Brook is known, through field evaluation to have livestock grazing near and wading in its waters. A golf course is proposed to be built along the stream in 1998-2000.

Moose Brook, Auburn

This brook is not on the state 305(b) list (the 305(b) listing is the Maine Department of Environmental Protection's water quality assessment for all surface waters in Maine and is summarized in Appendix J of this report) but five out of eight samples taken in Auburn from June - September of 1996 did not meet dissolved oxygen standards.

Unnamed Brook, North Yarmouth/Yarmouth

This two mile long stream is located on the western side of the Royal River Watershed and the Class B Dissolved oxygen standards are not met, according to Maine DEP, because of agricultural activities in the watershed.

Management Options: Because data for these tributaries are sparse, water quality monitoring efforts should be expanded by State and local groups to include more parameters (macroinvertebrate and total phosphorous) and more sampling sites in all tributaries of the watershed. Many of the watersheds for these streams are fairly small (less than 5 square miles), so restoration efforts of fisheries are manageable. Projects similar to the CCSWCD/DEP/ME IF&W Cole Brook project will help to restore the cold water fisheries in the western half of the watershed. Before restoration efforts take place, field evaluations in the form of watershed surveys should be undertaken. These watershed surveys are a great way for volunteers to become involved in watershed restoration (improving aquatic life by installing BMPs and other management measures) and protection. In addition, implementation efforts should focus on areas where town, state, and private roads cross these streams. Data suggests that many of these road crossings are contributing significant amounts of polluted runoff to the streams. Adding to the importance of installing Best Management Practices at these road crossings is the fact that due to the protection and deep water that culverts and bridges provide, these areas are often pooling areas that contain cold water fisheries. One particular approach for working in these streams would be to initiate "Adopt-A-Stream" projects for tributaries involving community groups, watershed citizens, and interested schools.

Royal River

The Royal River, as mentioned above, is meeting Class B water quality standards in most locations. However there has been concern expressed by agency representatives and citizens living near the river of excessive sedimentation. There are many eroded banks along the river that could be contributing to this excessive sedimentation. Some of these banks are naturally eroding due to hydrogeologic characteristics while others are "human induced". One particular site that is contributing a large amount of sediment to the River is the eroded banks of part of the old Sweetser gravel pit located on Mill Road in North Yarmouth.

The Royal River is one of the recreational attractions to the region and offers numerous swimming, boating and fishing opportunities. The river also provides habitat for numerous species of wildlife. The Friends of the Royal River is an active volunteer organization dedicated to preserving the ecological health of the river. The monitoring and outreach efforts of this group are helping to drive conservation, restoration, and environmental planning efforts in the watershed. Their efforts should be supported and continued if the long term sustainability of the resource is to be maintained.

Management Options: Continued volunteer monitoring efforts on the Royal River should be supported by federal, state, and local entities. Expansion of the number of sampling stations and parameters of the Friends of the Royal River monitoring program would greatly aid in determining where to focus implementation efforts. A Royal River Corridor Commission similar to the Saco River Corridor Commission may be helpful in maintaining recreational opportunities while at the same time, helping to further conservation and education efforts on the river. Establishing vegetative buffers would be a practical measure to reduce pollution loading into the river as well as stabilizing many of the eroded streambanks. Also, the formation of Future Lands Committees, such as the existing committee in North Yarmouth that was recently given 11 acres of land along the Royal River, will help to ensure the protection and proper use of the river corridor.

Royal River Estuary

The waste load allocation model developed by the Maine DEP, which was conducted to help determine discharge limits for the Yarmouth Waste Water Treatment Plant, suggests that the majority of the impact on dissolved oxygen (approximately 60%) is due to sediment oxygen demand (SOD). Water quality data were collected by Maine DEP staff on the Royal River Estuary from above head of tide to Brown's Point during the summers of 1990, 1992, 1993 and 1994. This work included monitoring at one site during 1990 and a multiple site, preliminary survey on July 28, 1992 during which Dissolved Oxygen, temperature and salinity measurements were made. During August/September 1993 and August 1994 intensive surveys were made which included water sampling for nutrients and biochemical oxygen demand (BOD) in addition to the above measurements. The intensive sampling events also included effluent sampling at the Yarmouth Sewage Treatment Plant (STP) Cross-sectional and tidal stage data were collected during June and July 1993. Staff from the USEPA collected sediment samples from the estuary during October 1994 for SOD determinations.

1. The survey data indicated non-attainment of Class SB dissolved oxygen standard for the Royal River Estuary.
2. The intensive surveys were used in developing and calibrating an average daily water quality model for the Royal River Estuary including the Yarmouth STP discharge.
3. The water quality model indicates non attainment of dissolved oxygen standards for all discharge scenarios including the no discharge condition. The majority of the impact on dissolved oxygen (approximately 60%) is due to sediment oxygen demand. The Yarmouth discharge accounts for 9.6% of the impact at license limits and 3.8% of the impact at performance loading.

Management Options: It is recommended that additional sampling be made after the estuary is dredged to determine if the removal of sediments will improve dissolved oxygen and allow current license limits. In the event of insufficient improvement, other alternatives would have to be investigated including a Use Attainability Analysis (UAA), reduction of license limits to more accurately reflect treatment plant performance (possibly in combination with a UAA) and removal of the discharge (by relocation or holding during the summer). In each case there would be no capacity for future load increases. **Note: At press time (September, 1997) this sampling was being undertaken by the Maine DEP.**

Groundwater/Aquifer

Groundwater issues in the Royal River Watershed have been studied in depth by the Maine DEP. Because of the importance of keeping town and private water supplies free of contamination, groundwater concerns are important to all residents in the watershed. The Maine DEP initiated a project in 1989 to determine threats to ground and subsurface water quality in Maine. The site types included in the assessment include underground and above-ground storage tank leaks, surface petroleum spills, municipal landfills, hazardous waste sites, uncontrolled sites, superfund sites, road salt storage sites, composting sites, residuals land utilization sites, wood ash land utilization sites, sludge land utilization sites and septage storage/disposal sites. **This information has been summarized for the Royal River Watershed and included in the map on the following page.** An exact location and description of each site (identified by the site numbers that appear on the map) is kept on file as part of the Groundwater database of Maine DEP. *For more information on these sites or the DEP database, please contact Florence Grosvenor, Hydrogeologist, MDEP, 287-7745.*

McKin Superfund Site and Adjacent Areas, Gray

What is now known as the McKin Superfund Site was until 1963 a working sand and gravel pit surrounded by farms, forests and residential areas. This seven acre pit is located approximately 3,500 feet from the banks of the Royal River. The pit was purchased in 1963 by Richard A. Dingal, owner of the McKin Company.

The site was purchased and operated to store and dispose of liquid industrial wastes. The site was originally constructed to deal with the clean-up debris from tanker spills. In 1972, a spill from a Norwegian tanker carrying industrial oil for Texaco Inc., lost over 100,00 gallons into Hussey Sound in Casco Bay off the coast of Portland. The waste generated by this spill led to an expansion of operations at the McKin facility. Between 100,000 to 200,000 gallons of oil and unidentified chemicals were annually received on the site between 1972 and 1977. These quantities proved to be too great for the facility and wastes were stored haphazardly.

Some local residents began to complain of odorous and discolored well water as early as 1973. Samples of the water were sent to the Maine State Health and Environmental Testing Laboratory. In 1977, trichloroethylene (TCE) and other compounds were identified in the water. The town of Gray ordered the McKin Company to shut down and 16 contaminated wells were capped the same year. Public water was provided to affected homes by mid-1978.

Clean-up at the site began in 1979 and by 1983, 45,500 gallons of liquid wastes were removed by the Maine Department of Environmental Protection. It is unknown what quantity of these liquid wastes may have leaked into the soil, aquifer and bedrock. In 1983, the Environmental Protection Agency announced that the McKin facility had been placed on the National Priorities List and it was included in the Superfund Program. There were 307 parties which signed the Consent Decree for the clean-up and included schools, municipalities, state government agencies, as well as businesses. Remediation of contaminated soils began in 1985. By 1987, 12,000 cubic yards of contaminated soils had been processed.

According to EPA, investigations conducted in the early 1980's showed TCE-contaminated groundwater had spread in both the bedrock and soils from the McKin property in two directions, east to the Royal River and north toward Collyer Brook. Following the treatment of soils in 1991, the responsible parties began operation of a limited groundwater extraction and treatment system

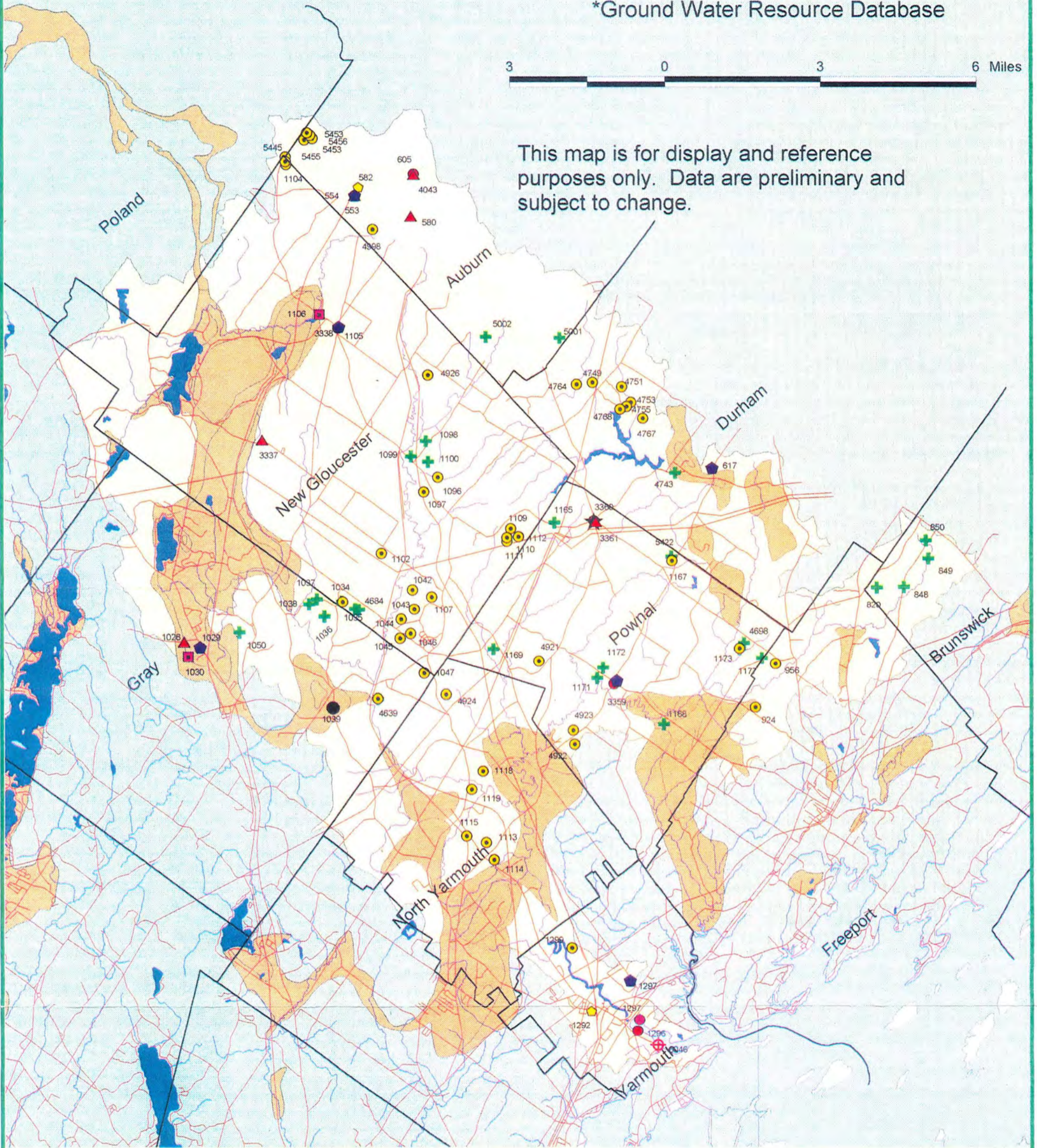


Threats to Ground and Surface Water Quality* Royal River sub-Basin

*Ground Water Resource Database



This map is for display and reference purposes only. Data are preliminary and subject to change.



Legend

Base Data

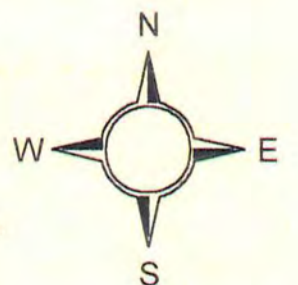
- Political Boundaries
- Transportation Routes
- Significant Sand and Gravel Aquifers
- Presumpscot Basin
- Lakes and Rivers
- Coastal Waters

Feature Data

- Underground Petroleum Storage Tank Leaks
- Aboveground Petroleum Storage Tank Leaks
- Closed Municipal Landfills
- Compost Sites
- Superfund Sites
- Hazardous Waste Sites
- Septage spreading/storage site
- Sand/salt storage site
- Surface Petroleum Spills
- Sludge Land Application Site
- Residuals Land Application Sites
- Uncontrolled Sites



Location Map



with the purpose of cleaning the groundwater in the soils near the McKin property. In October 1995, the responsible parties petitioned EPA and Maine DEP to suspend operation of the groundwater treatment system because computer modeling had estimated the time to restore the groundwater to drinking water standards was at least two hundred years.

EPA and Maine DEP agreed to suspension of the groundwater system and to reevaluate the approach taken for the site. Review of the groundwater data has shown that the concentrations of the chemicals in the shallow groundwater have decreased dramatically near the site, with eleven of the monitoring wells now below the 1985 clean-up standard. However, because of the known contamination of residential bedrock wells and the widespread TCE contamination of groundwater in the overburden soils, the agencies have agreed that further operation of the groundwater treatment system will not restore the groundwater within a reasonable time frame. The focus has now turned toward what efforts could be taken to prevent or minimize the discharge of 80-120 gallons a year of TCE into the Royal River from the groundwater.

EPA, Maine DEP, responsible parties, members of the Town of Gray and community groups began a mediation process in May 1997 with the goal of reaching consensus on further action for the McKin site. There are two principal issues to be resolved: the extent of public water which is needed to provide an alternate drinking water source and prevent exposure to contaminated groundwater; and the effectiveness and costs associated with an engineering remedy to prevent the continued discharge of TCE-contaminated groundwater into the Royal River. EPA with Maine DEP assistance is planning a limited field investigation to provide answers to the latter issue. The discovery in December, 1997 of TCE north of the confluence of Collyer Brook and the Royal River (an extension of the northern plume) will likely affect the public water issue.

Pole Yard at Sligo Road, Yarmouth

The New England Pole (NEP) and Treatment Co. Site (Site) is located in the Town of Yarmouth, Cumberland County, Maine. The Site is situated next to the Royal River at the intersections of Sligo road and the Maine Central Railroad. Soil sampling conducted by Maine DEP, USEPA, and the current Site owner have indicated that soil in the area of the treatment facility and pole storage area is contaminated with compounds associated with the wood preserving process. Samples taken in this area in April of 1993 by USEPA contractor Roy F. Weston, Inc. detected the following compounds: Pentachlorophenol at a range of 1,500 - 3,400 mg/kg, arsenic at a range of 10 - 90 mg/kg, and lead at a range of 20 - 478 mg/kg.

Contamination migration from the Site soil to the groundwater would most likely be limited due to glaciomarine clay underlying the Site. Most of the population within a four mile radius of the Site is served by municipal wells located between one and two miles of the Site. Although these municipal and private wells are within four miles of the Site, it is unlikely that these wells would be effected by Site contamination due to Site characteristics and the upgradient location of these wells. Therefore, the chance of people ingesting groundwater impacted by on-site contaminants is slight.

The majority of the population in the area surrounding the Site is served by municipal water; the closest private drinking water well is approximately 3,200 feet from the Site. Surface water runoff flows into the adjacent Royal River, which is considered a fishery and has significant wetland acreage downstream from the Site. Sediment samples taken from the probable point of entry (PPE) indicate that low levels of contamination may have migrated to the Royal River.

V. GENERAL RECOMMENDATIONS FOR ADDRESSING WATER QUALITY RELATED EFFORTS IN THE WATERSHED

The purpose of this section is to offer the reader a quick reference guide to management options in relation to various impacts to water quality in the Royal River Watershed. (Additional recommendations for the entire Casco Bay Watershed have been listed in the Casco Bay Plan which is available through the Casco Bay Estuary Project). Some of the options are general and relate to implementation measures while others outline where there may be a need for more planning before implementation is to take place. The management options have been divided into several categories: General, Erosion and Sedimentation, Urban/Development, and Agriculture/Forestry. The following table lists some possible resources that may be available for carrying out some of these recommendations:

Funding Source	Type of Grant	Contact Name/Number
DEP 604b Program	NPS Planning	Paul Dutram, MDEP (207) 287-3901
EPA Environmental Education	Environmental Education Grants	Maria Pirie, EPA, (617) 565-9447
EPA Sustainable Development	Community Environmental Grants	Rosemary Monahan, EPA (612) 565-3551
US Fish & Wildlife Grants	Habitat Restoration/Education	US Fish & Wildlife, (207) 781-8364
EPA/DEP 319 Program	NPS Implementation	Norm Marcotte, MDEP (207) 287-3901
Federal Highway Adm. ISTEAD	Environmental Remediation	Maine DOT (207) 287-3131
Maine Outdoor Heritage Fund	Wildlife/Habitat Projects	JoD Sapphire, MOHF (207) 688-4191
Maine Forest Service Grants	Implement Forestry BMPs	Dave Spicer, MFS (207) 287-2791
Nat. Oceanic/Atmospheric Admin.	Coastal Zone Management	Coastal Zone Mgmt. (207) 287-3261
New England Charitable Foundation	Community Grassroots Grants	Cheryl Fisher, NHCF (603) 225-6641
USDA NRCS CRP	Conservation Reserve Program	Wayne Munroe, NRCS (207) 839-7842
USDA NRCS EQIP	Implement Ag. Conservation	Wayne Munroe, NRCS (207) 839-7842
USDA NRCS WHIP	Implement Wildlife Protection	Wayne Munroe, NRCS (207) 839-7842
USDA NRCS WRP	Wetland Reserve Program	Wayne Munroe, NRCS (207) 839-7842

Several other resources are available from foundations, and various businesses. In order to effectively undertake watershed implementation and restoration efforts, funding needs to be focused and diversified. The University of Southern Maine has a unique resource center for obtaining funding for many types of projects. You can contact this grant resource center at: (207) 780-5029.

General Management Options

Management Option: Consider incorporating into the appropriate local policies, programs, and ordinances the recommendations for improving water quality contained in this Royal River Water Quality Management Plan. Efforts should be undertaken by all stakeholders in the watershed and needs to be coordinated from a central location. An implementation plan (and a plan for additional planning, where necessary) should be put into effect with short and long term goals clearly stated.

Management Option: Consider the establishment of an inter-local commission, such as the Royal River Commission to address issues of water quality, sedimentation and public access along the Royal River. A commission exists for the Saco River and an attempt could be made to learn more about the makeup, successes, and difficulties faced by that organization. A corridor commission should be led by local citizens (and could be formed from members of already existing groups such as the Friends of the Royal River and local conservation commissions) with technical assistance provided by federal, state, and local agencies. The Casco Bay Estuary Project may be a logical agency to initiate an effort of this sort.

Management Option: Watershed citizens should consider initiating the documentation and mapping of riparian areas in order to plan future establishment of riparian buffers along the corridor of the Royal River and its tributaries. Technical assistance and funding to get this type of an effort underway can be provided by several groups including US Fish and Wildlife, Cumberland County SWCD, USDA Natural Resources Conservation Service, Maine DEP, Casco Bay Estuary Project, and the Maine Department of Inland Fisheries and Wildlife. One method for training volunteers for this type of effort would be through a “watershed steward program” (See Appendix G for an example of a watershed steward program) that could be organized by local agencies and groups.

Management Option: Municipalities and conservation groups should continue to increase efforts to educate residents through school systems, workshops and newsletters regarding the values of watersheds and the importance of watershed protection; proper operation, use and maintenance of septic systems and leach fields; natural resource and open space protection; proper storage and disposal of household hazardous wastes; recycling programs; application, storage and disposal of pesticides, herbicides, and fertilizers; soil conservation; and good forestry management. Adopt a Stream and Adopt a Salmon programs are two avenues for initiating conservation education activities within a school. There are numerous groups and agencies that can provide educational assistance including Casco Bay Estuary Project, Maine DEP, Cumberland County SWCD, Natural Resources Conservation Service, U.Maine Cooperative Extension Service, US Fish and Wildlife Service, Maine Forest Service, and Maine Audubon are some of the best known sources for environmental education assistance and programming available to residents in the Royal River Watershed.

Management Option: Watershed citizens should consider working with (and continuing to work with where applicable) state agencies, environmental organizations and neighboring communities to establish a water quality sampling water quality program and undertaking watershed NPS survey efforts for significant surface water bodies that have no organized programs of this type. The Friends of the Royal River has been very active in water quality sampling efforts in the watershed over the last several years and have indicated that expansion of their program would be welcome.

Management Option: Federal, state and local organizations should continue to develop and initiate development of GIS data layers in the Royal River Watershed. The Casco Bay Estuary Project has developed the most comprehensive coverage to date and this information is available to the public. In addition to improving and expanding GIS coverage, stakeholders in the watershed should work to establish a detailed web page on the internet to enable easier access to all of the data and project information available on the watershed. The Friends of the Royal River already has a homepage located at: <http://www.cascobay.com/royal/royal.htm>

Erosion and Sedimentation Management Options

Management Option: Municipalities and local road associations should develop standards for maintenance, repair and construction of municipal storm drainage control facilities including ditches, culverts, and road embankments in order to minimize erosion and sedimentation; and develop standards for winter sand usage and removal. A current project (ending in 1998) is being undertaken by the Cumberland County SWCD and Maine DEP to work with watershed towns to develop these standards and provide proper training.

Management Option: Wherever possible, municipalities, agencies, and contractors should design, construct, and maintain BMPs for erosion and sediment control. Complete guidelines on BMPs for erosion and sediment control are available through the Cumberland County SWCD and the Maine DEP. Several projects have been implemented state wide to demonstrate the effectiveness of BMPs. The Maine DEP is the central focal point for these efforts.

Management Options: Municipalities should consider evaluating the adequacy of erosion and sediment and storm water management requirements in town land use ordinances. Review of these ordinances can be undertaken by a SWCD engineer. Town planning boards are often the best avenue to insure that these requirements are met in a given town.

Urban/Development Management Options

Management Option: Municipal entities should inspect potential pollution sources such as failed septic systems and collected surface stormwater runoff and address the problems and ensure the replacement of all outdated underground fuel storage tanks, in accordance with state law. The Maine DEP has an extensive database of existing sites (see Map in Chapter IV) and should be contacted if any other sites are known or located.

Management Option: Municipalities and watershed citizens should consider establishing an Open Space and Recreation Task Force and/or a Community Land Trust to accomplish activities such as: identify and prioritize parcels to be protected from future development using as criteria the land's importance to the protection of town character, ground or surface water resources, farmlands, scenic views, wildlife habitat or recreational potential.

Fish & Wildlife/Agricultural/Forestry Management Options

Management Option: Municipal entities should consider to ensure that phosphorus control performance standards include timber harvesting standards, recommendations for agricultural practices, and retention of forested areas to act as buffers.

Management Option: The USDA Natural Resources Conservation Service and local Conservation Districts should continue to develop and implement comprehensive agricultural waste management plans for livestock producers, develop and implement waste utilization plans, educate landowners on the need for established vegetative buffers and stream bank protection fencing adjacent to streams, demonstrate and apply innovative rotational grazing systems and livestock watering facilities and apply sediment and erosion control practices where necessary.

Management Option: Federal, State, and local entities should develop and implement educational information to private landowners, loggers, and the general public regarding wetlands, wildlife and wildlife habitats. The US Fish and Wildlife Service has an office in Falmouth, Maine and is active in providing assessment, education and outreach, prime habitat mapping, and many other programs in the Casco Bay Watershed and should be contacted in regards to protecting wildlife habitat. The Casco Bay Estuary Project is an additional valuable resource for wildlife programs.

Management Options: Federal, State, and local entities should conduct future BMP surveys and monitor to ensure BMP's are being practiced and target outreach programs in areas where they are not and develop incentives program for loggers and landowners for proper BMP use. The Maine Forest service would be the logical agency to offer suggestions for incentive programs.

Conclusion

The information and management options presented in this report are intended to provide a link to existing information and future water quality implementation efforts in the watershed. Although every question and aspect of the Royal River Watershed may not been addressed in these chapters, it is the intent of the authors and contributors to this report that it provide enough information to begin to undertake the necessary implementation efforts. Citizens have often complained about "too many government plans are put together and then just gather dust on the shelf." We hope that the citizens of the Royal River Watershed rise to the occasion and keep the momentum that has been gathered in the region over the last several years...

If you have any questions or seek additional information on this report, please contact Forrest Bell, Project Manager, Cumberland County SWCD, 381 Main Street, Suite 3, Gorham, ME, 04038. (207) 839-7842.

VI. GLOSSARY OF TERMS

Algae: Small simple plants without roots, that grow in the water. Blue-green algae are typically found in waters with high concentrations of phosphorus.

Algae Bloom: A growth of algae resulting from excessive nutrient levels or other physical and chemical conditions that enable algae to reproduce rapidly.

Anadromous Fish: A species, such as salmon, alewives, smelt, and shad, that is born in fresh water, spends a large part of its life in the sea, and returns to freshwater rivers and streams to mate and give birth (*i.e.* spawn).

Aquifer: A water-bearing soil or rock formation that is capable of yielding enough water for human use. In bedrock aquifers, water can move through cracks, or fractures.

Bedrock: The solid rock that underlies all soil, sand, clay, gravel, and loose material on the earth's surface.

Best Management Practices (BMP' s): Techniques to reduce nonpoint-source impacts from, construction, agriculture, timber harvesting, marinas, and stormwater. Manuals describing these techniques have been developed.

Buffer (vegetated buffer): Areas of vegetation, left undisturbed or planted between a developed area and a water body. Buffer vegetation can include trees, shrubs, bushes, and ground cover plants.

Catadromous Fish: Fish that migrate down river to breed in marine waters.

Combined Sewer Overflow (CSO): A pipe that, during storms, may discharge untreated raw sewage and stormwater. The overflow occurs because the sewage treatment plant does not have the capacity to treat the increased flow caused by stormwater runoff.

Dissolved Oxygen (DO): Oxygen dissolved in the water is essential for all plants and animals living in the water. DO is a measurement of the amount of oxygen in the water that is available for plant and animals to utilize. The amount of DO is used as an indicator of water quality and the level of life that the water can support.

Ecosystem: The interactive system of living organisms with one another and their physical environment.

Endangered: An "endangered" species is one which is in danger of extinction throughout all or a significant portion of its range. (A "threatened" species is one that is likely to become endangered).

Erosion: Wearing away of rock and soil by the gradual detachment of soil and rock fragments by water, wind, ice, and other mechanical and chemical forces. Human activities can greatly speed this detachment.

Erosion Controls: Physical measures installed prior to and through the duration of filling or grading activities in order to prevent soil erosion. A silt fence is an example of an erosion control; it is a physical barrier installed along the perimeter of an earth moving activity. Water can pass through the fence but soil cannot. Hay mulch is another example; when spread over bare soil it prevents rainwater from eroding the soil.

Estuary: A water body that forms a transition zone between fresh water and full-strength salt water.

Eutrophication: Enrichment of soils and water due to fertilization, sewage, effluent or other water that carry a high plant-nutrient component. The uncontrolled growth of nuisance algae that can indirectly deplete oxygen and kill marine life. This growth is caused by the excessive inputs of nutrients such as nitrogen.

Fecal Coliform Bacteria: A strain of bacteria (normally found in the intestines of warm-blooded animals) whose presence is an indicator of water polluted by human or animal wastes. High fecal coliform counts can lead to closure of shellfish beds. (The bacteria do not harm the shellfish, but they are an indicator of possible contamination by disease organisms causing a human health hazard).

Fertilizer: Nutrients used by gardeners and farmers to increase crop production.

Fish Ladder: A series of ascending pools of water constructed by humans as mechanisms to enable salmon or other fish to swim upstream around or over a dam.

Game Animal: Legal designation for animals which may be managed and hunted only under regulation.

Geographic Information Systems (GIS): GIS is a computerized system that lets users literally see their data by blending digital maps with databases and then generating color coded maps of the information being analyzed.

Groundwater: Water found under the ground, in the zones of soil and bedrock.

Habitat: A place used by plants and animals to live, feed, find shelter, and reproduce.

Herbicide: A substance used to destroy plants, especially weeds.

Impervious Surface: A surface, such as a roof or pavement, that cannot be easily penetrated by water. A hard surface that either prevents or retards the entry of water into the soil as under natural conditions prior to development and/or a hard surface area that causes water to run off the surface in greater quantities and at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways, parking lots, storage areas, concrete or asphalt paving, and gravel roads.

Indigenous: A naturally occurring species.

Intermittent Stream: A stream that flows during part of the year.

Leach Field: Part of a septic system. The area where the liquid (effluent) from the septic tank is dispersed into the soil.

Lake Ecology: The study of living things in and around a lake and their relationship to each other and their environment.

Macroinvertebrates: Invertebrate animals (animals without backbones) large enough to be observed without the aid of a microscope or other magnification.

Management Options: Suggestions and or strategies for citizens, municipalities, agencies or other groups to consider for the preservation and protection of the Royal River Watershed.

Mercury: Mercury is a naturally occurring element of the groups collectively referred to as "heavy metals". It can exist in a number of forms such as elemental mercury (the mercury in thermometers and dental fillings), inorganic mercury (most commonly used in manufacturing), and organic mercury (used as a pesticide and the form usually found in contaminated foods). Forms change from one to the other in the environment and in the body aided by bacteria. In high enough doses, all three forms present serious threats to human health; however, organic mercury (especially methylmercury) is a serious threat to human health at much lower doses.

Metals or heavy metals: A group of elements found in rocks and minerals that are naturally released to the environment by erosion, as well as generated by human activities. Certain metals, such as mercury, lead, zinc, and cadmium, are of environmental concern because they are released into the environment in excessive amounts by human activity and can produce toxic effects.

Monitoring (water quality monitoring): Assessing the condition of a water body over time by collecting physical, chemical, or biological information.

Mulch: A layer of hay or other material covering the land surface that holds soil in place so that it does not erode. It aids in the establishment of vegetation by holding the soil in place, conserving moisture, and minimizing temperature fluctuations.

Nonpoint Source (NPS): An indirect discharge, not from a pipe or other specific source, usually as a result of stormwater runoff. Contaminated runoff and seepage from many diffuse and/or small scale sources, mainly from human activity. It is generally initiated by stormwater runoff.

Nitrogen: A nutrient required for plant growth, often present in limited supply in the ocean during growth season. Nitrogen is present as organic nitrogen or in the inorganic forms of ammonia, nitrite, and nitrate. The inorganic forms are available to marine plants, while most other forms of organic nitrogen must be broken down by bacteria before they can be used for plant growth.

Nutrients: Any substance required by plants and animals for normal growth and maintenance. Enriched nutrient loads from land runoff, sewage, septic systems, and atmospheric deposition can result in excessive growth of algae and lead to degradation of water quality. Phosphorus is generally the nutrient of concern in lakes. Nitrogen is generally the nutrient of concern in salt water.

Overboard Discharges: Discharges into a water body from overboard discharge units (or systems). These units were designed to treat wastes from households and small commercial operations such as restaurants. Overboard discharge units have mechanical or sand filter treatment followed by chlorination.

Pathogen: An agent such as a virus, bacterium, or fungus that can cause diseases in humans.

Pesticide: Any chemical preparation used to control populations of organisms, including plants and animals, perceived to be injurious.

Phosphorus: An element found throughout the environment; it is a nutrient essential to all living organisms. Phosphorus binds to soil particles and is found in fertilizers, sewage, and motor oil, and in high concentrations in stormwater runoff. The amount of phosphorus present in a lake determines the lake's production of algae. A very small change in phosphorus levels can dramatically increase algae growth.

Point Source: Any confined and discrete conveyance (usually a pipe) from which pollutants are or may be discharged into a watershed.

Polluted Runoff: Runoff that has picked up contaminants or nutrients from the landscape (or air), as it flows over the surface of the land to a water body.

Remediation: Treatment of contaminated sediments so that the sediments are no longer toxic.

Retrofit: To enhance or create a runoff management system in order to reduce or eliminate polluted runoff from entering a water body in a previously developed area.

Riparian: Located or living along or near a stream, river, or body of water.

Runoff: Water that drains or flows off the surface of the land.

Sanitary Survey: A survey that includes a shoreline survey, water quality sampling, and an evaluation of physical influences used by the Maine Department of Marine Resources to determine how a shellfish area should be classified.

Sediment: Mineral and organic soil material that is transported in suspension by wind or flowing water, from its origin to another location.

Septic System: An individual sewage treatment system that typically includes a septic tank and leach field that are buried in the ground. The septic tank allows sludge to settle to the bottom and a scum of fats, greases, and other lightweight materials to rise to the top. The remaining liquid flows to the leach field where it is dispersed over soil in order to reduce the number of bacteria and viruses.

Site: The location or place of something. As it pertains to watershed surveys, the place that is generating polluted runoff.

Stormwater runoff: Runoff caused by rain or snow storms.

Stream (River, stream, or brook): A channel between defined banks including the flood way and associated flood plain wetlands where the channel is created by the action of the surface water and characterized by the lack of upland vegetation or presence of aquatic vegetation and by the presence of a bed devoid of top soil containing waterborne deposits on exposed soil, parent material or bedrock.

Threatened: In wildlife terms, a species present in its range but in danger because of a decline in numbers.

Topography: The physical features of a region such as the relief of the landscape and positions of water bodies.

Toxic: Poisonous, carcinogenic, or otherwise directly harmful to humans and other living things.

Tributaries: Streams or rivers that flow to a larger body water.

Turbid: A term used to describe water that is clouded by soil or organic particles.

Vegetated buffer: Areas of vegetation, left undisturbed or planted between a developed area and a water body that are used to capture pollutants from the surface water and groundwater. Buffer vegetation can include trees, shrubs, bushes, and ground cover plants.

Water quality: Pertaining to the presence and amount of pollutants in water.

Watershed: The geographic region within which water drains into a particular river, stream, or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains. Watershed boundaries are defined by the ridges of land separating watersheds.

Watershed Management: The long term management of the watershed through phases of assessment, planning, implementation and evaluation. Throughout these phases education plays a major role in reaching set goals.

Watershed Survey: A qualitative and quantitative process of determining the extent of pollution in a watershed by identifying existing non-point sources of pollution and inspecting the point sources of pollution.

Wetlands: Low lying areas inundated or saturated by water at a frequency and duration sufficient to support wetland vegetation. Wetlands can be forested, swamps, marshes, bogs, wet meadows, etc. Some of their valuable functions include holding runoff, and removing pollutants through a series of chemical, physical, and biological mechanisms.

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VIII. APPENDICES

The following pages contain information, summaries and reports that are relevant to this project and important to the Royal River Watershed.

APPENDIX A

PUBLIC MEETING IN FREEPORT TO ADDRESS WATERSHED ISSUES

The following information is from the 1994 Public Forum held in Freeport at Wolfe Neck Farm to address concerns and issues in the Royal River and Upper Coastal Watersheds. The project was eventually adjusted to cover solely the Royal River Watershed. This public forum was attended by more than 45 citizens, agency representatives, and local groups. The information obtained at this meeting and listed below was used to initiate the Royal River Project, and the issues were eventually reviewed by the project technical sub-teams. Many of these issues are addressed in this report in more detail.

Category #1 - General Water Quality Problems Affecting the Watershed Area

- Management of Stormwater
- Road ditch erosion
- Anadromous fish runs
- Sediment problems
- Toxins in the water
- Point source pollution affecting clam flats
- Maintenance of sewage treatment plants
- Lack of knowledge of PCB's, heavy metals in the Bay
- The effects of Androscoggin and Kennebec Rivers on the Bay
- Small pond failure, dam failure, spillway erosion
- Impact of nonpoint source pollution from agricultural and urban forest lands
- Horses and cows in the river/riparian zone removal/manure management
- Individual house construction, clearing of woodlands, sedimentation
- Old dumps in yards - dumping of tires, white goods, on back roads
- Improper sizing of culverts
- Improper forestry practices, harvesting techniques
- Lack of custom (contract) farmers to help people seed down areas
- Excessive water temperature in the summer
- Failing septic systems (individual)
- Loss of wetlands for water quality and flood control
- Improperly located or functioning parking areas/ boat launches
- Acid rain and acid fog
- Macro trends in forest management
- Riparian zone use
- Urban sprawl
- Carrying capacity of Royal River
- New plumbing codes
- Differences between towns on setbacks for shoreland zoning
- Drops in dissolved oxygen in the Bay
- Excessive gully erosion
- Golf courses - lack of resource management

Category #2 - Site Specific Water Quality Problems Affecting the Watershed Area

- Sligo Road pole yard
- Ash dump in Yarmouth
- Erosion of embankments of Maquoit Bay
- North Yarmouth area - drying up of perennial streams which are now intermittent
- Pineland Center waste treatment
- Development impact and runoff/erosion problems on Route 26 near Sabbathday Lake

Category #3 - Other Problems Affecting the Watershed Area

- Perception of long term goals of the people along the river in relation to recreation opportunities.
- Improper recycling of organic residues: manure, ash, residual sludges
- Lack of communication between state and federal agencies
- Lack of contractor certification programs
- Ozone levels and their effects on the watershed
- Nitrogen and toxic chemicals in air

Category #4 - Perceived Needs of the Watershed Area

- More information on the quality of the water/more frequent sampling needed
- Need for better coordination
- Mapping of coastal ocean currents to establish sources (path) of pollution. (It was later determined that the Casco Bay Estuary Project is currently doing a similar study)
- Clay and gravel mine reclamation
- Review implementation (or lack of implementation) of Best Management Practices of agricultural uses.
- Money for homeowners to remove/return outdated toxic materials
- Look at activities that are currently ongoing (education, stream sampling, and where we can supplement)
- Educational opportunities in the high schools for conservation education (park management, landscaping/urban uses)
- Using local cable access channels for environmental education
- Removal or replacement of underground storage tanks, above ground spills and how they are handled
- Clean-up of contaminated wells and well area
- Retrofit stormwater drains for water quality
- Zoning - lot size and setbacks
- Maintaining and protecting aesthetic qualities
- Land use regulations (tree growth tax law)
- Money for implementation/focus on implementation
- Education/resource center for volunteer citizen boards
- Expand current sampling procedures/measurement of effectiveness

Category #5 - Other Information Discussed

- This area is perceived as a "Golden Triangle" - Unspoiled area. We must maintain the quality of it.
- Town of Durham recently completed a study of runoff near Runaround Pond
- Large percent of the area is in forest land - forest land can be looked at as a solution to water problems

APPENDIX B

STRUCTURE OF THE CCSWCD/NRCS ROYAL RIVER WATERSHED PROJECT

The following information is intended to give the reader an idea of how the Royal River Watershed Project was structured and carried out. This project was the initial basis for completion of this Water Quality Management Plan.

PLAN OF ACTION (Developed September, 1994)

- Coordinate and identify critical resource groups and agencies.
- Link watershed problems (identified at February, 1994 public meeting) with resource groups and agencies that can help address problems.
- Develop a steering committee with sub-committee resource groups.
- Assist sub-committee resources groups.
- Prioritize watershed problems and concerns.
- Compile all existing resource data to be used in developing the Watershed Water Quality Management Plan.
- Develop public participation process.
- Cumberland County Soil and Water Conservation District to encourage public and private sector participation.
- Develop citizen advisory plan of action and coordinate public meetings.
- Develop Watershed Water Quality Management Plan and funding alternatives.
- Develop viable solutions consistent with local, regional, and national objectives.

STEERING COMMITTEES

In April of 1995, the sponsors worked with numerous local, state, and federal agencies and developed a **Technical Resource Steering Team (TRST)**. The TRST was composed of approximately twenty individuals. These individuals, based on their expertise, worked together in small sub-teams. The following four sub-teams were developed:

1. Agriculture
2. Erosion
3. Forestry/Wetlands/Wildlife
4. Urban

Each TRST sub-team was responsible for:

1. Assessing current information by reviewing existing data and reports.
2. Determining actual issues and causes.
3. Determining what additional research would be required to further study various issues.
4. Developing a table summarizing their findings.
5. Writing a chapter report describing how results were obtained.

Each sub-team summarized their findings in Issue/Cause Tables. These tables show several areas of pertinent information relative to each issue. The Issue/Cause Tables became the framework for many of the "Management Options" that appear throughout this report. The information in these tables includes:

1. Listing of resource issues and causes
2. Potential effect or impacts of these problems on the Royal River Watershed
3. A summary of information known to exist and the source of this information.
4. The identification of additional information needed to assess the problems.
5. The identification of actions needed to be taken to adequately assess the magnitude of the problem.
6. The identification of appropriate personnel and funding resources needed to implement the actions.

In the Spring of 1995, the sponsors developed a **Royal River Watershed Advisory Committee (RRWAC)**. This committee, comprised of area watershed residents interested in the protection of the Royal River, was responsible for:

1. Providing local input and suggestions.
2. Reviewing reports from the Technical Resource Steering Team.
3. Reviewing public outreach material.
4. Helping to advise the sponsors on the public participation process.
5. Developing the goals of the project.
6. Seeing the project through implementation.

This first meeting of this group took place in April of 1995 and continued on a quarterly basis through April of 1997.

In addition, the RRWAC created a slide show (with sound) for educational awareness and the values of the watershed. It describes the natural wonders of the watershed, the threats to it, and how this project came to be. This slide show can serve multiple purposes for educating citizens, town and students about the significance and importance of protecting this natural resource. **The slide show is available to the public for use and viewing by contacting the Cumberland County Soil and Water Conservation District (207) 839-7842.**

CHRONOLOGY OF EVENTS FOR THE CCSWCD ROYAL RIVER PROJECT

1990 Commencement of the Casco Bay Estuary Project

1992 Water Quality Assessment released by the Department of Environmental Protection (DEP) shows non-attainment status for the Royal River and some tributaries

1993 Natural Resource Conservation Service (NRCS) conducts a preliminary field assessment of the Royal River Watershed and corresponds with the Cumberland County Soil and Water Conservation District (CCSWCD)

Feb 1994 Preliminary public meeting held in Freeport to identify issues and publicize project

Aug 1994 EPA funds the CCSWCD for project through Section 104(b)(3) of the Clean Water Act

Oct 1994 Meeting held with agency stakeholders

Dec 1994 Decision made to reduce the geographical area of project to include only the Royal River Watershed

Feb 1995 CCSWCD initiates the gathering of existing data

Mar 1995 Royal River Watershed Advisory Committee (RRWAC) and Technical Resource Steering Committee (TRST) formed and first meetings scheduled

Oct 1995 First draft of watershed plan submitted to NRCS for review and assistance

Jan 1997 Due to budget constraints, NRCS unable to assist in completion of project

May 1997 CCSWCD completes first draft of watershed plan and requests review comments from agencies and towns

August 1997 Second draft of the watershed plan is completed and sent out for review

September 1997 Second draft review comments incorporated and Final watershed report completed and submitted to the EPA

APPENDIX C: MAINE 1997 FISH CONSUMPTION ADVISORIES*

**The following information is provided by the Department of Human Services- Bureau of Health, February, 1997.*

A. General Consumption Advisory of ALL Inland Surface Waters Due to Mercury Contamination

Pregnant women, nursing mothers, women who may become pregnant, and children less than 8 years old, should NOT EAT warm water fish species (bass, pickerel, perch, sunfish, crappie) caught in any of Maine's inland surface waters. Consumption of cold waters species (trout, salmon, smelt, cusk) should be limited to 1 meal per month. The consumption of older cold water fish (e.g. large lake trout) should be avoided.

All other individuals should limit consumption of warm water species caught in any of Maine's inland surface waters to 2 to 3 meals per month. People who eat large (older) fish are advised to use the lower limit of 2 meals per month. There is no consumption limit for cold water species.

Marine Fish and Shellfish Consumption Advisories

Lobster Tomalley: *Pregnant women, nursing mothers, and women who may become pregnant should NOT EAT tomalley (the green substance found in the body of the lobster). All others should limit consumption of lobster tomalley to 1 meal per month. A tomalley meal is eating the tomalley from one lobster.*

Striped Bass: *Pregnant women, nursing mothers, and women who may become pregnant, and children less than 8 years old, are advised to limit consumption of striped bass to 1 meal per month. All others should limit consumption to 2 to 3 meals per month, with the lower limit applying to those consuming large striped bass.*

Bluefish: Consumption of bluefish should be limited to one fish meal per month.

WHAT IS MERCURY?

Mercury is a naturally occurring element of the groups collectively referred to as "heavy metals". It can exist in a number of forms such as elemental mercury (the mercury in thermometer and dental fillings), inorganic mercury (most commonly used in manufacturing), and organic mercury (used as a pesticide and the form usually found in contaminated foods). Forms change from one to the other in the environment and in the body aided by bacteria. In high enough doses, all three forms present serious threats to human health; however, organic mercury (especially methylmercury) is a serious threat to human health at much lower doses.

WHY IS MERCURY IN OUR MAINE ENVIRONMENT?

While mercury is a natural component of the earth's crust and sediment, for 3,000 years mercury, in various forms, has been used in medicine and industry. Although most medicinal uses have stopped, and pesticide use is rapidly declining; industrial uses of mercury continue. Burning of fossil fuels, particularly coal; disposal of mercury containing solid waste in landfills; municipal

waste incineration; application of mercury-containing paints, fungicides, and pesticides; and combustion of waste oils all contribute to mercury in our environment.

HOW DID MERCURY GET INTO MAINE'S FRESHWATER FISH?

Any mercury released into the environment may be changed to the organic form and concentrated in the fish. In the past, some industries discharged mercury directly to water bodies. Although such discharges have been halted, some of this mercury remains in the environment and can be accumulated by fish. In addition, mercury emitted to the atmosphere (such as by burning coal, or incinerating garbage) can be transported long distances and deposited in remote environments. Although the amount of mercury is small, it is sufficient to account for the levels found in Maine's fish.

IS THERE A WAY TO REDUCE OR ELIMINATE MERCURY IN THE FISH THROUGH COOKING OR OTHER TREATMENT?

No special cleaning or cooking method will decrease mercury in fish. Mercury is stored in the fish fillet or muscle portion of the fish, not the fat. Thus, removing fat, skin, or other parts from the fish will not lower mercury levels.

Updated fish consumption advisories are being used in 1997 by the Maine Bureau of Health. As new data on the amounts of toxic chemicals in fish become available the Bureau of Health reassesses advisories to include the most up-to-date information.

Consumption advisories due to mercury contamination were first issued in 1994, and applied to consumption of fish from all lakes and ponds. This year, mercury advisories are being modified in two ways. First, separate consumption advisories are being issued for warm water (bass, pickerel, perch, sunfish, crappie) and cold water (trout, salmon, smelt, cusk) fish species (details are listed below). Second, consumption advisories are being expanded to include all inland surface waters of the state, including rivers and streams.

B. Why do we care about mercury and where does it come from?

Mercury causes toxic effects on the nervous system. The unborn child and young children are more susceptible than adults, due to their developing nervous systems. Toxic effects of mercury depend on the amount to which you are exposed. Some fish caught in Maine have been found to have levels of mercury that may be harmful to health. Mercury occurs naturally in the environment at low levels. Mercury levels are increased in the environment when mercury is released into the air from coal fired power plants, municipal/medical waste incinerators, and other industrial facilities. There are currently 34 states with mercury advisories.

The Maine Department of Environmental Protection (DEP) collects and monitors fish for toxic pollutants throughout the state. The Surface Water Ambient Toxic Monitoring Program (SWAT) allows the DEP to perform these studies. Data are given to the Bureau of Health for consideration of possible health effects if certain amounts of fish are consumed. The advisories are updated as the Bureau of Health receives and assesses the new data and the Maine Departments of Environmental Protection, Inland Fisheries and Wildlife and Marine Resources have been consulted. For information concerning the Surface Water Ambient Toxic Monitoring Program call the Maine Department of Environmental Protection, Office of Land and Water Quality at (207) 287-3901.

APPENDIX D

WATER QUALITY CONCERNS OF MUNICIPALITIES WITHIN THE ROYAL RIVER WATERSHED

** Provided by the Department of Economic and Community Development, November 15, 1992.*

This information lists water quality problems facing some towns within the watershed. Some municipalities did not respond to the survey by DECD and therefore are not listed.

Freeport:

Freeport has some of the most productive clam flats, yet many closed due to failing septic systems and nonpoint source pollution. Several pollution problems related to stormwater runoff have been identified by Robert Gerber, Inc. Exact source of coliform causing shellfish closures is unknown (except in an area where it is clearly the sewage treatment plant.). It is suspected, that the primary source is coming from failing septic systems and overboard discharges (there are six overboard discharges in town). The Royal River in Yarmouth may also be influencing the water quality in the Cousins River, since water from the Royal River flows into Cousins River on the incoming tide.

Without more information and research, Freeport cannot regulate its bedrock aquifers (it is noted that future public water source may need to be from a bedrock aquifer).

Many significant natural resources such as smaller streams, aquifers that are not currently used for public drinking water and wildlife habitat are not protected by local regulations. Stronger wetland regulations are needed.

Some sections of the enclosed drainage system are old and in poor condition. The condition of the State's storm drain tributaries at the outfall of the enclosed systems are of particular concern, since flows from these outfalls are causing, through erosion, the creation of deep gullies with steep sided slopes.

Gray:

The primary water quality concern in Gray is groundwater contamination. The Town's major water source was contaminated by the McKin site. The Town's dump is located in the recharge area of the current water supply.

The search for a new water source is a top priority. Most of Gray's developed land areas are located above the town's major aquifers.

Water quality for both surface and ground water sources may be threatened by the fact that existing lots in the village and around the lakes are extremely small and there is concern about septic contamination. Almost one third of the existing lots do not meet current acreage requirements. The majority of the non-conforming lots occur in the village center in the aquifer recharge zone.

New Gloucester:

In a 1990 public opinion survey, respondents defined those things as most important to town character and Clean Water was ranked #1.

Five areas in town overlaying groundwater are not attaining water quality standards due to non point source pollution (two leaking underground storage tanks, two uncovered sand and salt piles and a landfill). At least one of the town's sand and salt piles has been covered and it is believed that the underground storage tanks have been removed.

Robert Gerber, Inc. found that seven of ten wells sampled in the sand and gravel aquifer were affected by septic system affluent. Nitrate-N concentrations were found to be quite high "considering that elevations indicated few water quality problems should exist in the aquifer." Relative high concentrations of sodium chloride were also found. The study recommended more site specific sampling.

There are some extensively developed gravel pits that already increase the vulnerability of the aquifer.

Notched Pond is of particular importance as it is on DEP's list of endangered ponds and the outlet drains to Sabbathday Lake.

North Yarmouth:

A committee found 34 potential threats to groundwater that include historic and present locations of land use threats.

Poland:

In terms of groundwater, the primary sources of contamination are malfunctioning septic tanks, leaking underground storage tanks, salt from stockpiles and landfill leachate.

There are no aquifer protection provisions in the zoning ordinance that would protect groundwater from adverse land uses.

Pownal: There is some oil contamination coming from leaking underground storage tanks.

Yarmouth:

The Royal River Estuary is not meeting its DEP SC classification, due to overflow from Yarmouth's sewage treatment plant, which may present a problem to the Cousins River.

According to the Maine DEP, there are 29 licenses to discharge wastewater in Yarmouth. Most of these are private overboard discharge systems, discharging an average of 300 gallons per day of waste water. The major large discharge sources are CMP and the Town's sewage treatment plants.

Potential nonpoint sources of contamination are specifically identified including locations of agriculture and forestry operations, private septic systems, landfill, underground tanks, injection wells, sands and salt piles, resource extraction, industries and 16 businesses that use hazardous materials.

ACTIONS ALREADY TAKEN BY TOWNS*

** Provided by the Department of Economic and Community Development, November 15, 1992*

DURHAM:

- Durham has a residential growth ordinance and a back lot development ordinance and a groundwater protection ordinance.
- The groundwater protection ordinance encourages conservation and evenly distributed subsurface waste disposal systems. It discourages large multifamily development with large concentrated disposal systems, prohibits the handling of hazardous and leachable materials, minimizes maintenance and refueling of heavy equipment and prevents land use which disturbs the soil during periods of high groundwater.

FREEPORT:

- Freeport has aquifer protection regulations, open space preservation regulations, net residential acreage calculations, and two local conservation organizations to preserve resources and acquire open space.

GRAY:

- Sources of aquifer pollution are identified and summarized on the Threats to Groundwater map.
- There is an ordinance to protect the recharge area, however, it was adopted after most of the area had been developed.

NEW GLOUCESTER:

- The sand and salt pile owned by the Town has been covered. It is believed that the two leaking underground storage tanks have been removed.
- On-going monitoring in the area where salt contamination has been a problem. Recent test results show levels have dropped.
- Testing and monitoring the landfill, following its closure, will continue to take place.
- Results of the water quality monitoring efforts are on a computer database.
- New Gloucester has an Aquifer Protection Overlay Zone that limits the amount of impervious surface; establishes performance standards for sand and gravel extraction, density and permitted uses.
- A hydrogeologic study is required for any development proposed to take place in the Aquifer Overlay Zone.
- The Town's strategy has been to avoid the need for public water and sewer by allowing only low density development.

- New Gloucester has an implementation strategy to establish a contingency plan for septage disposal in the event that disposal through the Lewiston/Auburn water pollution control authority is no longer available.
- Water Resources Subcommittee has contacted communities that shares watersheds with New Gloucester to let them know that the subcommittee is available to work with them in a regional watershed protection effort.
- The town has initiated a regional groundwater protection effort in conjunction with Gray, Poland, Raymond and others who share the sand and gravel resource.
- A town-wide water quality monitoring program has been developed and is funded with yearly appropriations. Continued focus should be on well and lake/pond monitoring efforts and expansion into the area of Nonpoint source pollution assessments along streams and the Royal River.
- Potential areas of nonpoint source pollution and areas where historical land uses may have impacted water quality have been mapped by the Conservation Commission.
- The response program for malfunctioning systems is in place.
- The Conservation Commission is working with other groups that use town trails on mapping the system and identifying commonly used trails.
- The Conservation Commission Water Resources Subcommittee with the Royal River Committee are studying ways to protect Lily Pond and surrounding land from resource degradation.
- The Water Resources Subcommittee with the Royal River Committee are meeting with other towns to establish a Royal River Corridor Commission to establish guidelines and procedures for ensuring protection of the river and lands along its banks and should work with the Greater Portland Council of Governments on the current Royal River watershed project.

NORTH YARMOUTH:

- The committee found 34 potential threats to groundwater that include historic and present locations of land use threats.
- Efforts in the way of resource protection ordinances have been drafted.
- Continue to work with Yarmouth Water District relative to managing three existing and any future water supplies, that fall within North Yarmouth.

POLAND:

- Town currently has a hazardous waste ordinance and provisions for cluster development, open space preservation, stormwater management, soil erosion, lake watershed protection, and impact assessment on groundwater.
- Two acre minimum lot size was adopted to protect sand and gravel aquifers that cover most of the town and are the source for two bottling companies.

POWNAI:

- DEP “State of Maine Non-point Pollution Assessment 1989” list one area of Pownal as not attaining water quality standards due to non-point pollution. The source was an uncovered sand/salt pile that has since been enclosed.
- Town has agreement with Lewiston/Auburn and Portland for disposal of septic tank sludge disposal at the expense of the owners.
- The town plans to continue compiling and updating the 1991 maps of land use constraints.

YARMOUTH:

- Wellhead Protection Act, Shoreland Zoning and Floodland Management and the Resource Protection District.
- Passed a bond issue to make substantial upgrades to the sewer system. The sewer plan and improvements will cost between eight and ten million dollars.
- Working on stormwater improvement to meet federally mandated discharge standards.
- Continue the town’s septic system maintenance program to ensure that the septic systems within the watershed are properly maintained and pumped out.
- Continue to improve the water quality in the harbor so that all clam flats can be reopened.
- Continue systematic efforts to reduce inflow/infiltration.

CCSWCD Royal River Watershed Town Survey Results, May 1997

This survey was conducted by the CCSWCD as a follow-up to the DECD report. As in the DECD report, some towns did not respond to the survey.

1. What are current concerns that your town has about the quality of water within the Royal River Watershed or any of its tributaries?**AUBURN:**

Does not appear to have been an issue in Auburn in recent times.

NEW GLOUCESTER:

Housing construction and general development including logging, McKin Site, Pineland sewer system, and Sabbathday Lake Watershed.

NORTH YARMOUTH:

Effect of increased development on groundwater (our major source of drinking/home water); development includes associated issues such as runoff, erosion, impervious surfaces, fertilizer, herbicide/pesticide etc. Also interested/concerned with effects on surface water.

YARMOUTH:

Sedimentation, soil erosion, impact on shellfish and bottom feeders, navigation, increased dredging needs. General water quality - potential impacts on wastewater treatment plant license.

2. *Has your town worked in recent years (since 1990) with surrounding communities to protect natural resources? Please explain these past and on-going efforts.*

AUBURN:

Yes. Example: Lake Auburn Watershed Protection Commission; Taylor Pond Association, & Watershed Study; Little Wilson Pond Association; Cities of the Androscoggin Clear Water Team, Mid Maine Water Action Corp., Ordinances: Chapter 29-Zoning to include phosphorus control and agricultural resource protection, Chapter 30-Fill(ing of land), and Chapter 32-Design and Construction Standards to include erosion/sediment control and stormwater management.

NEW GLOUCESTER:

New Gloucester on Range Pond Advisory Committee; Sabbathday Lake report sent to Raymond.

NORTH YARMOUTH:

Not that I am aware of.

YARMOUTH:

Have worked with Friends of the Royal River - water quality monitoring.

3. *What types of future projects will your town be working on to protect the natural resources of the Royal River Watershed and will any of these projects require partnering of surrounding communities?*

AUBURN:

Nothing else planned at present except to continue monitoring efforts of Casco Bay and Royal River groups.

NEW GLOUCESTER:

Demonstration projects (BMPs) for Sabbathday Lake Watershed.

NORTH YARMOUTH:

No, the conservation commission and land committee have just initiated an open space analysis. Conservation Commission continues to review major subdivisions and manage town forest land.

YARMOUTH:

Hope to work with other communities to ensure use of Best Management Practices for development within the watershed.

4. *Approximately how many acres has your town put into land trusts or conservation easements?*

AUBURN:

Apparently none in the Royal River Watershed

NEW GLOUCESTER:

Do not know

NORTH YARMOUTH

Conservation Commission: 90 acres; North Yarmouth Land Trust: 60 acres; Pineland,
Department of Conservation: 107 acres

YARMOUTH:

Approximately 100

APPENDIX E

DMR SANITARY SURVEY FOR ROYAL RIVER

The following information is from the Sanitary Survey for Royal River Area I, January 1995, Maine Department of Marine Resources.

Description of Area

The Royal River in Yarmouth, Maine, is a narrow, winding river. Above head of tide, the river winds through farmland and residential districts before arriving at the town of Yarmouth. The fresh water then cascades down through a set of gradual falls and becomes tidally influenced south of Route 1. Though wider than up river, the tidal portion of the Royal River is still relatively narrow, about 1000' wide, and winds through residential neighborhoods until draining into Casco Bay, about 2 miles southeast of Route 1.

At head of tide, there is the Yarmouth Boat Yard and Yankee marina. About 2000' south of Yankee marina is the Royal River Boat Yard and Marina, and another 2000' south is the Yarmouth Sewage Treatment Plant outfall.

Southeast of the sewage treatment plant, the banks of the river become steep and covered with dense vegetation. The houses on the southern shore are all new and very large and are either connected to the sewer lines or have new inground septic systems. The southeastern shore, at the mouth of the Royal River, is an expanse of hayfield with farm buildings located more than 500' from shore. The houses on the northern shore are a mix of older and newer homes. The houses east of Woodland Street are on the town sewer lines. The houses east of Woodland Street have properly functioning inground septic system.

The mouth of the Cousins River joins at the mouth of the Royal River. There are no pollution sources draining from the Cousins River into the Royal River, and water quality in the Cousins River meets open approved standards.

Intertidally, the Royal River has soft shell clams as the primary resource of commercial interest.

The Royal River has been closed to shellfish harvesting because of three potential pollution sources at the head of the tidal estuary: 1) Yarmouth Sewage Treatment Plant, 2) two marinas, and 3) fresh water input from the upper, non-tidal portion of the river. These three sources have now been evaluated for their potential adverse effect on the Royal River.

Sewage Treatment Plant

The Yarmouth Sewage Treatment Plant was upgraded in November of 1993. All deficient pump stations have been corrected. The three primary pump stations in question with regard to water quality in the Royal River are Park Street, Royal River and the Harbor Pump Station. The Park Street Pump Station was replaced completely and the Royal River Pump Station and Harbor Pump Station were upgraded. These three stations can directly discharge into the river in case of mechanical failure, but will no longer overflow from excessive rainwater infiltration. All water through the pump stations will continue onto the plant. All pump stations have double pumps and red light alarms on site. In case of a mechanical failure, the red light stays on until recognized by a private citizen, plant operator, or police officer. All pumps receive routine

maintenance once a week. Two pumps, the Harbor Pump Station and the Royal River Pump Station are checked twice a day seven days a week. The plant operation is also checked twice a day on weekends and holidays. The new plant has a 20 year design, meaning that the plant should be sufficient to handle any population growth and development that may occur over the next 20 years. Unlike many sewage treatment plants, the Yarmouth Plant has an alarm on the chlorinations system, as well.

At the time of this report the system had been completely upgraded with the exception of the telemetry alarm system, which had not been connected. Since the time of the report the telemetry alarm system has been connected and is functioning. This system makes the response time to malfunctions less than one hour and is not dependent on when a civilian or police officer may see the red light alarms and report it.

Per the Town of Yarmouth Waste Water Discharge License issued by the DEP, the Yarmouth Sewage Treatment Plant is obligated not to exceed the following discharge limitations and to perform the minimum monitoring requirements. Failure to meet these obligations requires the plant operators to report the violation to the DEP.

A review of the EPA dye study that was conducted in August 1989, state that the sewage treatment plant outfall is exposed at low tide, but in actuality, only a part of the pipe is exposed and not the mouth of the pipe. The outfall is located directly off the point of land at the sewage treatment plant location. David Miller, of the DEP, evaluated the dye study for contamination effects at Cullen Point if a bypass occurs at the Harbor Pump Station. He concluded that if a spill of raw sewage occurs at head of tide, the minimum dilution at Cullen Point would be between 77:1 and 150:1. Three tide cycles later, it would be 800:1. He estimated that it would take three days for water quality to return to original bacterial levels. He also concluded that untreated effluent from the plant outfall would reach Cullen Point in less than six hours, if the spill occurred on an outgoing tide, and at low tide, it would take six to 12 hours.

Marinas

The two marinas dock approximately 150 boats during the summer months. About 60 of the boats are large enough to have heads, and therefore, are potential fecal coliform pollution sources. The Yankee Marina, at the head of the estuary, has a new toilet and shower building open 24 hours a day and most boat residents use the facility instead of their boat heads. All drains are connected to the town sewer. There is also a honey truck for pumping out boats. The truck then pumps into the sewer line. This practice has been in use for 4-5 years. There are plans for a formal pump out station.

The Royal River Boat Yard has no pump out station. It has two new bathrooms and showers that are connected to the town sewer. According to the marina calculation, the boats in the upper tidal area of the river will not adversely effect water quality below the sewage treatment plant outfall at Station 45.

Non-point pollution (Agriculture/Animals)

With regard to the non-tidal portion of the Royal River, survey samples were collected in the summer of 1993 under the old bridge at the base of the falls and at the bridge on Memorial Road near the Gillespie Farm. The scores were 460 and 75, respectively. The source of pollution in the upper river was either from overflow at sewer pump station, which has since been upgraded, or from nonpoint runoff. Most of the farmland bordering the river has been subdivided into large residential lots with new homes, new septic systems, and no development near the shore. Other

farmland is primarily hayfield, few grazing animals, and little cropland. There is a good buffer zone of trees and shrubs between most fields and the river.

There are no industries on the Royal River.

Hydrographic Information

Tides

The mean tidal range in this area is between 8.8 and 9 feet. The spring tidal range is between 10.1 and 10.5 feet. Neap tides average a little over eight feet. These numbers will vary from their predicted values depending on meteorological conditions. In general, low barometric pressures or onshore winds tend to create higher than predicted tides and offshore winds or high barometric pressures tend to create lower than predicted tides.

The mean tide in this area is about 4.9 feet. In other words, for at least one half of every day there is at least 4.9 feet more depth of water in the area than chart soundings would indicate.

There appears to be a correlation between ebbing tides and higher fecal coliform counts, but only at the stations northwest of the stone pier in the closed prohibited area. If this part of the river was to be open, samples should be collected on the ebb tide.

Rainfall

According to the Coastal Pilot, there is an average of about 42.9 inches of precipitation in the Brunswick area yearly. The monthly average is 3.6 inches with the maximum average precipitation occurring in November, 4.9 inches, and the lowest average occurring in July, 2.54 inches. At present the nearest rain gauge is located at the Freeport Sewage Treatment Plant and is monitored daily at 8:00 a.m.

The computer rainfall analysis includes data collected prior to the sewage treatment plant upgrade and is not representative of the Royal River at present. A review of the current data shows a correlation between rainfall and elevated fecal coliform levels at stations northwest of the treatment plant outfall, but no correlation at stations southeast of the outfall. Increased non-point pollution from the upper river after rainfall events does not adversely effect water quality southeast of the sewage treatment plant.

Winds

The United States Coast Pilot states that the prevailing winds during the warmer months are from the south and southwest and during the colder months from the northwest through the northeast in the Brunswick area. The mean wind speeds are greatest during the months of April and May. The lowest mean wind speeds are recorded during the month of August.

Winds have little effect on most of the river, because it is narrow and winding and banked by high ground on both sides. Where the Royal River joins the Cousins River, winds would assist in rapid mixing with open ocean waters and would have a beneficial effect on water quality.

River Discharges

Stormwater drains into the river via innumerable small seasonal streams. The primary influence to the shellfish growing area is the upper river, which cascades down a waterfall to head of tide. Stations at head of tide meet restricted standards due to this nonpoint pollution.

Immediately outside of the mouth of the river lies a part of Area I, known as Winslow Park, which is classified conditionally approved based on rainfall. Water quality results from station 55.5 indicate that water entering the river from this area meets approved area standards. Water quality in the Cousins River, which joins the Royal River at the mouth, also meets open approved standards and does not adversely effect the Royal River.

Water Quality

Prior to November 1993, when the sewage treatment plant was upgraded, there were numerous overflows from pump stations along the river and the plant was throttling off excess sewage at the Harbor pump station when the plant was at capacity. Sampling scores from the above mentioned stations were very high following rainfall events.

During the past three years, the river has been sampled and evaluated using an adverse strategy in 1992 and 1993 and a random strategy in 1994. Using the last 30 samples to determine a 90th percentile would incorporate the poor samples collected prior to the sewage treatment plant upgrade, which would not be an accurate assessment of water quality since the upgrade. Samples collected within the last three years are closely representative, since many pump station upgrades began two years prior to the completion of the upgrade.

Water quality meets open approved standards at stations 47, 48, 49 and 50, and restricted standards at stations 42, 43, 44, 45 and 46. The sewage treatment plant outfall at Station 45 requires a year round closed prohibited buffer zone. The two marinas at Stations 43, 43 and 44 require a seasonal closure from April 15 to November 1 due to the presence of the live aboard boats.

Conclusion

Stations 47 through 50 can be reclassified restricted for depuration provided that the depuration crew representative contacts the sewage treatment plant personnel prior to each time of harvesting to ensure that all sewage treatment systems are functioning properly. A zero hour test must be performed on the shellfish from the Royal River to ensure that the level of contamination in the clams conforms to the depuration requirements.

APPENDIX F
ROYAL RIVER DREDGING PROJECT SUMMARIES

U. S. Army Corps of Engineers, Public Notice, February 1, 1995

Public Notice Maintenance Dredging of the Royal River Federal Navigation Project Yarmouth, Maine

Project description: The authorized Federal navigation project in the Royal River consists of an 80 foot wide 8 foot deep at mean low water (MLW) navigation channel and an eight acre, six foot deep at MLW anchorage adjacent to the head of the channel.

Character and Purpose of Work: The proposed work involves dredging about 100,000 cubic yards of primarily fine grained sandy silt material from the channel and anchorage. Existing controlling depths of less than four feet in the channel (controlling depths in the vicinity of Whitcomb Creek are above MLW) and three feet in the anchorage are inadequate for the existing recreational and commercial vessel traffic. Dredging will restore the area to the authorized project dimensions. The work will be performed by a private contractor, using a mechanical dredge and scows, under contract to the Government. The dredge will remove the material from the bottom of the river and place it in scows which will be towed to the Portland Disposal Site where the material will be released. The Maine State Planning Office and Yarmouth officials have requested that this project be maintained.

Previous Dredging: The project was last maintained in 1985/1986 when about 42,600 c.y. of material was dredged from the anchorage and adjacent channel area.

The proposed work involves maintaining the Federal navigation project in the Royal River. To not dredge would result in failure to provide adequate depths for its continued use. Since feasible disposal options are limited to an open water disposal site, use of a mechanical dredge would be the most cost effective means of performing this work. Hydraulic dredging depends upon the availability of suitable nearby upland sites.

U. S. Army Corps of Engineers, Public Notice, June 29, 1995

Royal River Boatyard, Inc., Bayview Street, Yarmouth, ME 04096 has requested to upgrade an existing boatyard and marina in the Royal River at Yarmouth, Maine as shown on the attached plans and described as follows:

Maintenance dredge by mechanical means approximately 8,000 cubic yards of sand, silt and clay from an irregularly shaped 145' X 250' area to a depth of -6' mean low water. The maintenance dredging is designed to restore adequate access and mooring depths at an existing boatyard and marina.

Remove an existing marine railway on site and replace it with a 94' X 10' public boat ramp. The ramp will require the placement of approximately 30 cubic yards of gravel and precut concrete fill below the high tide line. The ramp will extend approximately 60' beyond the mean high water line.

APPENDIX G

EXISTING, ONGOING, AND PREVIOUS WATER QUALITY RELATED EFFORTS IN THE WATERSHED

Casco Bay Estuary Project

The Casco Bay Estuary Project is a cooperative effort to protect and prevent the pollution of Casco Bay by involving concerned citizens and local, state, and federal governments. The Casco Bay Plan (Casco Bay Estuary Project, Fall 1996) was developed through a collaborative process involving hundreds of individuals and dozens of organizations and government agencies. This plan represents the commitment of citizens, industries, and communities to protect Casco Bay. It marks the culmination of five years' effort involving scientific studies, public feedback, local government input, and countless meetings and discussions.

The watershed of Casco Bay encompasses 985 square miles of land, which includes 41 municipalities. It stretches from the coast at Cape Elizabeth east to Cape Small in Phippsburg, and northwest to Bethel, in the western mountains of Maine. Twelve significant lake and river systems feed the bay, including Sebago Lake and four major tributaries: the Presumpscot, **Royal**, Stroudwater, and Fore Rivers.

Recognition of the interconnections within each watershed has led to a new approach in environmental management and land use planning. Rather than focusing on local towns or individual species, efforts are now made to sustain the health of the whole ecosystem. The Casco Bay Plan incorporates a "watershed" view in its recommendations for protecting the Casco Bay estuary. To understand Casco Bay and prevent further pollution, this Plan focuses on five key issues of importance to the health of the bay. These issues, identified through an inclusive public process, are stormwater management, clam flats and swimming area, habitat protection, toxic pollution, and stewardship of the bay. **For more information on the Casco Bay Estuary Project, please contact Katherine Groves, CBEP Director, at 780-4820.**

Chandler Brook Project

The Chandler Brook Project is in full swing and will be winding down during the summer of 1997. This project, which began in September of 1994, is funded through Section 319 of the Clean Water Act by the United States EPA. The project sponsor, Cumberland County SWCD, is working with the USDA Natural Resources Conservation Service, the Maine DEP and area landowners in the Chandler Brook Watershed to protect the water resources of the watershed. Eight Best Management Practice (BMP) demonstrations have been completed or will be completed during the summer and fall of 1997. There will be a tour next fall of the sites which include agricultural and urban BMPs. The Friends of the Royal River are assisting the project by conducting pre-and-post BMP monitoring at the sites. **For more information contact Forrest Bell at (207) 839-7842.**

Roadside Runoff and Erosion Control 319 project

This is a 30 month project which runs through September of 1998. The purpose of the project is to reduce the amount of nonpoint source pollution from roadside erosion and runoff entering the Royal River and Upper Coastal waterways. During the course of the project, the Cumberland County Soil & Water Conservation District will: present convincing evidence to town officials of the need to adopt BMP training and implementation (emphasis will be placed on cost-avoidance benefits of BMP implementation and the resulting water quality protection and improvement); obtain commitments from towns to participate in the project; provide in-house, mandatory BMP training to road crews of participating towns; develop a model strategic plan for sustained annual training of road crews; conduct a "Ditch of the Year" competition; and in conjunction with Maine DOT, revise the "Runoff and Erosion Control Guidelines for Highway Crew Leaders" to include BMP technology. **For more information contact the Cumberland County SWCD at (207) 839 - 7842.**

University of Maine Cooperative Extension Royal River Project

The impact of non-point source pollution in the environment has been well documented in the Casco Bay Estuary. Over 40 percent of commercial shellfish beds have been closed due to bacterial contamination; bottom sediments are contaminated with heavy metals; and there has been a notable decline in the abundant marine life in the sub-tidal zone. The University of Maine Cooperative Extension received a water quality grant from Cooperative State Research, Education, and Extension Service to begin a non-point source pollution education project in the Royal River Watershed. The Royal River Watershed Project is now in its fifth (and final) year, and the following report summarizes project activities through the present.

Agriculture

The Dairy Demonstration Farm:

In 1994 we initiated a project in cooperation with a dairy in the watershed to determine how or if certain farming practices impacted water quality in an adjacent stream. This farm is located on very hilly terrain abutting a tributary of the Royal River. Two main problems were identified on the farm, the first and perhaps most obvious, was impact from livestock access to the stream. This presence not only degraded water quality through the introduction of nutrients via manure, but also caused major streambank erosion, further degrading water quality. Secondly, due to the hilly nature of the pasture area, nutrient management on the farm is not efficient due to difficulties involved with manure spreading on these hills; it is not done. Due to nutrient poor soils, forage quality was not as high as it could have been.

Our work on this farm has been directed at these issues. In the fall of 1994, we designed a management plan that would address these problems. The first issue was to establish a way to exclude cows from the brook, yet provide them with the water they need. In the summer of 1995, we established a watering system that would provide water to the pasture and exclude cows from the brook. The brook was fenced off and a Ram pump was installed in the falls in the brook that was then used to pump water to basins set on the highest point of the pasture. From the basins, water could be drawn to several points throughout the pasture. A rotational grazing system was put in place to facilitate the movement of cows throughout the pasture. The rotational grazing system reduces soil compaction and overgrazing in any one area of the pasture and can reduce the survival rates of opportunistic weed species. Rotating cows from one area to

another allows for a more uniform dispersal of manure over the pasture; nutrient build-ups in some areas and deficiency in other areas can be avoided.

Streambank plantings, to reduce bank erosion, took place in the spring of 1995 in collaboration with NRCS staff. Plantings of dogwood, willow, sand cherries, and beach and marsh grasses survived well. Other plantings of native willows along the streambank were not as successful due to the erratic winter weather and heavy bank losses. Approximately 25 percent of the willow saplings have survived. In the summer of 1996, day lillies were planted to stabilize another heavily eroded area.

We have documented improvements in both forage quality and bank stabilization. To assess how these activities affect water quality, we have monitored the benthic macroinvertebrate populations living in the brook. Comparing population data from 1994, before improvements were made, to data collected in Fall 1995, we have reason to be optimistic that changes in farm practices are positively affecting water quality. We saw increases in pollution intolerant families such as stone flies, mayflies, and caddis flies and saw an increase in total numbers of families, therefore enhancing the diversity of the site. Due to the flood of October 1996, last year's supportive data was lost. We will continue to monitor for at least one more year.

The Beef Demonstration Farm:

We have demonstrated low-input and non-chemical methods of weed control in field corn. We have compared suggested herbicide applications rates with low-input and combinations of herbicide mixes to determine their effectiveness in controlling common weeds. We have also compared the effectiveness of narrow row planting of corn in comparison to conventional wide row planting as a non-chemical weed control method. Trials using the Lely spring-tine cultivator were a great success in 1995; it proved to be as effective as traditional pre-emergence herbicides at controlling common weeds. In 1996, the Lely cultivator was used as the primary source of weed control on this farm. High rainfall and resultant heavy soils that year did not permit the cultivator to be as effective. The use of pre-side dress nitrate testing (PSNT) is encouraged to promote efficient fertilizer use on farms.

A rotational grazing system on this farm is also being used. The system was established to better control the feeding habits of pastured beef cattle, to better distribute manure over the pasture, to reduce streambank erosion, and to reduce nutrient and bacterial inputs into the Royal River. From intensive pasture management, there had been improvements in pasture productivity and we believe a reduction of sediment and bacteria into the river. We hope that continuation and expansion of the system in the future will continue to improve forage quality and water quality.

Rural and urban reduction of non-point source pollution

Streamlines:

The newsletter *Streamlines* continues to be well received by our readership. It is a great way to spread water quality information to those people who are harder to reach. We have also been able to update our subscribers on water related events that are happening in their area in our *Upcoming...* section. We regularly hear from many of our 1650 subscribers praising the publication and requesting more information to fuel their wetted appetites. Past issues have focused on composting and recycling, pond maintenance, the McKin superfund site, and safe home gardening and landscaping. It is our hope that small changes made at home from information gleaned from *Streamlines* will make a significant impact on the quality of the Royal River and on into the much larger Casco Bay.

The Safe H₂OME Program:

The Safe H₂OME Program has become a very useful educational tool in our water quality program. The five work sheets, *Home Well Construction and Maintenance*, *Safe Lawn and Garden Care*, *Household Wastewater Treatment*, *Household Hazardous Waste*, and *Lead in the Environment*, touch on areas of significance for most homes in the watershed and in Maine.

In 1995-1996, watershed citizens were provided with a free water test kit as an incentive to participate in the program. Along with an actual water test, participants responded to an evaluation of their home activities. Respondents felt that the following topic areas put their water supply at moderate-high to high risk for potential water quality problems:

<u>Topic</u>	<u>% Mod-High to risk</u>
Home Well Construction and Maintenance	25.8%
Safe Lawn and Garden Care	23.2
Household Wastewater Treatment	25.8
Household Hazardous Waste	23.6
Lead in the Environment	24.1

The following are the actual water test results from those respondents and reveal the percentage of homes that tested positive for the parameters indicated:

<u>Parameter</u>	<u>Percent Respondents</u>
Total Bacteria	27.4 %
Fecal coliform and <i>E. coli</i>	15.4 %
Nitrate	none above EPA standard (10 mg l ⁻¹)
Arsenic	1.0 %

Having completed the Safe H₂OME Program, respondents were asked to name an activity or possible problem area around their home that they would likely make changes to as a result of participating in the Safe H₂OME Program. The responses were the following:

<u>Area of change</u>	<u>Response</u>
Reduce use of hazardous products	38.9 %
Regular water testing	23.4
Improve septic system maintenance	13.7
Improve well construction	10.9
Decrease water use	5.7
Use lead-free plumbing	3.4
Increase soil organic matter	2.3
Increase soil nutrient testing	1.7

The previous results give us valuable information and direction for future programming needs for the watershed and the State of Maine.

Public environmental education in the watershed

Benthic Macroinvertebrate Monitoring:

We have included the Advanced Biology class at Yarmouth High School in our benthic macroinvertebrate (BMI) monitoring program at our cooperating dairy. Students were involved in placing rock baskets in the brook to sample BMI populations in the fall. Later, students were involved in identifying and sorting these organisms. Students also aided in data interpretation to determine trends. The class effectively identified the usefulness of this data to interpret water quality changes.

School Presentations:

We regularly work with a variety of school groups and teachers to ensure that water science is an important part of watershed school's curriculum. Last year 14 fifth-grade classes from Gray, Durham, and Poland participated in these programs. We incorporated much of what we had learned from our BMI monitoring program into our presentations. Students were taught about the precious nature of our drinking water, and then we proceeded out to a local brook to study BMI populations living in the brook. Students were encouraged to think about what these populations might tell us about water quality by considering population diversity and types of families present. We then discussed land-use and how land-use planning is an important way to preserve the quality of our waters.

Conclusions

Activities in the Royal River Watershed have continued to raise the public's awareness about non-point source pollution that may be affecting the quality of the Royal River. We increased our youth programming to encourage provocative thought and interest in the environment at an early age. Our Safe H₂OME Program continues to be a successful educational tool for residents of the Royal River Watershed and has provided us with some important information about the actual quality of residents' home drinking water. Through our agricultural programming, we have continued to demonstrate the viability of low or non-chemical methods of pest control and raise awareness of how agricultural practices can impact the environment. Overall, the project continues to be beneficial to the health of the watershed and the Casco Bay Estuary. **For more information on this project, please contact Umaine Cooperative Extension at 581-3241.**

Casco Bay Technical Assistance Project

The Cumberland County Soil and Water Conservation District recently completed this project which was funded through the Casco Bay Estuary Project and the US Environmental Protection Agency. The purpose of this one year project was to protect and improve the water quality of Casco Bay and its watershed by providing one-on-one direct technical assistance and incentives to municipal staff, especially code enforcement officers, board members, contractors, developers and others to implement best management practices and stormwater runoff management systems. Municipalities play a vital role in protecting Casco Bay. **For more information on this project please contact Betty Farley at (207) 839-7842.**

Sabbathday Lake Watershed Survey

The primary purpose of this watershed survey was to identify and prioritize existing sources of polluted runoff in the watershed of Sabbathday Lake (located in New Gloucester), particularly the identification of soil erosion sites. The secondary purpose was to raise public awareness in New Gloucester and Poland of Nonpoint source pollution and its effects on lake and stream water quality. The project was initiated by members of the Erosion Sub-Team from the Royal River Watershed Project.

As with other watershed surveys conducted throughout Maine, Sabbathday Lake's survey utilized trained volunteers to identify erosion sites within the watershed. Volunteers consisted of New Gloucester Water Resources Committee members, Sabbathday Lake Association members, and other town citizens. In April of 1996, a team of 17 volunteers from the Town participated in two three-hour training sessions. The training included an indoor session on April 11th focusing on lake ecology, nonpoint source pollution, and identification and documentation of problem areas. This was followed by field training on April 13th which involved an outdoor session to look at actual sites and discussion on the problems found and how to document them.

Volunteers identified 120 sites during the survey process. Of these, 75 were determined (through follow-up analysis by DEP and the CCSWCD) to have an impact on the water quality of Sabbathday Lake and are documented in a full report: Sabbathday Lake Watershed Survey Project. This report gives locations of sites, the problems encountered at each site, and recommendations for correcting the problems. In addition, the report gives the sites rankings according to priority and the technical/funding level necessary for installation. The reports were distributed to town officials and committee members.

The watershed survey identified the percentage of the total number of sites represented by each land use. State and town roads account for nearly half (48%) of the total. Private roads, driveways, and residential sites comprise an additional 41% of the total with the remaining 11% divided among commercial, beach, boat access, and logging road sites. These are nearly identical numbers that were calculated as part of a watershed survey for Runaround Pond in Durham which is also a small sub-watershed of the Royal River.

A 319 Project has been proposed for the Sabbathday Lake Watershed by the Cumberland County Soil and Water Conservation District, the Town of New Gloucester and the Sabbathday Lake Association. This project will demonstrate BMP implementation sites on roads and private lands to the citizens of the watershed. **For more information please contact Forrest Bell, CCSWCD, at (207) 839-7842.**

Cole Brook 319 Project

Cole Brook, located in Gray, is a two-mile long tributary of Collyer Brook and eventually the Royal River. Suburban development, agricultural activities, and some naturally occurring erosion along Cole Brook's corridor have contributed a very large amount of sediment that has destroyed this once bountiful trout habitat. Due to the excess sediment, this stream is currently too shallow to support the trout habitat that it contained ten years ago.

This two-year project, which runs through June of 1998, is attempting to restore and improve the aquatic habitat that has been destroyed due to heavy sediment loading from various sources. The

project plan includes stabilizing and treating two eroding gullies adjacent to the Cole Brook riparian corridor. Restoring and planting riparian vegetation, installing in-stream trout habitat improvement structures and conducting stream bio-monitoring. Several partners are working with the project sponsor (Cumberland County Soil and Water Conservation District) on the project which is funded under Section 319 of the Clean Water Act by the United States Environmental Protection Agency and is managed by the Maine Department of Environmental Protection including the USDA Natural Resources Conservation Service, the Maine Department of Inland Fish and Wildlife, and Trout Unlimited.

Royal River Watershed Steward Program

The Watershed Steward Program is modeled after Cooperative Extension's Master Gardener Program. Program participants in the Royal River Watershed, called Watershed Stewards, received 20 hours of technical training on water quality issues. In return, they identify and carry out projects in their communities that benefit the watershed. Program facilitators are available to provide ongoing technical and possibly financial support for projects. The goal of the Watershed Steward Program is to increase public knowledge of how watersheds function and to encourage community service.

The first round of classes of the Watershed Steward Program was attended by 22 residents of the Royal River Watershed. Topic areas of the eight class sessions which took place during the Spring of 1997 included Water Quality Monitoring, Habitat Restoration, Watershed Surveys, Public Water Supplies, and Environmental Education. The next phase of the program is the inclusion of the participants in volunteer projects in the Royal River Watershed.

Friends of the Royal River Fish Ladder Maintenance Project

In addition to the monitoring work described in Chapter 3, The Friends of the Royal River, in Partnership with the U.S. Fish and Wildlife Service and the Maine Department of Marine Resources, have adopted the two fish ladders on the Royal River in Yarmouth. These fish ladders are critical to the upstream and downstream passage of anadromous fish such as alewives, shad, sea-run brown trout, and possibly Atlantic Salmon. Annually, these fish migrate up the Royal River and its tributaries to spawn and the following year the young migrate to the ocean to develop into adults. Fish ladders provide a route for the fish around human-caused obstructions such as dams. In these times of dwindling state and federal budgets, the Friends of the Royal River have agreed to manage the fish ladders at Elm Street and Bridge Street with the supervision of the appropriate agencies.

Our adoption program got off to a busy start last May with removal of debris in the ladders (some unfortunately the result of vandalism), acquisition of materials and the construction and installation of baffles for the fish ladders. Baffles are the wooden pieces that are inserted between the cement walls of the fish ladder. They provide eddies, or calm spots, the fish use as they swim up or down the ladder. Hancock Lumber of Yarmouth donated the lumber and hardware needed for this project. The rest of the work was done by volunteers. The Yarmouth Parks Department assisted by letting us use their tool shed and electricity during construction. After the ladders were ready the gates were open and the fish ladders were operational. Many thanks to all involved for getting this project off to a great start! Future plans for ladders include yearly maintenance, opening the ladders every May and closing them every November, and

interpretive signs at the ladders explaining how they work and who maintains them. - Bob Houston, Friends of the Royal River Newsletter, 1996

U.S. Fish and Wildlife Service Gulf of Maine Program

(See inserts on following pages)

Casco Bay: important habitats and land use development

Gulf of Maine Coastal Ecosystems Program

Casco Bay, located where New England's northern rockbound coastline meets southern beaches and salt marshes, is surrounded by 15 Maine towns. Though still rich in natural values, Casco Bay and its surrounding watershed are subject to threats of increasing development.

In coordination with the Casco Bay National Estuary Project, Gulf of Maine Coastal Ecosystems Program biologists completed an analysis of fish and wildlife habitats in the towns surrounding Casco Bay. Using data collected by Maine Dept. of Inland Fisheries and Wildlife, Maine Dept. of Marine Resources, Maine Office of GIS, U.S. Fish & Wildlife Service's National Wetland Inventory and Maine Audubon Society, Gulf of Maine Program biologists identified and ranked important wildlife areas for colonial waterbirds, seabirds, wading birds, anadromous and freshwater fish, eelgrass, cordgrass, marine worms, shellfish and endangered/threatened species (bald eagles, roseate terns, piping plovers and least terns). Biologists also used satellite imagery to identify and map current land use in the area. All data was combined to create a composite map highlighting important habitat for the species evaluated. Findings were reviewed by a panel of biologists from state agencies and non-governmental organizations, and their comments were incorporated in the final report and accompanying maps. Currently, the Gulf of Maine Program and other cooperators are distributing the information to interested individuals, local land trusts, town planners, conservation commissions and other conservation organizations in the region.



For further information, please contact:

U.S. Fish and Wildlife Service
Gulf of Maine Coastal Ecosystems Program
4R Fundy Road
Falmouth, Maine 04105
(207) 781-8364
FAX (207) 781-8369
<http://www.fws.gov/~cep/maine.html>
R5ES_GOMP@mail.fws.gov
Project Leader, Stewart Fefer

The Gulf of Maine Program and the Casco Bay National Estuary Project staffs also explored a related question: "What would happen to existing fish and wildlife habitat if the towns surrounding Casco Bay developed to the extent permitted by current land protection plans?" The Casco Bay National Estuary Project staff completed a preliminary "build-out analysis" of the region by working with town planners to determine potential future land cover. The Gulf of Maine Program integrated the build-out analysis with the composite habitat map to identify important areas that could be threatened. This information, once verified on a town-by-town basis, will help focus voluntary, locally-initiated habitat protection efforts towards those areas most threatened by development pressures.

Contact the Gulf of Maine Program for a more detailed 4-page version of this fact sheet or a copy of the 75-page technical report which includes maps of important habitats. You can also find the technical report on the Internet at <http://rossby.unh.edu/edims/banner/casco/casco.htm>



Protecting fish and wildlife habitat in the Casco Bay watershed

Gulf of Maine Coastal Ecosystems Program

In coordination with the Casco Bay Estuary Project, U.S. Fish and Wildlife Service's Gulf of Maine Program biologists have been working for the past 1-1/2 years to identify important fish and wildlife habitats in the fifteen towns surrounding Casco Bay. Using data collected from state and federal agencies and non-governmental organizations, Gulf of Maine Program biologists identified important wildlife habitats for colonial waterbirds, seabirds, wading birds, fish, eelgrass, cordgrass, marine worms, shellfish and endangered/threatened species. After mapping habitat for individual species or closely related groups of species, Gulf of Maine Program biologists overlaid the habitat information for each species to create a map identifying important fish and wildlife habitat for all species included in this study. This fact sheet briefly summarizes the methodology, presents results, and seeks to catalyze voluntary efforts to protect habitat in the Casco Bay region. A 75-page U.S. Fish and Wildlife Service technical report, "Identification of Important Habitats in the Lower Casco Bay Watershed," details methodology, documents data sources, and includes habitat maps for all species evaluated. The technical report is available in local libraries and on the Internet at <http://rossby.unh.edu/edims/banner/casco/casco.htm>

Wildlife in Casco Bay

Lobsters, clams, bald eagles, terns, alewife, eelgrass and people all share Casco Bay and its surroundings.

We're all interrelated, and we are all part of the essence of Casco Bay's heritage. As barometers of the Bay's health, fish and wildlife measure the quality of our environment and help define the character of our lives.

However, rapid population growth and associated development activities threaten to destroy or degrade natural habitats in Casco Bay and its surrounding watershed.

IDENTIFYING IMPORTANT FISH AND WILDLIFE HABITAT IN THE 15 TOWNS SURROUNDING CASCO BAY:

To identify important habitat, Gulf of Maine Program biologists completed a GIS analysis that involved three major components:

1. Select species: The first step in completing this study was to select plants and animals representing a cross-section of important species in the Casco Bay estuary. Species were selected on the basis of: ecological importance, economic importance, institutional importance, sensitivity to development pressures, and availability of data.

2. Identify and map habitat for each species or group of species: For some species, such as least terns, precise field surveys were available so habitat could be mapped with confidence from existing data. For other species, such as great blue herons, scientifically verified sitings were insufficient to fully represent areas actually used by herons. In those instances, field sitings were supplemented with habitat suitability profiles that identified appropriate habitat, based on selected environmental conditions. Habitat suitability profiles were developed by reviewing scientific literature and by seeking advice from species experts.

Recognizing that some habitat provides greater ecological value than other habitat, relative habitat values were determined for each species. Habitat scarcity, intensity of use, the quality of environmental conditions, and the amount of habitat disturbance were all important in assigning relative habitat values.

Once identified, habitat was mapped for each species or species group. Multi-color maps for all 11 species or species groups are available in the 75-page technical report. In addition, large maps identifying habitat for each species or species group are available at the Gulf of Maine Program office, providing users greater clarity in distinguishing relative habitat values. Habitat maps for a single species or species group can focus protection, enhancement and restoration efforts for specific purposes, such as shellfish management, endangered species recovery, or fish passage maintenance.

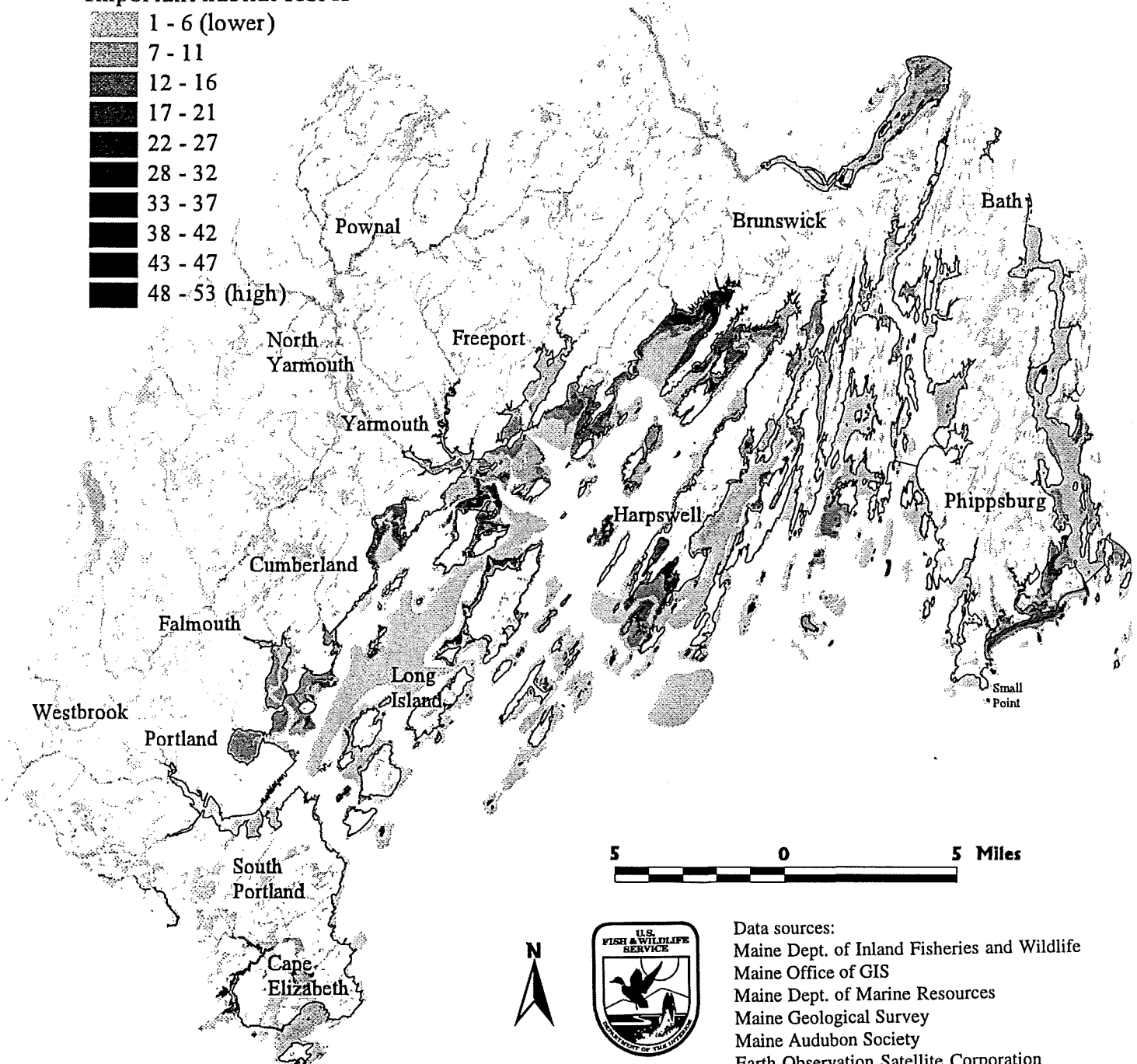
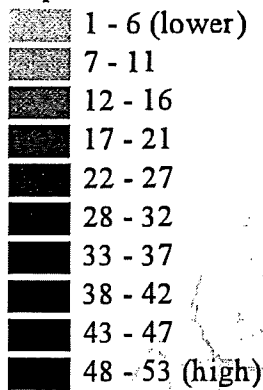
For further information, please contact:

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<http://www.fws.gov/~cep/maine.html>
Project Leader, Stewart Fefer



Important habitats for all evaluation species (Lower 15 towns in Casco Bay Watershed)

Important habitat scores



Data sources:
 Maine Dept. of Inland Fisheries and Wildlife
 Maine Office of GIS
 Maine Dept. of Marine Resources
 Maine Geological Survey
 Maine Audubon Society
 Earth Observation Satellite Corporation
 U.S. Geological Survey
 U.S. Fish and Wildlife Service
 National Wetland Inventory
 Prepared by:
 U.S. Fish and Wildlife Service
 Gulf of Maine Project

APPENDIX H

MCKIN SUPERFUND SITE UPDATE

The following information appears in an EPA Project Fact Sheet dated January, 1996.

SITE BACKGROUND

The Mckin Superfund Site in Gray, Maine, operated as a waste collection and transfer station from 1964 until 1977. Complaints from nearby residents alerted local officials in 1973 of contamination of area groundwater. Investigations of the site found that the soil and groundwater were contaminated, primarily with trichloroethylene (TCE) and 1,1,1-trichloroethane.

The Maine Department of Environmental Protection (ME DEP) and the U.S. Environmental Protection Agency (EPA) worked together to remove waste from the site and to conduct a study of the nature and extent of contamination. A cleanup remedy was selected in 1985 and was documented in a Record of Decision. The plan called for cleanup of site soils and restoration of area groundwater. The soil cleanup was successfully completed in 1987 by the parties deemed potentially responsible (PRPs).

Operation of the Groundwater Extraction and Treatment System (GETS) began operation in 1990. Since that time, the system has been extracting and treating contaminated groundwater. In addition, EPA and the Maine DEP have been working with the PRPs to evaluate the GETS and better understand the movement of contamination from the site through groundwater. This ongoing evaluation has shown that, although some contamination has been removed from the aquifer, it would take many years (perhaps several hundred) to fully restore the groundwater so that it could be used for drinking water.

CURRENT SITE STATUS

Currently, the PRPs are working with the EPA and DEP to complete an evaluation of the GETS and also to evaluate alternative plans for addressing the contamination. The GETS has temporarily been turned off during the evaluation period. The EPA and the DEP will need to make two decisions regarding the groundwater cleanup.

Is it impracticable to restore the groundwater so that it meet performance standards set in the Record of Decision? Based on the information available to date, it appears that a GETS will not be effective in completely restoring the aquifer within the near future.

If groundwater is not restored, what should be done to insure that human health and the environment are protected? EPA and DEP have not yet made a decision on a new strategy for the site. A new strategy will have to insure that residents in the contaminated area do not use groundwater, and will have to address the discharge of contaminated groundwater to the Royal River.

To prevent residents from drinking contaminated groundwater, several institutional controls (such as land use regulations) are being evaluated. EPA and DEP consider local input crucial in selecting the best options.

Currently, a portion of the Royal River near the McKin Site exceeds water quality standards for consumption of water and fish because contaminated groundwater is discharging to the river. It

does not exceed standards for fish consumption alone. In other words, contamination from the site should not be of concern to people eating fish from the Royal River. However, there would be a concern if someone were eating fish and using river water as a long-term source of drinking water. At this time, no one in the affected area is known to be using the Royal River for drinking water.

An evaluation of a new strategy will focus on whether it is possible or practical to physically contain contaminated groundwater from discharging to the Royal River, and will evaluate potential restrictions on use of the River.

OPPORTUNITIES FOR PUBLIC INVOLVEMENT

In October of 1995 EPA and the State of Maine held a public meeting to begin discussions about a new direction for the McKin Superfund Site. As summarized below, there will be several opportunities for interested citizens and local officials to become involved in the decision making process.

- The results of the TECHNICAL EVALUATION currently being completed by the PRPs and other recent site data will be made available to the public for review. Draft and final documents will be available in the Gray Public Library and several other locations in the area.
- A PUBLIC INFORMATION MEETING will be held in early spring to discuss the results of the evaluation and present the alternatives under consideration of the McKin Site.
- After carefully reviewing the technical evaluation of the site and all of the different alternatives for future action, EPA, in conjunction with ME DEP, will issue a PROPOSED PLAN which will propose an amendment to the Record of Decision and establish a formal public comment period.
- During the public comment period, anyone who is interested in commenting on the plan may do so in writing or at a PUBLIC HEARING. While this is an opportunity for formal comment, we encourage interested citizens to provide comments at any time.
- After the end of the public comment period, EPA and DEP will take into consideration all of the comments on the plan and make a final decision on how to protect human health and the environment at the McKin Site.

If you have any questions about the McKin Site or upcoming activities, please contact one of the following:

Terrrence Connelly, EPA Project Manager; (617) 573-9638
Sheila Eckman, EPA Project Manager; (617) 573-5784
Rebecca Hewett, Maine DEP Project Manager; (207) 287-2651
Elizabeth Swain, PRP Representative; (207) 774-2458

Trichloroethylene: What is it and Why Should I be Concerned?

*By John M. Jemison, University of Maine Cooperative Extension
Streamlines Newsletter, Spring 1996*

Trichloroethylene and tetrachloroethylene (TCE) are the primary chemical contaminants entering the Royal River from the McKin site. Trichloroethylene is an industrial chemical that has been used to dissolve grease from metal, frequently engine parts. It is heavier than water, which has implications on how it moves in bedrock and soil. People can smell TCE at very low levels. It has a sweet smell and a slightly burning taste when inhaled.

Trichloroethylene is one of the most common contaminants at superfund sites in the United States. A suspected carcinogen, the Environmental Protection Agency has set a drinking water standard of 0.005 ppm (parts per million). Above this level, if a 150-pound human drinks two quarts of water a day for 70 years, he or she would have a one in a million chance of developing cancer.

The physical and chemical properties of TCE affect the product's fate in surface and groundwater. In contrast to many common organic contaminants, such as gasoline or fuel oil, TCE is heavier than water. If you had a pool of water and poured TCE and gasoline into the pool, gas would float and TCE would sink to the bottom. This property affected how TCE likely moved at the McKin Site. Had the substance acted more like gasoline, the clean-up would have been more successful. Instead, much of the TCE sank down to the top of and infiltrated into cracks in the bedrock. So, that is why some TCE will recharge the river system for many years to come.

The positive physical and chemical aspect of this chemical is its volatility. Once the chemical enters the river system, it gets diluted by the river water and evaporates readily into the atmosphere. Data collected at the site indicates that the highest river concentrations are between 0.015 and 0.035 ppm. It becomes undetectable further downstream. Of the estimated 1,000 to 1,200 pounds of TCE that enters the river each year, little, if any, ever reaches Casco Bay.

You may be wondering what is the greatest risk with this contamination? Since public water has been supplied to the homes in the affected area, drinking TCE should not pose a problem. The contaminated soil had been removed and cleaned, so volatilization into the air from the soil on site should be minimal.

It is estimated that in the most highly concentrated parts of the plume, groundwater TCE concentrations exceed 2 ppm (400 times the drinking water standard). However, most river water concentrations are below the drinking water standards, therefore swimming should not be a problem. Also, fish do not accumulate or concentrate TCE to any major extent, so fishing should not be a large concern given the low levels in the river. The data indicate that from a half of a mile below the site to Yarmouth, there should be no detectable TCE in the river. However, more sampling is needed to know where TCE levels are no longer detectable in the river.

APPENDIX I

HAZARDOUS SUBSTANCE EMERGENCY RESPONSE PLAN

As part of the Royal River project conducted by the Cumberland County SWCD, the Citizen's Advisory Committee requested that research be done to determine what sort of emergency response plan would occur if a vehicle carrying hazardous substances overturned and spilled into a water body in the Royal River. Research involved meeting with staff from the Cumberland County Emergency Management Agency (CEMA). The following are the results of our research.

The Emergency Response Guide produced by CEMA discusses the levels of response, chain of command and public notification in the event of an emergency. It contains forms, check lists and standard operating procedures for companies to use as a guide to setting up emergency response in preparation should a spill of a hazardous substance occur.

The Cumberland County Emergency Management facility has a SENERIO computer program that helps define an area that would be potentially affected should a spill occur. Information such as the weather, time of day, and chemical involved are entered into the program and an affected radius is computed. Also, any contributing facilities in that affected area are highlighted. For instance, if a spill happened at NYNEX and through the SENARIO program a radius was determined that included CMP, then CMP would be considered a contributing facility. CMP would then be notified to act according to plan.

In addition to identifying contributing facilities, special facilities are also identified. Special facilities include hospitals, day care centers, nursing homes, etc. These facilities must be notified if they fall in the affected area.

The appendix in the Hazardous Substance Emergency Response Plan contains the framework that each company that uses hazardous substances has completed. This prompts the company to be completely prepared and accountable for a plan of action should a hazardous substance emergency occur.

The Hazardous Substance Emergency Response Plan is constantly updated as companies add or delete chemicals they use, companies move, new day care centers open, etc. This is a dynamic plan. This is not a stand alone document but is designed to compliment individual community plans.

What happens in response to a hazardous spill depends on the resources available to that community where the spill occurred. Usually the community fire department will be in control of the situation. Fire departments have a mutual aid pact to pool resources and if necessary contact the DEP. The fire departments also have a contact with the three Hazmat response units of Cumberland County.

If a spill occurs on the Maine Turnpike or on Interstate 295, the state police will be in control of the situation. If the spill occurs in a community that does not have a full time fire department or police force then the Cumberland County Sheriff Department will take control. Spills east of U.S. Route 1 are covered by the Coast Guard.

APPENDIX J

STATE OF MAINE 1996 WATER QUALITY ASSESSMENT SUMMARY

Water quality can be described in terms of physical, chemical and biological characteristics, but public interest is centered on potential uses of water. The DEP receives many calls from citizens concerned with questions such as "Is this water safe for swimming?", and "Are fish safe to eat?". Maine waters are therefore managed under a use-based classification system. The designated uses under State law and Federal regulations are: fish consumption, aquatic life, support, swimming, secondary contact, drinking water supply, and agricultural. Waters which attain Maine's lowest water quality classification standards (C for fresh water and SC for tidal waters) also meet the fishable-swimmable goals of the Clean Water Act. Maine law sets forth additional designated uses: industrial process and cooling water, hydroelectric power generation, and navigation.

The control of nonpoint source pollution is crucial to protecting Maine lakes, ground water, wetlands, coastal bays and restricted estuaries, smaller riverine waterbodies and selected larger rivers. Lake restoration efforts are addressing the results of nonpoint source pollution, while educational efforts are addressing the causes. Guidance has been published to help people implement Best Management Practices to control nonpoint source pollution throughout Maine.

According to the US Fish & Wildlife Service, Maine is estimated to have lost about 20% of its wetlands since colonial times. New regulations have been adopted to better protect wetlands. A system to track wetlands losses has been developed and is in the beginning stages of implementation. A recent grant proposal, would allow the data to be incorporated into Maine's Geographic Information System.

The greatest threat to Maine groundwater is leaking underground storage tanks. Maine requires that all underground tanks be registered, and those tanks not sufficiently protected be removed. Under this program, 38,600 tanks have been registered, and 1,500 to 2,500 tanks have not yet been registered. About 23,000 tanks in Maine have been removed since 1986.

All Maine people must take an active role in protecting their water resources. State, federal and regional agencies must continue to 1) do more to inform the public about environmental issues, 2) provide more and better technical assistance to municipalities, and 3) take an active role in introducing environmental issues to school curricula.

Public interest is centered on the uses which can be made of water. Questions such as, "Is that water safe for swimming?", "Are fish caught there safe to eat?" and "Does the water in that lake turn green in the summer?" make up a large portion of the inquiries from the public received by the Department of Environmental Protection Bureau of Land and Water Quality. To answer such questions, Maine waters are managed under a use based classification.

As established in Maine Statute, a classification consists of designated uses (such as swimming or aquatic life habitat), criteria (such as bacteria, dissolved oxygen and aquatic life) which specify levels of water quality necessary to maintain the designated uses, and in some cases, specific limitations on certain activities such as types of discharges. Thus, to answer a question about swimming one might reply, "Yes, that river is classified as suitable for water contact recreation and the data collected show that bacteria criteria are being met." If a water body is meeting all its classification standards, it can be described as "attaining its classification." If a water body is

not attaining its classification, Maine statutes direct the DEP to take actions to improve water quality.

NPS and Water Quality

Maine Waters Impaired or Threatened by Nonpoint source pollution. The State of Maine uses a water classification system to assess and determine whether a water body has impaired or threatened water quality. This system sets water quality standards for different classes of waters. If a water body does not meet its assigned standards, it is considered “impaired”. If a water body meets its criteria but soon may not due to existing or expected activities in its watershed, it is considered “threatened”.

Nonpoint source water pollution is the primary cause of impairment or threatened status for lakes. The quality of the information upon which these data are based is highly variable. For lakes, there is a large set of data from the Lake Volunteer Monitoring Program and DEP monitoring efforts. Only a very few are receiving point source discharges.

The Assessment also identifies lakes which are considered threatened by nonpoint sources resulting from further development of their watersheds. This is based on the Lake Vulnerability Index which assesses the potential for lake eutrophication (i.e. overproduction of algae leading to a lack of oxygen). This potential is determined by measuring lake hydrology (i.e. flushing and turnover rates) and projecting population growth in the watershed.

Most of the water quality monitoring on rivers, streams and brooks has been performed to determine point source impacts. Thus, the small streams and brooks most susceptible to nonpoint source impacts are generally not evaluated unless they receive point source discharges. The Assessment therefore greatly underestimates the miles of stream impaired by NPS. Moreover, while the Assessment includes *impaired* rivers, streams and brooks, there has been no evaluation to identify *threatened* rivers, streams, and brooks.

The situation is similar for marine waters. The Assessment identifies six marine and estuarine areas of concern for toxics contamination based on sediment and/or blue mussel tissue analysis. There are no standards for toxic contaminants in sediment or biological tissue, however, so it has not yet been determined whether the levels of contamination constitute an “impairment” or a “threat”. This contamination is probably due to a combination of current and historical point and nonpoint pollution, but little work has been done to identify the sources.

The importance of BMPs for NPS Control: Best Management Practices (BMPs) are the primary tools for preventing or abating water pollution caused by nonpoint sources. Utilizing BMPs as the cornerstone of its efforts, the NPS Program has experienced varying degrees of success with raising public awareness and acceptance of nonpoint source pollution, what it is, what it does, and how it can be controlled. Success in convincing people to use BMPs has varied with the level of educational effort directed at explaining the problem, and the level of resources available to implement the “fixes” (i.e. the BMPs themselves). The extent to which a significant environmental risk can be demonstrated to the public often determines the degree to which preventive or corrective action is supported. In Maine, lakes are the resources at greatest risk from nonpoint pollution sources. Towns that have sensitive lakes, and particularly those whose residents live on and regularly use those lakes, usually are aware of NPS issues and potential solutions because the greatest educational effort has focused on lake-related NPS issues.

Normal seasonal and annual variations in runoff causes naturally wide ranges in water and habitat conditions. Identifying the magnitude of water quality and habitat benefits resulting from the installation of BMPs usually requires expensive long term monitoring. There are few direct measures of water quality improvement due to BMP implementation. The many BMPs that have been implemented independent of watershed projects, either voluntary or as a result of regulation, have resulted in reduced loading of pollutants to receiving waters and elimination of many chronic problems (for instance, recurring sedimentation below an eroding ditch washout). Clearly, there are strong indications that a sustained effort applied over many years in a specific watershed to gain adoption of all types of BMPs can significantly reduce pollutant loading and help improve water quality. Widespread improvements in watershed stewardship and use of BMPs over years can yield important improvement in water quality. This has been demonstrated in several Section 314 lake restoration projects.

Maine NPS Priority Waters List

The Royal River, Sabbathday Lake and Casco Bay are listed by the DEP as priority waterbodies. This list of priority waterbodies, as amended in 1996, for lakes, rivers and marine waterbodies will be the focus of the Nonpoint Source Program. It is expected that the list will be reviewed every two years as the water quality assessment report is completed.

Special State Concerns and Recommendations

The high risk issues related to water quality are summarized below. Source: "Maine Environmental Priorities Project, Report from the Steering Committee, Consensus Ranking of Environmental Risks Facing Maine", January, 1996.

Drinking water and Domestic Use Water

Private Water Supplies: Approximately 78% of people in Maine obtain their drinking water from private supplies, most of which are individual groundwater wells. Nitrates and nitrites from septic systems and agriculture activities are common sources of groundwater contamination in Maine. Other significant causes of contamination include oil and gasoline spills, leaking petroleum storage tanks, arsenic, agricultural pesticides, and improper handling or disposal of industrial chemicals.

Public Water Supplies: Of the Maine residents served by public water supplies, approximately 20-25% receive water from groundwater sources, and are therefore exposed to the risks associated with private supplies. Most public supplies come from surface waters, however. These sources have a higher incidence of contamination by bacteria and parasites such as giardia and cryptosporidium. Although all public drinking water is chlorinated and most is filtered, the Maine Department of Human Services noted an increase in microbial contamination between 1994 and 1995. Other health concerns include trihalomethanes, which are chemical by-products of the chlorination process, and lead from plumbing fixtures or lead soldered pipe.

Freshwater and Marine Ecosystems

Land Use: Increased residential development pressure has become a major threat to Maine waters, especially in southern, central and coastal areas. While agriculture and forestry techniques have improved with the use of Best Management Practices, these activities also continue to impact water quality. A direct effect of poor land use practices is the loss of wetlands which provide critical wildlife habitat, flood protection, groundwater recharge and shoreline erosion control. Wetlands trap sediment, nutrients and contaminants which can

damage aquatic ecosystems. Increased nutrient and sediment loading to lakes, rivers and coastal waters accelerates eutrophication and destroys aquatic habitat.

Surface Water and Sediments

Lakes: Nonpoint source pollution is the primary threat to Maine lakes. Sources include commercial and residential development, agricultural, and atmospheric deposition. Runoff rich in nutrients may result in algal blooms, dissolved oxygen depletion, fish kills and other changes in aquatic communities. Since May 1994, a consumption advisory has been in place for all Maine lakes due to high levels of mercury detected in fish. Elevated levels of mercury and associated reproductive and health problems have also been detected in loons and eagles which consume fish from Maine lakes.

Rivers and Streams: In addition to nonpoint sources of pollution, many rivers in Maine are adversely impacted by industrial point sources, domestic wastewater treatment plants and combined sewer overflows which contribute nutrients, heavy metals, and organic compounds. Fish consumption advisories have been issued for 236 river miles due to dioxin contamination.

Estuarine and Marine Waters: Maine coastal waters are also vulnerable to nutrient enrichment and eutrophication. The presence of metals and other toxic compounds in marine organisms and sediments is a concern. Significant sources of marine pollution include municipal discharges, combined sewer overflows and overboard discharges. The Department of Human Services has issued a consumption advisory for lobster tomalley because of high dioxin levels. Many shellfish harvesting areas in Maine are closed either seasonally or year round due to bacterial contamination. In the fall of 1996, a major oil spill in Portland Harbor resulted in additional widespread closures of shellfish harvesting areas along the southern Maine coast.

Designated Uses Ascribed to Maine's Water Classifications

RIVERINE WATERS

- Class AA -** Drinking water supply, recreation in and on the water, fishing, navigation and a natural and free flowing habitat for fish and other aquatic life.
- Class A -** Drinking water supply, recreation in and on the water, fishing, industrial process and cooling water supply, hydroelectric power generation, navigation, and a natural habitat for fish and other aquatic life.
- Class B -** Drinking water supply, recreation in and on the water, fishing, industrial process and cooling water supply, hydroelectric power generation, navigation, and an unimpaired habitat for fish and other aquatic life.
- Class C -** Drinking water supply, recreation in and on the water, fishing, industrial process and cooling water supply, hydroelectric power generation, navigation, and a habitat for fish and other aquatic life.

LACUSTRINE WATERS

Class GPA - Drinking water supply, recreation in and on the water, fishing, industrial process and cooling water supply, hydroelectric power generation, navigation and a natural habitat for fish and other aquatic life.

ESTUARINE & MARINE WATERS

Class SA - Recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, navigation, and a natural and free flowing habitat for fish and other estuarine and marine life.

Class SB - Recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, navigation, and an unimpaired habitat for fish and other estuarine and marine life.

Class SC - Recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, navigation, and a habitat for fish and other estuarine and marine life.