STATE OF MAINE

1998 WATER QUALITY ASSESSMENT

A Report to Congress
Prepared Pursuant to Section 305(b) of the
Federal Water Pollution Control Act, as Amended

Prepared by the
Maine Department of Environmental Protection
Bureau of Land and Water Quality

Document Number: DEPLW2000-23

ACKNOWLEDGEMENTS

For the 1998 Water Quality Assessment, the Department has thoroughly reviewed water quality information from as many reliable sources as possible. We used data from many volunteer groups who have demonstrated sound data acquisition principles. These include:

Affiliates of Clean Water/Partners In Monitoring
Maine Volunteer Lake Monitoring Program, Inc.
Presumpscot Riverwatch
Sheepscot Valley Conservation Association

In recent years, the Department has cooperated in the training of volunteers to gather data. Our thanks go to the **University of Maine Cooperative Extension Service**, the **River Watch Network**, the **State Planning Office**, and the **USEPA Environmental Services Division** who have assisted in volunteer coordination and training.

Special acknowledgment goes to the **Penobscot Indian Nation** who provide comprehensive monitoring for rivers, streams and lakes in the Penobscot River watershed, and who also assist the Department with our monitoring work. This data has given us a very thorough assessment of water quality for that basin.

Additional sources of data include:

Acadia National Park
Casco Bay Estuary Project
Maine Department of Human Services
Maine Department of Marine Resources
USEPA - Environmental Services Division
US Geological Survey, Maine District Office
University of Maine, Water Resources Institute

Information received from businesses through permit applications and compliance monitoring have also been incorporated in this water quality assessment.

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PART I

SUMMARY AND OVERVIEW

Introduction

The State of Maine is known for the beauty and abundance of its natural environment, especially its waters. The first inhabitants and their descendants relied on Maine waters for food and transportation. Later, rivers were used to transport logs to lumber and paper mills, and to generate power. Fishermen also made their living from Maine waters. Where hydropower was available, industries flourished. With the development of cities and industrial growth, however, the quality of Maine waters suffered.

When the people of Maine recognized pollution as a threat to their future, they took actions to improve the environment. These actions began in the late 1960's and placed Maine at the forefront of the national effort to protect the environment. The Federal Water Pollution Control Act of 1972 provided the framework for significant improvements in the quality of Maine waters that have been achieved in the past 20 years. Federal, State and local funds were spent to construct municipal wastewater treatment facilities. Many Maine industries also constructed facilities to treat their process wastewater. Maine people became more aware of issues affecting water quality and changed their actions appropriately.

The results are dramatic. Atlantic salmon and other fish now return to Maine rivers, and waters that were once open sewers are now clean enough to swim in. Unfortunately, Maine people are still not able to use all their waters. Toxic chemicals in fish limit the use of some Maine waters. Several wastewater treatment plants remain to be built, and many existing facilities need to be upgraded. Ground water, wetlands, rivers and streams, lakes and marine ecosystems continue to be threatened by toxics, bacteria, excess nutrients and poorly planned development

The most important water quality initiatives for the future are pollution prevention, nonpoint source management, watershed-based assessment and planning, coordinated land-use management and water quality monitoring. As we approach the 21st century, the cumulative environmental effects of human activity are increasingly evident. It is also evident that point source control and end-of-pipe treatment will not suffice to achieve the next increment of water quality improvement. We must work with industries, municipalities and individuals to change the activities that cause the pollution.

The Quality of Maine Waters

The designated uses under Maine State law and Federal regulations are: fish consumption, aquatic life support, swimming, secondary contact, drinking water supply, and agriculture. Waters which attain Maine's lowest water quality classification standards (C for freshwater and SC for tidal waters) also meet the fishable-swimmable goals of the Clean Water Act. Maine State law sets forth additional designated uses: industrial process and cooling water, hydroelectric power generation, navigation, and only for lakes and ponds, trophic stability.

- **Rivers and streams**. The total length of rivers, streams and brooks in the State of Maine is estimated as 31,752 miles. It is estimated that 395 miles (1.2%) do not fully support the fishable-swimmable goals of the Clean Water Act. For major rivers, approximately 78% of evaluated waters attain the fishable goal, while 91% are considered swimmable. A higher percentage of minor rivers, streams and brooks meet the fishable (99.4%) and swimmable (99.7%) goals. Additionally, there are 98.3 miles (0.3%) of rivers and streams that do not meet higher classification standards assigned to those waters in Maine's water quality laws.. The uses not fully supported are: Fish consumption - 268 miles (0.9%), Aquatic Life Support - 259 miles (0.8%), Swimming and Secondary Contact - 197.5 miles (0.6%).

- **Lakes and Ponds**: The total area of Maine Lakes and Ponds is estimated as 987,283 acres. Of this area, 66% of Maine lakes fully support designated uses other than fish consumption, 18.4% fully support those uses but are threatened, and 15.6% partially support the uses. GPA classification requirements established by State law other than for fish consumption, are met in 84.4% of the total acreage of Maine lakes. The uses not fully supported are: Aquatic Life Support - 10.4%, Swimming - 5.2%, and Trophic Stability - 3.4%. All Maine lakes are classified as partially supporting fish consumption due to a fish consumption advisory issued in April of 1994 that bans consumption for a subpopulation of the state.

- **Estuarine and Marine Waters**: There were 238 closed shellfish areas reported, which is up from the 230 reported in the previous 305b report, but the actual area of closure was approximately 210,600, down from the 244,780 acres reported in 1996. An additional 31,400 acres were conditionally opened, some of them representing areas formerly prohibited. At the end of 1997, prohibited and conditional or restricted areas encompassed approximately 242,000 of 1,825,000 total acres (13.3%) of Maine tidal flats and waters.

- **Ground Water**: No estimate exists for the percentage of ground water not attaining its designated uses.

Causes and Sources Affecting Use Support

- In Maine, dioxin contamination in fish tissue is the single most significant cause of non-attainment of uses in major rivers.

- The most significant causes of non-attainment of uses in other riverine waters are dissolved oxygen deficit (organic enrichment), habitat alteration (particularly hydrological modifications from dams) and bacteria (pathogenic indicators).

- Significant sources of organic enrichment and bacteria in riverine waters include municipal point sources (mostly combined sewer overflows), nonpoint source pollution, and inadequate on-site wastewater treatment systems or untreated discharges.

- The most significant causes of non-attainment of uses for Maine lakes are mercury contamination and organic enrichment from nonpoint sources of pollution such as atmospheric deposition, stormwater runoff, and agriculture.

- The most significant cause for non-attainment of uses for marine and estuarine waters is pathogenic indicators, mostly from municipal and small (overboard discharge) point sources.

- The most significant causes for non-attainment of ground water classification are: petroleum compounds from leaking underground and above ground storage tanks, other organic chemicals from leaking storage tanks or disposal practices, and bacteria from subsurface disposal systems or other sources.

Trends in Water Quality

- Fish consumption advisories have been issued for three Maine rivers and for the entire Maine coast tomalley, due to elevated levels of dioxin discovered in fish tissue and lobster tomalley. Maine has been working with the Kraft pulp and paper mills to reduce the levels of dioxin in their discharges. Recent data has shown a downward trend in contamination for some rivers. Current changes in bleaching technology being implemented by the mills are expected to lower the amount of dioxin discharged. Maine has established a goal of eliminating dioxin advisories on its rivers by 2002.

- Mercury contamination in Maine's waters continues to be a high concern. Maine did an extensive study of mercury contamination as part of the REMAP program and has since issued an advisory on fish consumption for all Maine lakes. The Surface Water Ambient Toxics Program currently underway has revealed that mercury contamination in river fish is similar to that found in lakes. It is expected that Maine may issue an advisory in the future for all freshwaters. The trend in mercury contamination is unknown at this time.

- The water quality of the majority of Maine lakes has remained stable, thereby providing consistently clean water for all to appreciate. However, threats to lake water quality increase with development pressures, making lake protection the preferred approach to lake water quality management than restoration. Analyses of Maine lakes, however, demonstrate that the previous decline in quality of some lakes has been reduced and that preventative measures are working in other watersheds.

- Trends in lake water quality are difficult to assess due to the time lag between cause and observed effect, and the quantity of data required to apply statistical tests. Trends are examined using a combination of Best Professional Judgement and statistical analysis of clarity data. Results indicate that the majority of Maine's lakes remain stable.

- It is also difficult to assess trends between the 1998 report and previous 305b reports for rivers and streams. For this reporting period, many new data sources and new methods were employed causing a number of waterbodies to be listed as nonattainment. The state is improving its NPS assessment capability. Many waters, particularly the small streams where historically there was less monitoring conducted, may have had water quality problems for many years but were not monitored and not reported.

- The best information is for large rivers where monitoring is more continuous and comprehensive. These waters show a continued trend toward improvement. The Maine DEP has established a goal to remove dioxin advisories by the year 2002. Paper mills have already incorporated technology to reduce dioxin. This will also yield benefits of reducing color discharges. All communities with CSOs are also engaged in assessment, rehabilitation and treatment to remove or reduce these sources.

- Marine and estuarine waters have not been comprehensively assessed (majority of monitoring is for bacteria only), therefore empirical evidence to conclude nonattainment or adverse impact is less available than for freshwaters. Biological standards must be developed to assess attainment and additional monitoring must be conducted to assess impact. Six "areas of concern" have been identified along the coast with respect to toxic contamination. Shellfish growing and harvesting areas have been the focus of pathogen indicator sampling. New audit methods for tracking closures is now in use by DMR and provides different numbers from previous reports. Comparison with previous reports is not recommended because differences are due to changes in the accounting system as well as changes in water quality.

- Regulations regarding underground storage tank installation have begun to show progress in ground water protection by decreasing the likelihood of new leaks. Closure of landfills and installation of covers over sand/salt piles will also protect the quality of ground water in the future. However, above ground home heating oil tanks are an increasing source of spills, which may require new measures to address.

Specifics

- 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, if funded, would allow the data to be incorporated into Maine's Geographic Information System.

- 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 technicál assistance to municipalities, and 3) take an active role in introducing environmental issues to school curricula.

- The DEP needs to continue to link pollution prevention activities with the watershed approach to water quality management. The pilot program developed for the Androscoggin River basin has been very successful, involving local officials and citizen groups to establish programs to reduce pollution. DEP staff are working with the towns to establish local teams and to provide them with the knowledge and focus to identify problem areas and develop solutions.

PART II

BACKGROUND

Chapter 1 - Total Waters

Maine is the largest and least densely populated state in New England. Most of the population is concentrated in the southern and coastal portions of the State and in a broad band on either side of Interstate 95. Maine's 5,785 lakes and ponds cover an area somewhat larger than the State of Rhode Island. There are over 7,000 brooks, streams and rivers in Maine, ranging in length from less than two miles to nearly 200 miles with an estimated total length of 31,752 miles. The St. Croix, St. John, St. Francis and Southwest Branch of the St. John make up part of the U.S./Canada boundary while the Salmon Falls River lies on the Maine/New Hampshire boundary. Numerous lakes lie on the New Hampshire and Canadian boundaries. Inland and coastal wetlands and marshes in Maine are estimated to exceed 5,000,000 acres in area. At least 1,315 square miles are underlain by significant sand and gravel aquifers.

Over 400 river and stream systems, ranging in size from a few hundred acres to over 1,850 square miles, empty into Maine's estuarine and near shore waters. For most reporting purposes, Maine is divided by the U.S. Geological Survey into 6 major drainage basins. Two of these (the Western Coastal Basin and Eastern Coastal Basin) are, in fact, made up of dozens of smaller basins that empty into the Atlantic Ocean. Large portions of 4 river basins are located in New Hampshire, Quebec and New Brunswick. Table 2-1.1 presents this information in summary form.

The number of lakes, reservoirs and ponds, and the acres of lakes, reservoirs and ponds used in this report are taken from the Maine Department of Inland Fisheries and Wildlife (DIFW) Lake Index file rather than from USEPA RF3/DLG estimates. The Maine DEP believes that the DIFW Lake Index file (determined from 15' USGS topographic maps; 1:62,500 scale) provides a more accurate estimate of lake numbers and acres than the USEPA RF3/DLG estimates (based on maps having 1:100,000 scale).

In addition, all of our lake data is referenced by a lake identification number, as is the DIFW database containing lake acreage. It would be a monumental task to link the USEPA RF3/DLG acreage estimates to our database, and this could potentially introduce error due to map scale differences.

Under the auspices of the Casco Bay National Estuary Project, the entire coastline of the State of Maine has been digitized as a data layer on the State's Geographic Information System. The information was taken from USGS maps at a resolution of 1:24,000, which provides a much higher level of detail than the DLG estimates. With this higher level of detail and the inclusion of Maine island shoreline miles, this report now estimates that there are 5,249 coastal miles of shoreline.

Table 2-1.1 State of Maine: Population and Natural Resource Statistics.

Population (Mid-1990 estimate)	1,227,928	
State Surface Area	33,265	mi^2(100.0%)
Forested Upland	21,262	mi^2 (63.9%)
Forested Wetland	4,688	mi^2 (14.1%)
Other Fresh Wetland	3,190	mi^2 (9.6%)
Brackish/Saline Wetland	246	mi^2 (0.7%)
Cropland	924	mi^2 (2.8%)
Pasture	216	mi^2 (0.6%)
All Lakes and Ponds (5,788/987,283 acres)	1,543	mi^2 (4.6%)
Significant Lakes and Ponds (2,314/959,193 acres*)		
Other land	1499	mi^2 (4.5%)
Area Underlain by Significant Sand/Gravel Aquifers	1,315	mi^2
Total Area of Estuarine/Marine Waters	2,851.6	mi^2
Linear miles of Ocean Coast	5,249	miles
Number of Major Drainage Basins	6	
Total lengths of rivers, streams, etc.	31,672	miles
Total length of rivers	3,704	miles
Total length of streams	3,909	miles
Total length of brooks	22,829	miles
Total length of creeks, etc.	1,230	miles
Names and mileages of inland border waters (total miles = 272)		
Monument Brook (U.S. - Canada)	11	miles
Saint Croix R. (U.S. - Canada)	52	miles
Saint Francis R. (U.S. - Canada)	27	miles
Saint John R. (U.S. - Canada)	45	miles
SW. Branch of the St. John R. (U.S. - Canada)	50	miles
Salmon Falls R. (ME - NH)	30	miles
North Lake, Grand Lake, Mud Lake, Spruce Mountain Lake, Spednik Lake, Grand Falls Flowage and Woodland Lake (U.S. - Canada)	42	miles
Umbagog Lake, Lower Kimball Pond, Province Lake, Stump Pond, Balch Pond, Great East Lake, Horn Pond, Northeast Pond, Milton Pond and Spaulding Pond (ME - NH)	15	miles

Chapter 2: Water Pollution Control Program

A. Watershed Approach

Maine's water quality programs utilize watershed based strategies in many ways and at many levels. The following discusses the watershed based approaches of the Point Source Control Program, the Pollution Prevention Program and the Nonpoint Source Control Program.

1. Point Source Control

Contact: Michael Barden, DEP BLWQ, Division of Water Resource Regulation
(207) 287-7700

EPA and DEP have undertaken a cooperative watershed-based approach to issuing National Pollutant Discharge Elimination (NPDES) permits. This initiative follows a five year cycle, with permits for each of five watersheds issued in the same year. Using this approach, EPA and DEP staff are better able to focus ambient water quality information collection and fieldwork, and to manage the watershed as a whole. The process also allows other agencies to anticipate technical review requirements. The goal is to produce higher quality permits that improve protection for sensitive environmental areas. It is estimated that all major discharges will be reviewed within two five-year cycles. The schedule for the current cycle is:

1997: Penobscot River and Coast, Union River South and West
1998: Kennebec River and Coast to Presumpscot River

2. Nonpoint Source Control

Contact: Jeff Dennis, DEP BLWQ, Division of Watershed Management, (207) 287-7847

Assessment: More than 8,000 discreet watersheds have been delineated and digitized on GIS. These include all the lake watersheds as well as many small stream and estuarine watersheds. They provide the basis for several models used to evaluate to what degree watersheds are threatened by nonpoint sources. These include the Lake Vulnerability Index, the phosphorus allocation methodology for evaluating new development, and most recently the Watershed Pollution Potential Index.

The Lake Vulnerability Index has been used for nearly a decade as one means of identifying threatened lakes. This model is based on the assumption that new residential and commercial development will account for the majority of new phosphorus loading to Maine lakes. The model simply estimates the growth rate (based on new construction information in municipal property tax reports) for each lake watershed, assumes a given increase in phosphorus loading for each increment of growth and, using a simple phosphorus loading model sensitive to the hydrology of each lake, projects the annual increase in lake phosphorus concentration resulting from this growth. The higher the projected increase, the more vulnerable, or threatened, the lake. Since point discharges are not allowed to Maine lakes or their tributaries, the growth related phosphorus sources considered in this projection are all nonpoint.

In 1987 and 1988 the DEP developed a method for evaluating the potential impact of new development in lake watersheds based on an areal phosphorus allocation for each lake's watershed. The areal allocation is defined by the lakes current water quality status, its apparent susceptibility to internal recycling of phosphorus, its value as a water supply or coldwater fishery and an anticipated build out scenario for the lake's watershed. It is intended to evenly distribute the burden of lake protection over landowners in the watershed and over time. The allocation provides guidance to state and local regulators of new developments in sensitive lake watersheds.

The DEP has also developed a preliminary GIS based index to identify which of the 8,000+ delineated subwatersheds statewide have the greatest potential export of nonpoint pollutants to their receiving waters. The index, called the Watershed Pollution Potential Index (WPPI), is based on extraction of relevant land use, soils, slope, population and transportation information from various statewide GIS coverages for each subwatershed. The preliminary index, which focuses on nutrient export potential, has been developed for and applied to the Casco Bay watershed. It is currently being refined and will be applied to the western half of the state next, and eventually statewide when adequate land use coverage is developed for the entire state. Stream watersheds with high pollution potential indices are evaluated in the field for obvious impairment using a recently developed stream assessment methodology which relies heavily on an analysis of the macroinvertabrate community and is still being refined.

Volunteer watershed surveys are a key component of DEP's Nonpoint Source Control Program. Trained volunteers canvas the watershed identifying and describing/characterizing specific nonpoint pollutant sources. This information is screened and field evaluated by professionals (either DEP staff, SWCD staff or private consultants) to set priorities, identify solutions and define implementation strategies. All of the sixteen watershed surveys performed to date have been in lake watersheds and have been based on a lake watershed survey guidance manual developed in 1992. Surveys planned for the next few years include stream and coastal watershed surveys, and a guidance manual for Coastal Volunteer Watershed Surveys has recently been published. The results of watershed surveys often provide the core information for 319 NPS watershed implementation projects.

Prioritization: The DEP is in the process of developing and implementing an open ended nonpoint source prioritization system for water resources and their associated watersheds. The system is based on evaluations of impairment of/threat to the resource (as defined in part by the tools discussed above), relative value of the resource, technical feasibility of the solution and the level of public support. The system will identify priorities for resource assessment, watershed survey and planning, education and outreach, and BMP implementation. The system considers the resource in the context of its watershed at every level of evaluation.

Implementation: Many of the 319 NPS control implementation projects are "watershed" projects - projects which comprehensively address the nonpoint problems within an entire watershed. All the elements of these projects from education through planning and regulation to BMP implementation emphasize the entire watershed as the management unit for water resource protection. Even projects which are not comprehensive watershed projects are done with the aim of demonstrating or otherwise promoting BMP utilization throughout the watershed.

The State's Growth Management Program encourages municipalities to consider lake watersheds in their comprehensive planning process, and to tailor the regulation of development to the sensitivity of the watershed in which it occurs. DEP provides information and technical support to municipalities to accomplish this.

B. Water Quality Standards Program

Contact: David Courtemanch, DEP, BLWQ, Division of Environmental Assessment
(207) 287-3901

The water quality of Maine can be described in terms of physical, chemical and biological characteristics. Public interest in water quality is centered on the uses that 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 (DEP) Bureau of Land and Water Quality. To answer such questions, Maine waters are managed under a use-based classification system.

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.

In addition to the Maine water quality classification system, the requirements of the Federal Clean Water Act (CWA) establish national interim goals (designated uses) "wherever attainable ... of ... the protection and propagation of fish, shellfish and wildlife ... [and] recreation in and on the water." **All waters which meet State standards also meet the interim goals of the Clean Water Act.**

C. Point Source Control Program

Maine uses multiple approaches to ensure that point source discharges of wastes receive adequate treatment prior to their release to waters of the State. Maine law prohibits any discharge of wastes to waters of the State without a license, and to receive a license, an applicant has to demonstrate the ability to provide the appropriate level of treatment. All of the larger municipal and commercial sources of wastewater in the state are licensed and treated, or conveyed to licensed facilities for treatment. A few small towns or villages are only now installing treatment, mostly with Federal or State funding assistance. A number of financial assistance programs support new construction, as well as upgrades or additions to existing facilities.

Many communities in Maine are characterized by low population densities and depend on individual subsurface disposal systems to provide sewage treatment. For areas not served by community collection systems, the Maine Subsurface Wastewater Disposal Rules require that property owners provide adequate means of treating their own wastewater, in accordance with specifications established by the rules. The rules are enforced at the municipal level and administered at the State level by the Department of Human Services.

Most sources of wastewater of all types in Maine, including communities, industrial or commercial businesses, and residences, have either installed treatment facilities or discharge their wastes to facilities managed by other owners. The traditional approach with this group is: license compliance inspection coupled with technical assistance in operations and maintenance; enforcement where necessary; and periodic re-licensing. Recent new directions include expanded technical assistance in all aspects of treatment facility operations and maintenance, and pollution prevention.

1. Pollution Prevention

Contact: Don Albert, DEP BLWQ, Division of Engineering and Technical Assistance
(207) 287-7767

Industrial Pollution Prevention: The water pollution prevention unit continued providing on-site technical assistance to eight large pulp and paper mills. Over the years the unit has helped mills reduce their biochemical oxygen demand (BOD) discharge by over 15,000 lbs/day. In addition, mills have reduced their use and of ammonia, phosphoric acid, and the emission of chloroform. The industry is saving more than $500,000 per year in reduced chemical and polymer use as a result of direct technical assistance. On September 29, 1995, the Department held a one-day conference on Pollution Prevention. The focus was on pollution prevention in paper mills throughout the state. Guest speakers included several industry representatives, Maine Governor King, DEP Commissioner Ned Sullivan, and Dr. Bruce Piasecki from Rensselaer Polytechnic Institute in New York.

Municipal Pollution Prevention: The MWPP program provided DEP and municipal officials information about effluent quality trends, facility design capabilities, chemical and energy use, and financial status. The objective is to assist in long-term planning and to reduce the potential for effluent violations. The MWPP program helped target technical assistance, establish benchmarks and measure municipal pollution prevention efforts.

Androscoggin River Basin Project: The Androscoggin River Basin Project has involved local officials and citizen groups to establish local teams that implemented many pollution prevention activities. A watershed-wide household hazardous waste collection was very successful. Nearly 300 students from eight schools within the watershed attended a Watershed Festival held at Bates College. Four canoe trips were held on the Androscoggin River. The purpose of the trips was to celebrate the successes that have been made and to get people out on the river to see what a beautiful river it is.

2. Construction of Wastewater Treatment Facilities

Contact: William Brown, DEP BLWQ, Division of Engineering and Technical Assistance (207) 287-7804

Since the passage of the Clean Water Act, considerable amounts of grant and loan money have supported a very successful effort to clean up Maine's surface waters. Despite this success, there are still significant needs for continued clean-up efforts. These efforts are directed toward upgrading existing treatment facilities, control of combined sewer overflows, and construction of individual on-site treatment facilities. DEP administers multiple programs through the Division of Engineering & Technical Assistance to address these areas.

In some communities, existing treatment facilities are not adequately treating sewage, due to age of the facility, design deficiencies or operational problems. Excess groundwater or surface water entering sewage collection systems cause sewer overflows, ineffective treatment and/or excessive treatment and maintenance costs.

Although most of the larger communities in Maine are served by publicly-owned sewage treatment facilities, there are still some areas where domestic sewage is inadequately treated or not treated at all. Such areas may include entire towns, as well as homes, businesses and seasonal dwellings. Included in these communities are areas with malfunctioning septic systems and untreated straight-pipe discharges.

State Revolving Loan Program: Federal and State funds for the construction of municipally-owned sewage treatment facilities are administered in conjunction with the Maine Municipal Bond Bank in accordance with the requirements of the Federal Clean Water Act and State law, Title 38 MRSA, Sections 411 and 412. The program is designed to distribute loan funds to communities with sewage treatment problems.

The State Revolving Fund (SRF) program provides low-interest loans (2% below market rates) to communities and sanitary districts to upgrade treatment facilities. Twenty-eight SRF projects have been initiated during 1996, 1997, and 1998 borrowing over $65 million.

The DEP Municipal Priority Point System is the mechanism used to rate individual projects. The system incorporates five priority categories listed in descending order of relative priority as follows: 1) water supply protection, 2) lakes protection, 3) shell-fishery protection, 4) water quality concerns, and 5) other facility needs. Within each of these priority categories, points are assigned depending on whether the severity of the problem is assessed as low, medium or high. The DEP Municipal Priority Point System is described in more detail in the "State of Maine Municipal Wastewater Construction Program," published annually by the Division of Engineering and Technical Assistance. In addition to describing the administrative aspects of the Municipal Wastewater Facilities Construction Program, the above-mentioned document includes the Multi-year SRF Project list and the Additional Needs project list. The Multi-year SRF Project list includes all projects likely to need upgrades, whether major or minor. The Additional Needs list is primarily for areas that presently do not have treatment facilities.

Maine still has a need to make state grants to communities which would have unusually high annual user charge even with the subsidized interest rate offered through the SRF program. These projects may also receive grants and loan funds from Rural Development as well as grants from the State Department of Economic and Community Development. The bond issues that provided the State match for Federal revolving fund capitalization included additional grant funds dedicated for various projects.

Maine Combined Sewer Overflow Program

Contact: Steve McLaughlin, DEP BLWC, Division of Engineering and Technical Assistance (207) 287-7768

Thirty-six Maine communities are served by combined sewer systems, which are partially or completely combined (ranging from 5% to 100%). During dry weather, all of the sewage in a combined system is conveyed to the treatment plant for adequate treatment. However, during rainstorms or snow-melt periods, stormwater mixes with the sanitary sewage, causing flows that exceed the capacity of the sewer system. This results in combined sewer overflows (CSOs), which vary extensively in pollutant types, concentrations and loads, as well as in volume of overflow and severity of impact to the receiving waterbodies. An additional seven towns with sanitary sewer overflows (SSOs) are being assisted by the CSO program because they experience storm-related overflows from their sanitary sewers which behave and exert effects similar to CSOs.

Maine has established an aggressive program, coordinated with EPA's CSO program, to assist communities in evaluating the design, condition, activity and effects of combined sewer systems and overflows, leading to the development of CSO Master Plans. Through these CSO Master Plans, communities conduct studies to determine: 1. the quantity and pollutant loads of CSOs; 2. the impact of CSOs on receiving waters; 3. sensitive areas, where uses are of higher priority and; 4. analysis and recommendation of technologies that will provide a high level of CSO control at a cost that communities can afford. However, it has become clear that the level of CSO control necessary for full attainment of current water quality standards will be very expensive and lengthy to complete. Indeed, several Maine communities have determined through studies of their sewer systems that complete CSO control would cause significant social and economic hardship. Also, most CSO control programs will require terms of up to 15-20 years to complete. Even if a community's recommended plan was to eventually eliminate all CSO problems, water quality standards and designated uses would continue to be violated until the program was complete. This would put the CSO communities in a dilemma. They would be doing all they were financially capable of doing, yet still be violating current water quality requirements. This would leave them open to potential lawsuits by people not in agreement with the recommended CSO Master Plans. Finally, communities need a clear sense of direction and assurance that the actions they take are appropriate and are in full compliance with the law.

Maine Small Community Facilities Program

Contact: Richard Green, DEP BLWC, Division of Engineering and Technical Assistance
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In 1981, the Maine Legislature enacted a law designed to allow the State to help finance small wastewater treatment projects. The law authorizes up to $1 million each year for the construction of waste treatment systems and authorizes the DEP to pay 25% to 100% of the costs of such systems. The maximum project cost funded by the program is $100,000 per year for each town. Projects are reviewed for priority points under a system very similar to the Municipal Priority List, and then selected from the resulting list in descending numerical order. Funds for this program are provided from bond issues approved by Maine voters. The Small Community Facilities Program was last funded for the 1999 construction season by a $500,000 bond issue approved in November 1998.

This program fills a need which is largely unmet by the State Revolving Fund Program. It allows DEP to clean up scattered small-scale problems by funding installation of individual or cluster treatment systems in a very cost-effective manner. During the fourteen year period the Small Community Facilities Program has been in existence, 3500 small systems in 200 towns have been constructed through the expenditure of over $18 million in grant funds. As a result of these efforts, significant benefits have accrued, including the elimination of public health threats and reopening a number of shellfish growing areas to harvest.

3. Licensing of Wastewater Discharges

Contact: Michael Barden, DEP BLWQ, Division of Water Resource Regulation
(207) 287-3901

The Division of Water Resource Regulation, Bureau of Land & Water Quality, is responsible for the licensing and re-licensing of all surface wastewater discharges, whether industrial, commercial, municipal or residential. In Maine, the vast majority of wastewater discharge sources have previously been licensed. Therefore, the licensing program is focused largely upon renewal of existing licenses, rather than development of new licenses. As technology advances, and as our understanding of the effects of human activities upon the environment grows, the limits included in discharge licenses must be refocused. Currently, there are approximately 215 industrial licensees (includes cooling water and misc. sources), 135 municipal or quasi-municipal licensees, and about 1,950 sanitary discharges from residential and commercial state and federal licensees.

Currently, industries that do not discharge to publicly-owned treatment facilities are issued National Pollutant Discharge Elimination System (NPDES) permits by the EPA, as well as Waste Discharge Licenses from the Maine DEP. Maine is in the process of seeking NPDES delegation and has adopted rules (Chapters 520-529) that will be effective upon delegation of the NPDES program.

Wastewater discharge limits in the State are based upon two criteria: 1) a standard of performance of technology or level of treatment provided for a specific wastewater or pollutant, or, 2) the level of treatment required to provide protection for the water quality standards of the receiving water. When developing license limits, the more stringent of these criteria is used in the license. Most effluent standards and criteria are the same as those under the Clean Water Act (CWA).

The Clean Water Act established national "standards of performance" for the control of pollutant discharges from all sources. Section 301 of the CWA required that, by 1977 all point source discharges of "conventional" pollutants be treated by the application of best practicable control technology. The Code of Federal Regulations, in Title 40, establishes these technology-based effluent limitations which serve as the minimum licensing standards for many point source discharges.

Municipal and industrial dischargers of wastewater containing toxic or hazardous pollutants are required to apply "best available control technology" in order to achieve effluent limitations established pursuant to Sections 301 and 307 of the CWA. The Administrator of the EPA publishes additional guidance in the form of effluent limitations and standards of treatment efficiency for control of specific pollutants from categories of discharge sources. As for discharges of conventional pollutants, effluent limitations for toxic and hazardous pollutants are included in the NPDES permits and the Maine Waste Discharge Licenses for industrial or municipal dischargers. In early 1995, the Department began implementing the requirements of Maine's Surface Waters Toxics Control Program, which requires effluent testing for whole effluent toxicity (WET) and priority pollutants and many industrial and municipal treatment plants. The program is set forth in Chapter 530.5 of the Department rules.

Municipal Wastewater Treatment: The CWA requires that discharges from municipal treatment systems receive secondary treatment (providing 85% removal of conventional pollutants), except where water quality concerns require more stringent limits. The only exception to this requirement is a variance under Section 301(h) of the CWA, allowing primary treatment where the dilution ratio and depth of the water allows rapid mixing of the effluent into the receiving water. Maine has twelve municipal facilities discharging under primary variances; all discharge into the ocean or into waters with high-volume tidal flows.

Municipal licenses include requirements to disinfect at least seasonally due to the possibility of discharging pathogenic micro-organisms. Because most municipal dischargers use chlorine in some form to disinfect, limits for total residual chlorine are included in many municipal licenses. The deleterious environmental effects of reactive chlorine have led to the recent addition of de-chlorination requirements to many municipal licenses, especially for those that discharge into waters with relatively low dilution factors. Municipal licenses also include requirements to monitor CSO activity and to develop plans for control of these overflows. Many municipalities accept wastewater from industrial or commercial facilities either with or without pre-treatment. Where an industrial source contributes 10% of the flow to a municipal facility and discharges a pollutant that has a categorical standard, a limit for that pollutant will be added to the municipal license.

Industrial Wastewater Treatment: A wide variety of industries in Maine use processes which result in the generation of contaminated wastewater. The chemical and biological constituents of wastewater from Maine's industrial point sources are as varied as the industries themselves and include everything from wood fiber to shrimp wastes to metallic compounds. Some industrial wastes lower the dissolved oxygen of the receiving waterbodies. Others may alter the pH or add pollutants with potential for toxic effects on aquatic life.

Starting in 1972, Maine and its industries made an intensive effort to provide best practicable treatment for all industrial discharges, many of which were untreated. By 1977, all major industries with individual discharges were providing secondary treatment or its equivalent. Since then, additional small industrial discharges have received treatment as municipal treatment facilities have been constructed, or individually, as additional untreated industrial discharges have been discovered.

Industrial dischargers in Maine are regulated in two ways: 1) the industry discharges to a municipal sewage collection system; or 2) the industry discharges directly to a receiving waterbody. Industries which discharge wastewater to publicly-owned sewage treatment facilities are required to pre-treat wastes which would otherwise interfere with the operation of those treatment facilities, or which would not be adequately treated by the municipal treatment process. The pretreatment program is presently administered as part of the NPDES program by the EPA, but the DEP conducts some of the pretreatment inspections and provides assistance to municipalities in understanding pretreatment issues and in developing local limits.

Elimination of Licensed Overboard Discharges

Contact: Dave Achorn, DEP BLWC, Division of Engineering and Technical Assistance (207) 287-7766

From the inception of its waste discharge licensing program, Maine has issued licenses to individual homeowners or businesses, or to small clusters, where existing lots were unsuitable for subsurface disposal and no municipal system was available. This eventually led a large number of licensees (more than 2900 in 1987), which made it impossible for DEP to adequately monitor compliance or evaluate re-licensing applications. The large numbers of small overboard discharges (OBDs) led to closures of a significant number of shellfish growing areas.

Due to concern over the effects of the burgeoning number of licensed small point source discharges, the Maine Legislature passed an act (the "Overboard Discharge Law") in 1987 which prohibited new discharges of non-municipal sanitary wastewater. In 1989, substantial changes were made to the Overboard Discharge Law. These changes prohibited new discharges and expansions of existing, licensed discharges, required DEP to inspect all OBDs each year, established an inspection fee to fund the inspection effort, and established the OBD Removal Grant Program. For any licensed discharge to a shellfish growing area, plus great ponds and small rivers and streams with drainage areas of less than 10 square miles, which causes nuisance conditions, or for which subsurface disposal is a viable alternative, a conditional license is issued which expires 6 months after offer of grant assistance from the DEP. With the goal of reclaiming closed shellfish areas, this law has great significance for the future management of Maine coastal waters.

4. Underground Injection Control (UIC) Program

Contact: Tammy Gould, DEP BLWQ, Division of Water Resource Regulation
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Underground injection wells are a specialized form of subsurface wastewater disposal. They are being discussed separately, because they are the object of a specific regulatory program established by the Federal Safe Drinking Water Act. The Federal program groups underground injection wells into five classes, only one of which -- the catch-all, Class V wells -- are found in Maine. Some Class V wells commonly found in Maine include floor drains discharging to soil, ground water or septic systems; drainage or dry wells; septic systems serving 20 or more persons per day; and injection wells such as heat pumps re-circulating fluids into the ground and re-injection wells at hazardous waste clean-up sites.

The DEP was awarded UIC Primacy for Class V wells effective September 26, 1983. The State UIC Program is established in rules of the Board of Environmental Protection, Chapter 543. Class V wells are handled in accordance with the Department's wastewater discharge licensing authorities as established by 38 MRSA, Sections 413 and 414 and through the state plumbing code, 144A CMR 241.

In the early years of Maine's UIC Program, several major categories of businesses (e.g. service stations, food processors, dry cleaners, photo processors, car and truck washes) were surveyed regarding their floor drains. Many facilities reporting floor drains discharging into or onto the ground were sent notices of regulation (NOR), with explanation of the regulations and how to comply. Those failing to comply based on the NOR letter were sent Notices of Violation (NOVs). Only one UIC case went beyond the NOV stage: in that case, the violator entered into a Consent Agreement with the DEP for discharges, including hazardous wastes to the ground water and surface water. In addition to closing the floor drains and other remedial work, the violator paid a total monetary penalty of $70,000.

In addition to this enforcement case, the UIC program has been successful in removing a large number of small, widespread threats to ground water, mostly through the closure of floor drains. In 1998, the program began to emphasize on-site inspection and has begun to show remarkable progress. Focussing efforts that year on the Kennebec River Basin, 477 inspections yielded 96 violations -- unlicensed discharges of wastes through floor drains and other conveyances into or onto the ground. Fifty-nine of the sites were brought into compliance by the end of December through voluntary well closures or NOVs. 1999 will find the program moving to the Androscoggin River Basin and, in 2000, to both the St. John and Presumpscot River Basins.

5. Compliance Evaluation

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DEP uses a three-part program to evaluate the compliance of wastewater treatment facilities. The compliance evaluation program involves on-site inspections of wastewater treatment facilities, occasional sampling of their effluent quality on a selective basis, and monthly evaluation of the licensees' self-monitoring reports. Discharge licenses also require immediate reporting of any major malfunctions, bypasses or exceedences of license limits to DEP inspectors.

The intent of the inspection program is to foster voluntary self compliance and to encourage licensees to be aggressive in attaining optimal operation and maintenance of their treatment facilities. During 3560 or other types of thorough inspections, all major areas of the treatment facility are inspected to ensure proper operation and maintenance, including treatment equipment, pumping systems, self-monitoring records, process control and laboratory testing procedures. In addition, several state routine inspections are done between the more thorough inspections to insure that proper operation is continuing. These inspections are usually less intensive than the 3560 type inspections and focus on specific plant problems, operator assistance projects and other compliance follow-up activities. Unlike the 3560 type inspections, these are usually not announced so that a better idea of a plant's normal day-to-day operation can be gained. Effluent samples are sometimes collected for analysis by the DEP to ensure that self-monitoring by the licensees accurately represents the quality of the effluent.

An important part of the inspection & compliance program is monthly Non-Compliance Review (NCR) meetings held by the DWRR. At these meetings, representatives of all regional offices, the licensing section, the enforcement section and DETA discuss specific compliance problems at licensed treatment facilities and decide upon specific courses of action. Possible responses to compliance problems range from monitoring the situation to providing technical assistance, providing engineering design reviews, funding upgrades to treatment facilities, to formal enforcement action. The NCR process has improved consistency in addressing compliance problems, has helped foster voluntary compliance, and has facilitated the referral of appropriate violations to the enforcement section. In addition to monthly NCR meetings, Quarterly Noncompliance Review (QNCR) meetings are held with EPA to discuss and coordinate actions regarding waste water treatment problems.

DEP and EPA work together closely in the area of compliance evaluation, as both State and Federal permits are required in Maine. Inspections, enforcement actions and other compliance activities are shared, and DEP staff may serve as representatives for both agencies in most cases. DEP also assists with EPA's pretreatment program by conducting inspections or accompanying EPA staff, and by serving as a local contact for the public. DEP provides an inspector to serve as a Pretreatment Coordinator.

The DEP also provides inspector coordination and laboratory problem resolution for the annual EPA Discharge Monitoring Report (DMR) Quality Assurance Studies. In these studies licensed facilities are required to analyze QA control samples for their discharge parameters to determine if their ongoing self monitoring testing data reported on their Discharge Monitoring Reports is accurate. Inspectors work with the licensees or their contract labs to correct any unacceptable results.

Technical assistance is also provided to the operators of wastewater treatment facilities. In addition to responding to requests for help with specific problems such as sludge bulking and odor control, programs are conducted which take a more systematic approach to improving wastewater treatment operations by examining all aspects of treatment plant design and operation.

Operations Management Evaluations (OMEs) are done to diagnose license compliance problems and to provide on-site operator training. OMEs are focused on operation and maintenance problems including process control, personnel and financial management. OMEs result in recommendations for procedural changes as well as follow-up operator training targeted towards improving wastewater treatment. DEP conducts twelve OMEs per year on a worst-first priority basis.

Maine requires that chief wastewater treatment plant operators be certified by the DEP through a certification process that consists of qualifying examinations for five levels of certification for biological facilities and three levels of certification for physical/chemical facilities. The smaller municipal facilities can have a Grade I operator in responsible charge, while the larger and/or more complex facilities must have a Grade V operator in responsible charge.

Investigation of Citizen Complaints: During the past two years, the DEP Bureau of Land and Water Quality has investigated over one thousand citizen complaints concerning discharges to the water. Many of these required field investigations and extensive follow-up work to achieve eventual compliance with discharge laws. A number of complaint investigations have led to lengthy enforcement actions. Overall, a significant portion of the bureau's staff time is devoted to responding to citizen concerns.

6. Enforcement of Water Quality Laws

Contact: Dennis Merrill, DEP BLWQ, Division of Water Resource Regulation
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The general philosophy of the DEP, Bureau of Land and Water Quality is to gain compliance and resolve problems at the least formal level appropriate, and to maximize the spirit of cooperation between the DEP and the regulated community. By fostering voluntary compliance with Maine's water pollution control laws, the overall effectiveness of the enforcement program is maximized and unnecessary litigation is avoided.

Formal enforcement actions become necessary when violations of environmental laws are severe enough to warrant action regardless of the remediation effort; or when the violator is not responsive in preventing or remediating environmental damage or refuses to cooperate with DEP. Formal enforcement actions originate both from license or permit violations, and from detection of unlicensed activities through complaint investigation or other fieldwork. DEP enforcement priorities have generally been based on the size of violations, potential for environmental harm, recurrence of violations and precedents involved.

The Division of Water Resource Regulation is responsible for all formal enforcement actions regarding wastewater discharges taken by the Bureau of Land and Water Quality. Enforcement of non-point source pollution problems is shared by the divisions of Water Resources Regulation and Land Resource Regulation in the Bureau of Land Quality. Other agencies such as the Land Use Regulation Commission in the Department of Conservation and local code enforcement offices also are able to address land use problems which lead to non-point source pollution. In addition to formal enforcement actions, the enforcement sections assist and confer with other units on violations that do not require formal action. Finally, considerable effort is put into assuring that compliance schedules and programs resulting from enforcement actions are properly implemented.

D. Nonpoint Source Control Program

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In 1991, the Maine legislature amended its water quality law to implement a Nonpoint Source Water Pollution Management Program to restore or protect water resources from pollution caused by nonpoint sources. The term “nonpoint source” (NPS) was created under the Federal Clean Water Act to distinguish “point source” discharges (i.e. sewage or industrial process wastewater discharges from pipes or ditches, etc.) for which permits are required, from other more diffuse sources that do not require permits. Atmospheric deposition is considered as a nonpoint source. Nonpoint sources of pollution are associated with all the various land uses in urban, suburban and rural areas, industry, agriculture, roadways, waste disposal, forestry activities, etc.

The Maine DEP administers Maine's NPS programs to promote a coordinated effort among responsible agencies to control or prevent nonpoint source pollution. The basic program objective is to prompt people to use State agency defined (38 M.R.S.A.410-H1) "best management practice guidelines" (BMPs) to prevent water pollution. Four state departments (Transportation, Agriculture, Conservation and Environmental Protection) are responsible for developing and implementing specific BMPs for the nine major categories of NPS pollution as outlined in the State's 1989 NPS Management Plan. These categories are Agriculture, Silviculture, Development, Resource Extraction, Transportation Facilities and Support, Chemical Use and Storage, Solid Waste Disposal, Marine Industries, and Hydrologic Modification.

For 1996-97, the Department continued to implement the NPS Management Plan to encourage actions by governments, organizations, industry, and individuals to prevent or minimize the discharge of NPS pollutants. Program resources were assigned to support efforts both statewide and in specific watersheds, to improve and protect waters that are threatened or impaired due to NPS pollution. The Department provided direct technical assistance and information about BMPs to agencies, municipalities, businesses, and individuals, and administered an NPS Pollution Prevention Grants program under section 319(h) of the Clean Water Act, to provide financial assistance to sponsors that encouraged or implemented BMPs through education efforts and field projects. The resulting diversity of resources, perspectives and expertise helped foster teamwork, better communications, technology transfer, and increased public involvement and awareness about NPS pollution.

NPS and Water Quality

Maine Waters Impaired or Threatened by NPS: The State of Maine uses a water classification system to assess and determine whether a water body has impaired or threatened water quality (38 MRSA § 464). 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".

The State of Maine Water Quality Assessment uses available information to report the impairments and threats to water quality, including both point and nonpoint pollution sources. Part 3, Chapter 2 summarizes the sources and extent of waterbodies that fail to attain their classification standards.

Nonpoint source water pollution is the primary cause of the 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 that 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.

NPS Assessment Initiatives: Insufficient data on nonpoint source impacts to streams and coastal water bodies has significantly affected the focus of the nonpoint program. Since there has been reasonably good information available to identify impairments and threats to lakes, the majority of nonpoint source watershed projects and general technical assistance has been focused on lake watersheds. This is not because small streams and coastal water bodies are not affected by nonpoint sources, but rather because so few streams and estuaries have been evaluated for these impacts. Until recently, staff resources were not available to address these data deficiencies. But federal funding and a recent DEP reorganization have allowed some resources to address this need. So that the state's nonpoint source control effort can be focused more effectively, several new projects are underway to fill the information void.

The first of these projects is a method to identify watersheds most likely to have nonpoint source impacts, called the Watershed Pollution Potential Index (WPPI). The core of the index is a Geographic Information System (GIS) data layer containing the boundaries of 8,000 stream and lake watersheds statewide. The GIS extracts information within each watershed on population, housing density, road density by road class, land cover, slope and soils from several other data layers. It then combines the information to give a relative index of nonpoint pollution potential. The index is initially being developed for the Casco Bay drainage basin, but it will be applied statewide as soon as the land cover data layer is available.

Those watersheds for which the WPPI indicates a high nonpoint pollution potential will be prioritized for further assessment. In 1994, the Division of Watershed Management developed and tested a prototype rapid stream assessment procedure to identify obvious impacts on stream water quality, biota and habitats. The procedure requires only one visit to the stream in the late summer and, if proven successful, will be used to detect nonpoint source impacts in stream watersheds prioritized by the WPPI.

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 variation 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 voluntarily 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 improvements in water quality.

Guidance manuals developed for implementing nonpoint source BMP practices include:

"Maine Erosion & Sediment Control Handbook for Construction: Best Management Practices", Cumberland County Soil and Water Conservation District and DEP, March, 1991.

"Strategy for Managing Nonpoint Source Pollution from Agricultural Sources and Best Management System Guidelines," Developed by: NPS Agricultural Task Force, October, 1991.

"Best Management Practices for Erosion and Sediment Control", Maine Department of Transportation (MDOT), May, 1992.

"Erosion and Sediment Control Handbook for Timber Harvesting Operations - Best Management Practices," Maine Forest Service, June, 1991.

"Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development", DEP, issued 1989, revised 1992.

"Maine Best Management Practices for Stormwater Quality and Quantity Control", DEP, November, 1995.

"BMPs for Marinas and Boatyards: Controlling Nonpoint Pollution in Maine, an Environmental Guide for Marinas & Boatyards", DEP/ SPO, December, 1995.

"Best Management Practices for Maine Agricultural Producers. Protecting Groundwater from Nutrients and Pesticides", University of Maine Cooperative Extension, May, 1989.

Program Planning, Coordination and Management

The State's 1989 NPS Management Plan directs NPS efforts on a statewide basis and on specific waterbodies listed as "priority waters" (Table 2-2.2). Priority waters are selected based on NPS impairment or threat status, value of the waters, and feasibility for success of restoration or protection efforts. The NPS Management Plan and the list of priority waters provide a basis for structuring 319 implementation projects and other NPS projects that help turn BMP planning and development ideas into effective on-the-ground pollution controls.

Coastal Nonpoint Source Program

Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 requires the State to amend its Nonpoint Source Management Plan to comply with federal guidelines focused on nonpoint sources that impact coastal waters. The State submitted an amended plan in July, 1995. The main thrust of these proposed amendments is that the State must have enforceable mechanisms to implement management practices for agriculture; forestry; urban development;

transportation; hydromodification; and marine industries. The State may continue to rely primarily on non-regulatory tools to implement best management practices, but must have backup authority to enforce these practices when the voluntary methods do not work.

The following Table 2-2.2 is the list of priority waterbodies, as amended in 1992, for lakes, rivers and marine waterbodies for which the Department will focus the Nonpoint Source Program. The list is intended to be flexible as the rankings of individual waterbodies are expected to change with changes in environmental, demographic, and political situations. It is expected that the list will be reviewed every two years as the water quality assessment report is completed.

Table 2-2.2 Maine NPS Priority Waters List
Source: Maine Nonpoint Source Management Plan

WATERBODY #	NAME	COUNTY
STREAMS		
128	Perley Brook	Aroostook
135-144	Aroostook River	Aroostook
140	Presque Isle Stream	Aroostook
149, 150	Upper & Lower Prestile Stream	Aroostook
152	Meduxnekeag River	Aroostook
224	Kenduskeag Stream	Penobscot
225	Souadabscook Stream	Penobscot
317	Varnum Stream	Franklin
318	Wilson Stream	Franklin
320	Carrabbassett Stream	Franklin
	Mill Stream	Somerset
322	Messalonskee Star	Kennebec
325	Sebasticook River	Kennebec
326	Twentyfive-mile Stream	Kennebec
333	Bond Brook	Kennebec
334	Cobbosseecontee Stream	Kennebec
411	Dead River	Kennebec
414	Little Androscoggin R.	Oxford
418	Sabattus River	Androscoggin
523	St. George River	Knox
526	Damariscotta River	Lincoln
603	Royal River	Cumberland
607	Pleasant River	Cumberland
614	Ossipee River	York
615	Little Ossipee River	York
618, 619	Saco River	York, Cumberland
623	Mousam River	York

Table 2-2.2 (continued). **Maine NPS Priority Waters List**

WATERBODY #	NAME	COUNTY
LAKES		
123	Long Lake	Aroostook
124	Cross Lake	Aroostook
125	Square Lake	Aroostook
145	Madawaska Lake	Aroostook
223	Pushaw Lake	Penobscot
321	Belgrade Lakes	Kennebec
325	Sebasticook Lake	Penobscot
326	Unity Pond	Waldo
328	China Lake	Kennebec
333	3-mile Pond	Kennebec
333	Webber Pond	Kennebec
334	Cobbosseecontee	Kennebec
335	Togus Pond	Kennebec
410	Canton Lake	Oxford
413	Lake Auburn	Androscoggin
414	Thompson Lake	Oxford
414	Pennesewassee Lake	Oxford
517	Branch Lake	Hancock
517	Floods Pond	Hancock
518	Graham Lake	Hancock
520	Philips Lake	Hancock
522	Lake Megunticook	Knox
523	St. George River	Knox
524	Chickawaukie	Knox
527	Damariscotta Lake	Lincoln
530	Nequassett Lake	Sagadahoc
605, 606	Sebago Lake	Cumberland
623	Mousam Lake	York
603	Sabathday Lake	Cumberland
605	Highland Lake (Bridgton)	Cumberland
605	Keoka Lake	Oxford
407	Roxbury Pond	Oxford
MARINE		
	Casco Bay	Cumberland
	Boothbay Harbor	Lincoln
	Cobscook Bay	Washington
	Piscataqua River Estuary	York, Oxford
	Scarborough River Estuary	Cumberland

Maine Dept. of Environmental Protection
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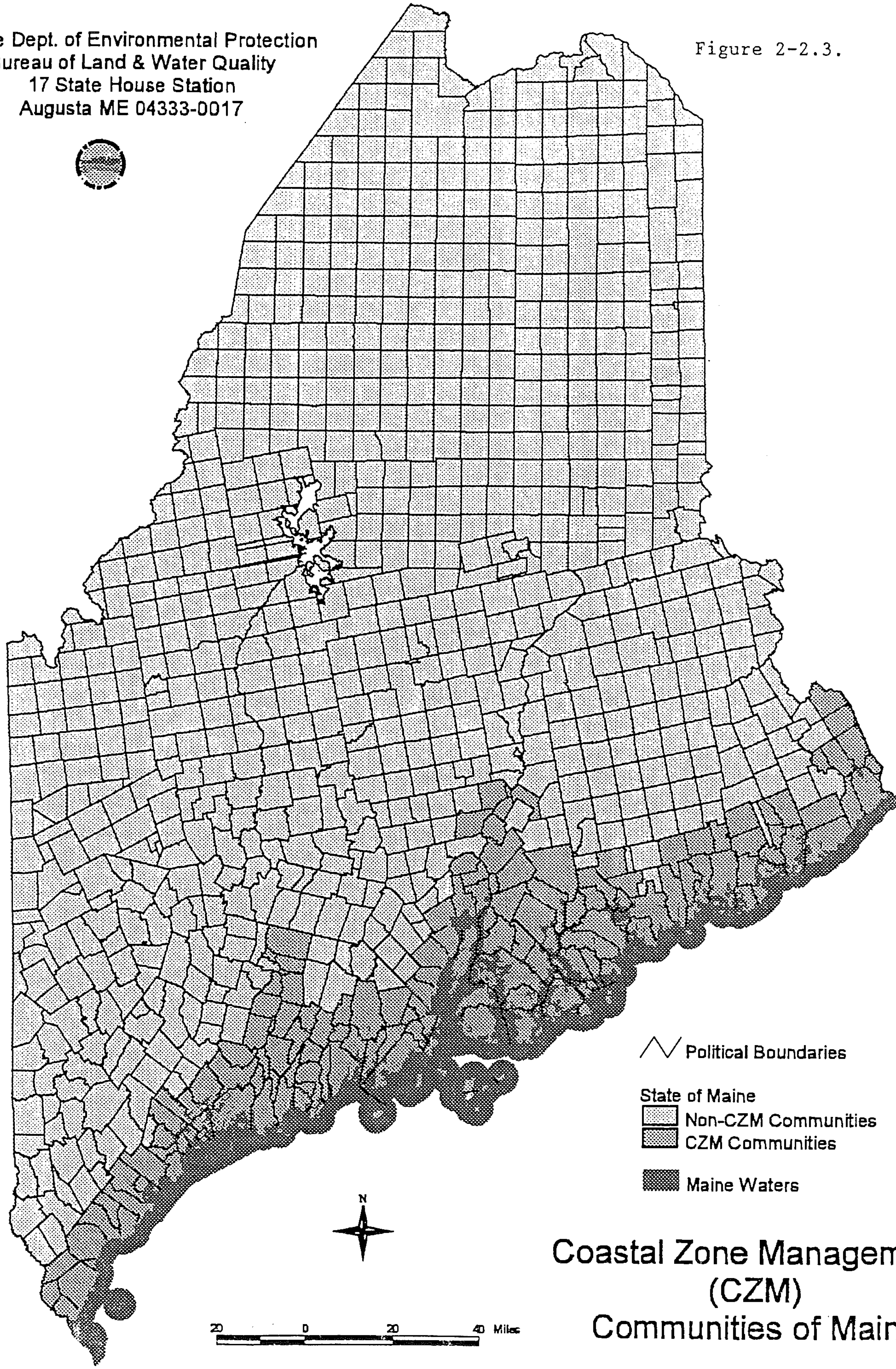
Figure 2-2.3.



Coastal Zone Management (CZM) Communities of Maine

Chapter 3 - Cost/Benefit Analysis

The assessment of costs and benefits of water quality protection is an extremely difficult exercise. Determination of direct economic costs of environmental regulation is complex, but with some effort, financial outlays can be determined. Indirect economic costs of water quality protection, such as jobs lost or gained, effects on competitiveness, productivity, worker satisfaction, etc., are often based on assumptions or subjective evaluations and are difficult to distinguish unequivocally from other economic costs.

Comparison of the benefits of water quality protection to economic costs is difficult at best, and often impossible. Because dollar values cannot be assigned to many of the benefits, the environment would nearly always suffer by restricting the comparison to economic aspects. In fact, such a superficial analysis of water quality protection efforts would undoubtedly have deterred the progress Maine has made over the last three decades. Tourism is an important component of Maine's economy; water quality undeniably is one component of Maine's attraction to tourists, but what is the increment resulting from our efforts to protect and improve our waters?

The direct benefits of the construction of numerous wastewater treatment plants for industrial and municipal facilities have been dramatic. Waterbodies that were once polluted are now supporting their designated uses of swimming, fishing, wildlife habitat, and recreation. Some Maine towns currently charge premium taxes for riverfront properties that, only 20 years ago, no one wanted. After cleaning up the severe pollution our focus has now shifted to sources and contaminants that were previously masked by the large-scale problems.

Costs of the State Water Quality Program

Contact: Paul Dutram, DEP BLWQ, (207) 287-7696

In 1997, the cost to administer water-related programs was approximately 11.7 million dollars. This cost includes positions focused primarily on land use regulation, however these staff are frequently involved with related water quality issues. Programs in the Bureau of Land and Water Quality include licensing, compliance, enforcement, technical assistance, pollution prevention, wastewater engineering, environmental assessment, lake restoration, nonpoint source control and groundwater protection. There are numerous other programs within and outside of the DEP that control impacts to water quality (i.e. the Subsurface Waste Disposal Rules, Agriculture's Pesticide Control Board and Manure Handling Compliance Program, Marine Resources shellfish program, Soil Conservation Service farming assistance). There is no comprehensive effort to catalog all water quality-related State administrative costs.

Water Quality and Property Values

Contact: Roy Bouchard, DEP BLWQ, Division of Environmental Assessment, (207) 287-7798

Over the last 4 years, several studies have been completed which illustrate the value of lakes in Maine's economy and the relationship of water quality to economic measures. In 1996, the

University of Maine published a report which analyzed the linkage between lake clarity and property values ("Water Quality Affects Property Prices: A Case Study of Selected Maine Lakes", Maine Agricultural and Forest Experiment Station, Misc. Report 398, February, 1996). This hedonic valuation study was the first of its kind on lakes, and was the basis for a companion study using contingent valuation methods published in 1998 ("Lakefront Property Owners' Economic Demand for Water Clarity in Maine Lakes", Maine Agricultural and Forest Experiment Station, Misc. Report 410, September, 1998). An investigation of the value of lakes in Maine's economy was completed in 1997 ("Great Ponds Play and Integral Role in Maine's Economy", Water Research Institute, Univ. of Maine, REP 473, April 1997). In addition, research into the value of lake water quality to non-property owners has recently been completed and will soon be published. The purpose of all of these projects is to quantify the economic costs of degraded lake water quality and the benefits of maintaining and improving water quality. This work shows that, although varying somewhat by market area, a one meter reduction of summertime minimum clarity (secchi transparency) results in 3-15+% reductions in expected market price of shorefront property. Additional analysis by DEP suggests that as much as 3-5 % of the tax burden could be shifted from shorefront owners to others in the watershed depending on the town involved. Preliminary estimates of aggregate property value loss on the 164 monitored low-color lakes which have minimum clarity below 3 meters is between 200 and 400 million dollars.

More than 25% of Maine adults who do not own lakefront property (well in excess of 200,000) use lakes each year. These users spend up to $100 million annually to recreate on lakes, 59% of which is spent within 10 miles of their lake(s) of choice, substantially stimulating local economies. In examining the value of water quality to Maine resident, non-property owners, researchers found that consumer surplus (value derived in excess of what is paid for the recreational experience) exceeds $7.5 million annually. This consumer surplus would be reduced by $1-2 million annually if small, but measurable decline in lake quality occurred.

In aggregate, lake expenditures by all users support over 50,000 jobs in Maine and generate $1.8 billion in total direct expenditures. The net benefit of avoiding measurable water quality decline in Maine lakes exceeds $2 billion dollars annually.

New Facility Construction

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In 1994 and 1995, 27 projects were completed with assistance from the Maine Construction Grants Program (11), the State Revolving Fund(16) or a combination of Farmers Home Administration grant/loan and State grant money. These projects included new facilities, upgrades, additions, modifications and abatement of combined sewer overflows for a total cost of approximately $110,000,000 to complete. In addition to this list of complete projects, 17 projects are in progress, with an estimated total worth of $63,787,000.

Small Community Grants
Contact: Richard Green, DEP BLWC, Division of Engineering and Technical Assistance
(207) 287-7765

The Small Community Program, since 1982, has disbursed $17,000,000 in grant funds to assist municipalities in construction of individual or cluster systems to eliminate discharges to surface waters from malfunctioning systems or straight pipes. This amount of funding has resulted in construction of new treatment facilities worth approximately $19,000,000. Since the 1996 305(b) report, $4,000,000 has been disbursed to fund approximately $3,500,000 in new small facility construction.

Overboard Discharge Grants
Contact: Dave Achorn, DEP BLWC, Division of Engineering and Technical Assistance
(207) 287-7766

The Overboard Discharge Grant Program commenced in 1990 and to date has been funded with $4.5 million in bond issue funds. 111 grants totaling $2.9 million have been made to towns and individuals. The program has spent $1,830,000 while, removing 202 systems. These systems are often constructed on very limited sites, which results in higher than normal costs to achieve the benefit of eliminating the wastewater discharges from commercially valuable shellfishing areas.

At present, no comprehensive data exist on the total wastewater treatment infrastructure installed by businesses and industries, or on the annual increment.

Nonpoint Source Management
Contact: Norm Marcotte, NPS Coordinator, DEP BLWQ, Division of Watershed Management
(207) 287-7727

Table 2-3.2 summarizes costs for nonpoint source pollution management involving federal grants under Section 319 of the Clean Water Act and non-federal matching funds.

Table 2-3.2 . Summary of Section 319 Grant Totals by Grant Year.
(Source: Maine DEP grant records, January 1998)

GRANT YEAR	FEDERAL COST	NON-FEDERAL MATCH	TOTAL
1996	$1,085,700	$723,800	$1,809,500
1997	$1,075,000	$717,025	$1,792,025

Pollution Prevention

Contact: Don Albert, DEP BLWQ, Division of Engineering and Technical Assistance
(207) 287-7767

Any costs to implement pollution prevention programs are generally counterbalanced many times over by economic benefits alone, and produce significant environmental benefits as well. By reducing or eliminating the use of toxic chemicals, the environment suffers less contamination, human health is affected less by environmental contamination, businesses reduce their regulatory costs, treatment costs often decline and many industries have actually reduced their production costs as a result of re-evaluating their processes during pollution prevention programs.

Chapter 4: Special State Concerns and Recommendations

Priorities for Environmental Protection

The Maine Environmental Priorities Project (MEPP) was initiated in 1993. It represents a collaborative effort among State government officials, environmental organizations, businesses, academic institutions, and the general public to set priorities for environmental protection. The MEPP process is designed to identify, compare and rank environmental problems. As a result of this process, a number of issues were identified as "high risk" with respect to ecological, public health and/or quality of life concerns. 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.

1. 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 ground water wells. Nitrates and nitrites from septic systems and agricultural 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, storage or disposal of industrial chemicals.

Public Water Supplies: Of the Maine residents served by public water supplies, approximately 20-25% receive water from ground water 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 the presence of lead from plumbing fixtures or lead soldered pipe.

2. 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, ground water recharge and shoreline erosion control. Wetlands also 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.

Non-Native Species: Accidental or illegal introductions of non-native species pose a risk to existing aquatic communities. Fisheries in some Maine lakes have been altered by species including northern pike, muskelunge, black crappie and several minnows. Exotic plants such as Eurasian milfoil often spread rapidly once introduced.

Dams and Hydrologic Manipulation: Dam construction and flow alteration may adversely affect aquatic systems in a number of ways. Potential impacts include loss of wetlands and aquatic/riparian habitat, fluctuating water levels and reduced fish passage. In Maine, such changes have reduced or eliminated some historic anadromous fish runs, including those of Atlantic salmon, sturgeon, alewives and smelt.

Harvesting in Estuaries and Marine Waters: Recent dramatic declines in commercial fisheries in the Gulf of Maine have lead to concern about harvesting practices and over-fishing. The potential impact of coastal pollution is largely unknown. Since the early 1980's, groundfish landings have declined by approximately 40%, and clam stocks by roughly 67%. There is also concern over current harvesting rates for lobsters and sea urchins. Outbreaks of "red tide" caused by a tiny marine dinoflagellate are common in the Gulf of Maine. These organisms accumulate in shellfish, and produce a toxin which may cause paralytic shellfish poisoning in humans. The Department of Marine Resources conducts regular monitoring, and closes affected areas to harvesting.

3. Surface Water and Sediments

Lakes: Non-point source pollution is the primary threat to Maine lakes. Sources include commercial and residential development, agriculture, 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 that consume fish from Maine lakes.

Rivers and Streams: In addition to non-point 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: Coastal waters are vulnerable to the same point and non-point threats as rivers, streams and lakes. The Department of Human Services has issued a consumption advisory for lobster tomalley because of high dioxin levels. Shellfish harvest areas are closed either seasonally or year round due to bacterial contamination. And oil and chemical spills result in additional widespread closures of shellfish harvesting areas along the southern Maine coast.

Strategies and Recommendations

Although we have achieved much success in reducing water quality impairment from large single sources, the types of problems facing our water resources today demand new and innovative approaches. As this report illuminates, the most prevalent unaddressed threats to our surface waters are from the cumulative impacts of smaller more diffuse sources. The Department is pursuing a number of strategies to improve our ability to address these problems.

Pollution Prevention

Contact: Ronald Dyer, Office of Innovation and Assistance, DEP Office of the Commissioner (207) 287-2812

The DEP has made a substantial commitment to pollution prevention (P2), which is critical for the future of environmental protection. Regulation based upon waste treatment and end-of-pipe controls has allowed tremendous strides in environmental improvement, and regulatory efforts must not be abandoned. To achieve the next level of environmental improvement, however, we must now invest in preventive measures and implement processes that generate less pollution. P2 offers a non-regulatory approach to environmental protection by focusing on removal of pollution and elimination of toxics from processes. Pollution prevention provides businesses the opportunity to reduce operating costs, reduce future environmental liability and create green marketing strategies. P2 is a cost-effective approach that produces tremendous environmental benefit. Pollution prevention makes good business and environmental sense for Maine.

In its 1994 Agenda For Action, the Department includes pollution prevention as one of five priorities. That documents calls for a pollution prevention program that: encourages the use of nonpolluting technologies and waste minimization; promotes the sustainable use of natural resources and protection of the environment through conservation, recycling and material reuse; and includes environmental considerations when evaluating products and processes.

Toward that end, DEP conducts training workshops for industry, and serves as a statewide clearinghouse for pollution prevention technology and idea transfer. DEP also administers the Small Business Technical Assistance and Maine Environmental Partnership Programs, and publishes a quarterly newsletter and other materials. Pollution Prevention teams consisting of staff from DEP and industrial facilities work together intensively to evaluate and improve all areas of the operation from production through waste treatment.

Toxics Monitoring of Surface Waters

Contact: Barry Mower, DEP BLWQ, Division of Environmental Assessment, (207) 287-7777

In 1993, EPA funded a study of fish tissue contamination in Maine lakes. Through the Regional Environmental Monitoring and Assessment Program (REMAP), DEP obtained fish tissue, water quality and sediment baseline data for 125 lakes statewide. The Surface Water Ambient Toxics Monitoring Program (SWAT) was established in 1994 to provide comprehensive long-term monitoring of toxic contaminants in surface waters statewide. The Dioxin Monitoring Program, focuses on contamination below major known sources of dioxins and furans. Together, these programs provide a basis to evaluate the risks that toxic substances present to humans and wildlife.

Whole Effluent Toxicity Testing
Contact: Dennis Merrill, DEP BLWQ, Division of Water Resource Regulation, (207) 287-7788

Maine's program to evaluate the discharge of toxic pollutants, Chapter 530.5 of DEP rules, has been in place for nearly three years. Many wastewater treatment facilities have begun testing their effluent as required by the rule, and those results are being submitted to DEP. In addition, considerable effluent toxicity data collected to meet EPA permit requirements or for other reasons are also kept on file.

Whole Effluent Toxicity testing has identified a significant number of municipal treatment facilities which have demonstrated either reasonable potential for effluent toxicity or actual water quality exceedences. Of the 67 facilities which have done "No Observable Effect Level" (NOEL) testing, 33 (49%) were found to have reasonable potential for water quality impacts using EPA's method to calculate reasonable potential. Eighteen facilities (27%) demonstrated effluent toxicity sufficient to exceed water quality criteria at low flow conditions.

As initially constructed, the toxics rule places its primary emphasis on the toxic characteristics of individual discharges, and individual toxicity problems must be identified and addressed on a facility-by-facility basis. It is equally important, however, that test results be reviewed on a more global basis to see if trends or common problems can be identified. Toward this end, the data management systems used to store and evaluate toxicity test results need to be refined to make them as useful and responsive as possible.

While not specifically addressed in the toxics rule, some attention should be given to the "absolute" toxicity of effluents. Absolute toxicity could be thought of as "pounds" toxicity and includes consideration of both test values and discharge quantities. As written, the rule relies largely on dilution factors and fails to address the actual amount or degree of effluent toxicity in any other sense. By looking at absolute toxicity coupled with knowledge of demographic and physical attributes of each treatment system, it may be possible to compare facilities on a uniform basis to determine the most significant loading or relatively more toxic characteristics. This sort of information and perspective would help to support pollution prevention efforts.

Watershed Management
Contact: Don Witherill, DEP BLWQ, Division of Watershed Management, (207) 287-7725

The Department supports the watershed approach as a means to comprehensively assess resources, identify threats, and produce solutions that are tailored to the problems. Setting priorities based on impacts to the resource can help target available funds where they are most needed. A common feature of a watershed approach is regulatory flexibility; regulatory controls are combined with other approaches to produce the best environmental results at the lowest cost. Further, watershed management typically involves all levels of government as well as the private sector.

Land Use and Growth Management
Contact: Jeff Madore, DEP BLWQ, Division of Land Resource Regulation, (207) 287-7848

It has long been recognized that land use practices have direct impacts on water quality. The State of Maine has several programs in place to regulate land use activities with potential adverse environmental effects. The Site Location of Development Law (Site Law) requires developers of large projects to obtain permits from the Department before beginning construction. Significant revisions to the Site Law, including new stormwater management and erosion control laws became effective in 1997. Under the Natural Resources Protection Act (NRPA), a permit from the Department is required for any activity in, on or adjacent to a protected natural resource, including rivers, streams, brooks, great ponds, coastal wetlands, freshwater wetlands, sand dunes and fragile mountain areas. The Mandatory Shoreland Zoning Act requires towns to control building sites, land uses, and placement of structures within the shoreland area in order to protect water quality, habitat and fishing industries, and to conserve shore cover, public access, natural beauty and open space. Also important to environmental protection is the Growth Management Act, enacted in 1988. This program is based on comprehensive planning and stronger state and local cooperation.

Education and Outreach
Contact: Barbara Welch, DEP BLWC, (207) 287-7682

Since many of the impacts to the environment come from individual actions, public education is vital. The Department has a responsibility to help each citizen to better understand the environment; the consequences of his or her actions upon it and what can be done to avoid them, and the requirements of environmental laws. Voluntary compliance is the primary means of environmental protection.

Each year the DEP performs many outreach tasks with the intention of informing, educating, and involving Maine citizens interested in water quality-related issues. Five central issues for managing Maine water resources have persisted from previous years. The central issues include 1) improving the coordination and cooperation of federal, state, regional and local governments, 2) educating and involving the people of Maine in the process of managing their environmental resources, 3) increasing the enforcement of environmental laws, 4) providing technical assistance to municipalities, 5) increasing the monitoring of water quality, and 6) promoting the incorporation of environmental education into the curriculum of Maine schools in order to educate tomorrow's decision-makers.

Volunteer Monitoring
Contacts: Linda Bacon, DEP BLWC, (207) 287-7749, Scott Williams, Maine Volunteer Lakes Monitoring Program, (207) 225-2070, and Kathleen Leyden (coastal monitoring), State Planning Office, (207) 287-3261

A corollary of the education/outreach program is the support of volunteer monitoring. Maine citizens in many areas of the State, including lake watersheds, rivers and coastal areas are increasingly interested and concerned about the quality of their waters. Many of these people are willing to devote time and effort to monitor the quality of their waters in order to help protect and improve those waters. The Department has helped organize and present the annual Water Quality Monitoring Fair, which provides workshops and seminars on many facets of establishing and running volunteer monitoring programs. Additionally, this fair is an event at which volunteers can share their experiences with other volunteers and establish better lines of communication with the staff of DEP and other state agencies with expertise or responsibilities in the habitats of interest to the volunteers. The State will be well-served to continue support of this program and expand its assistance to volunteer monitors in other ways, such as establishing a statewide database management system for coastal volunteer monitoring data.

Geographic Information System (GIS)
Contact: Maine Office of Geographic Information Systems, (207) 287-3897

The Maine Geographic Information System serves as the foundation for a system of well-coordinated and accurate natural resource management information. The spatial format of GIS greatly enhances the analysis of technical information, leading to better informed planning and regulatory decisions, which also provides greater predictability for the regulated community. The Department continues to expand the use of GIS in its programs. The Division of Environmental Assessment contains an Environmental Indicators Unit, which provides services and support to enhance our ability to use all of our water quality and water impact databases, as well as GIS.

Environmental Indicators
Contact: Leon Tsomides, DEP BLWQ, Division of Environmental Assessment, (207) 287-7844

The State of Maine, as well as the rest of the nation, have used a performance-based regulatory approach since the passage of the Clean Water Act. This approach was appropriate and achieved tremendous strides toward reducing discharges of pollutants to the environment, with corresponding dramatic improvement in the quality of our waters. This approach should be maintained in place, but now needs to be augmented by other approaches. One of these is the use of impact standards that measure actual biological response. Maine's environmental law incorporates biological community integrity standards, and rules establishing the numerical criteria to determine whether those standards are met have been developed for rivers and streams. The State needs to continue its progress in this area and expand the use of biological community integrity measures to all types of State waters.

PART III

SURFACE WATER ASSESSMENT

Chapter 1 - Surface Water Monitoring Program

The water sampling programs of the DEP Bureau of Land and Water Quality are conducted to administer two portions of environmental law: the Water Classification Program (38 MRSA, Article 4-A); and Protection and Improvement of Waters (38 MRSA, Chapter 3). Although the Bureau of Land and Water Quality works under the authority of numerous other statutes and regulations, for the water resources and water quality programs, they can be considered as secondary and supportive of the Water Classification Program and Protection and Improvement of Waters statutes.

The following is a description of the water sampling program of the Bureau of Land and Water Quality:

I. **Ambient Water Quality Monitoring**

A. **Attainment of Classification.** Assess attainment of present and proposed standards for the classification of surface waters.

1. Bacteria
2. Dissolved oxygen
3. Aquatic/marine life (ambient biomonitoring)
4. Trophic state (for lakes)
5. Fish/shellfish consumption
6. Other parameters (e.g. priority pollutants at selected sites)

B. **Assimilative Capacity and Wasteload Allocation Studies.** Assess whether present and proposed discharges and/or impoundments would violate the classification standards for dissolved oxygen, temperature, toxics, etc. during 7Q10 (the minimum seven day low flow which occurs once in ten years) or other critical flow conditions.

1. Ambient monitoring
   a. Flow gauging
   b. Time-of-travel studies

c. Intensive sampling of discharges and ambient waters for pre-selected flow conditions.

2. Modeling to predict assimilative capacity of waterbodies at critical flows.

C. **Combined Sewer Overflow Master Plans.**

1. Ambient monitoring
   a. water quantity/event frequency
   b. water quality
2. Sewage system modeling

D. **Hydropower Licensing/Relicensing.** Ambient monitoring (aquatic life and water chemistry) is required as a condition of licensing. Habitat assessment required to determine allowable drawdown and downstream flow alteration.

E. **Lake Diagnostic Studies**. Assess lake problems through analysis of in-lake and lake watershed parameters.

F. **Tissue Monitoring**. Assessment of contamination levels of metals and organics in fish and shellfish tissues through Maine's Surface Waters Ambient Toxics (SWAT) Monitoring Program and Dioxin Monitoring Program and the Regional Environmental Monitoring and Assessment Program (REMAP).

G. **Sediment Monitoring**. Assessment of contamination levels in sediments for metals and organics (SWAT, REMAP and Casco Bay Estuary Project).

H. **Special Studies**. Sampling programs supportive of scientific research necessary for the resolution of difficult, hypothetical and/or unusual water quality problems.

II. **Compliance Monitoring**

A. **Compliance Sampling**. Assess compliance with wastewater discharge licenses by sampling effluents.

B. **Bioassay Monitoring.** Assess toxic effects of whole or mixed effluents using standardized laboratory bioassays as specified in department regulation (Chapter 530.5).

C. **Diagnostic Evaluations**. Aid municipal treatment plant compliance through intensive diagnostic evaluations.

III. **Investigations**

A. **Complaint Investigations**. Respond to allegations of unlicensed discharges by sampling suspected discharges and ambient water quality above and below suspected discharges.

B. **Sanitary Surveys**. Assess status of overboard discharges usually pertinent to reopening shellfish areas

The ambient water quality monitoring program results in the following products:

1. A biennial report to Congress (Section 305b) and the Maine Legislature which describes the attainment status of all State waters;

2. Recommendations on license conditions for wastewater discharges, 401 certification (hydropower), Natural Resource Protection Act permits;

3. Reports evaluating the attainment status that would result from proposed changes in classification standards and recommendations to the legislature for changes in classification;

4. Reports addressing specific environmental problems (e.g. establishing or rescinding fish consumption advisories); and,

5. Reports, articles and news releases for local officials and the general public describing the suitability of various State waters for swimming and fishing.

Table 3-1.1. Priorities for Water Quality Sampling.

HIGH PRIORITY

Fresh	Marine
1. Lakes with extremely vulnerable or highly vulnerable characteristics.	1. Commercially harvested shellfish areas.
2. River mainstems which receive multiple major discharges.	2. Harbors and other confined waters adjacent to population centers.
3. Streams and brooks which drain populated or agricultural areas.	3. Select pristine waters which are considered to be representative of similarly situated waters.
4. Select pristine waters represent-ativeof similarly situated waters.	

MEDIUM PRIORITY

Fresh	Marine
1. Waters (other than lakes) impacted by nonpoint source pollution.	1. Shellfish areas which are occasionally harvested.
2. Waters with threatened quality due to proposed discharges and/or activities.	2. Waters with threatened quality due to proposed discharges and/or activities
3. Lakes with moderately vulnerable characteristics.	3. Swimming areas

LOW PRIORITY

Fresh	Marine
1. Most pristine/unthreatened waters.	1. Most pristine/unthreatened waters.

DEP FIVE YEAR MONITORING ROTATION

St. John, Presumpscot watersheds	1994; 1999
Saco, Southern coastal watersheds	1995; 2000
Penobscot, downeast watersheds	1996; 2001
Kennebec, mid coast watersheds	1997; 2002
Androscoggin watershed	1998; 2003

Selection of Waters To Be Sampled

The steps necessary for generation of the products described above include: selection of waterbodies to be sampled, selection of appropriate sampling locations on those water bodies, establishing sampling stations, scheduling of sampling at these stations, sampling by qualified personnel, data entry, processing and analysis.

Water quality is the cumulative result of multiple factors. The Maine ambient water quality monitoring program is biased toward waters in the more populated areas of the State and specifically toward those waters impacted by people. Table 3-1.1 serves as a general guide for selection of waters to be sampled (high priority). This guide is not restrictive. The state is currently monitoring on a five year rotation of watersheds one year in advance of licensing activities for each watershed. In addition to those waters selected by the Maine DEP for monitoring, waters are monitored by groups such as the US Geological Survey, Penobscot Indian Nation and a number of volunteer monitoring groups, each of which have their own purposes for selecting a water and the parameters to be monitored. As practical, the Maine DEP coordinates monitoring with these groups.

I. **River and stream assessment of attainment.**

A. **Assessment of Bacteria Standards.** To produce an assessment of attainment for human contact water quality criteria, a minimum of 12 samples should be collected between May 15 and September 30 at regular intervals (usually weekly). The samples are then analyzed for the most probable number of *Escherichia coli* bacteria.

B. **Assessment of Dissolved Oxygen Standards.** Dissolved oxygen sampling is scheduled for "worst case" conditions of low flow, high temperature, between 5:00am and 9:00am. Sampling is focused on flows which approximate 7Q10 when available. Additionally, the DEP and USGS cooperatively maintain a number of full time monitors on the major rivers below important dischargers.

C. **Biological Monitoring of Rivers, Streams and Brooks.** Contact: Susan Davies, DEP BLWQ, Division of Environmental Assessment, (207) 287-7778.

The State of Maine water quality classification law includes explicit language pertaining to the condition of aquatic life. These aquatic life standards establish, in narrative form, the characteristics of the aquatic community that are required to exist in order for a waterbody to attain a given classification, and these characteristics are specific and different for each water quality classification. The standards are further refined, in the statute by defining many technical and specific use terms, allowing a clear conceptualization of the general differences in aquatic life between classes. The narrative standards allow the State to discriminate between three water quality classes, in terms of the aquatic biota they are capable of supporting. The specific language in the standards is drafted in such a way as to provide for the use of available benthic macroinvertebrate community assessment approaches, to determine attainment of classification.

Approximately 350 stations on 125 different rivers and streams have been monitored to assess the condition of the benthic macroinvertebrate community since the program was started in 1983. Sample collection and analytical methods are described in Chapter 2 of this section. The program currently is able to sample about 35 sites per year. (The electronic database contains raw data and computed analyses for over 400 sampling events.) *

The State of Maine uses the results generated through this protocol in water quality management, reporting, planning, permitting, and enforcement and has found it to yield valuable information not provided by the traditional tests of water quality such as chemistry, dissolved oxygen and effluent toxicity testing.

D. Assimilative Capacity Studies. The DEP conducts assimilative capacity studies for toxic compounds and for oxygen-demanding substances. The results of these studies are used to establish license conditions for point source dischargers to these waters and are typically incorporated in Total Maximum Daily Load (TMDL) determinations.

1. Assimilative Capacity for Toxics. Maine has adopted EPA's Ambient Water Quality Criteria (AWQC) to prevent "toxic pollutants in toxic amounts" in State waters. Maine's Toxic Pollution Control Program, Chapter 530.5, describes integration of the AWQC with licensing procedures. Initially, the AWQC are used to calculate effluent limitations. These are compared to Best Practical Technology (BPT) based effluent limits and the more stringent of the two limits is proposed in the draft wastewater discharge license. There is also a provision for site-specific criteria in the rule.

Site-specific methods generally follow EPA's Water Effects Ratio guidance with additional requirements specific to Maine. The major deviation from EPA testing protocol is the DEP requirement that a salmonid be used for testing toxicity to fish. This is required because Maine's Water Quality Standards require that all fresh surface waters be suitable to support all species of fish indigenous to the receiving waters. Salmonids are indigenous to almost all Maine waters. Other differences include a greater number of tests than is required by EPA.

2. Assimilative capacity for oxygen-demanding substances. The following situations precipitate studies of assimilative capacity:

a. For rivers where D.O. has been found to be lower than the requirements of classification, a study is conducted to determine how much reduction in pollutant loading is required to attain classification standards for D.O.

b. For rivers where a new BOD discharge is proposed, the river is modeled to ensure that the new discharge will not violate the D.O. requirements of classification.

An assimilative capacity study for D.O. begins with field surveys designed for the calibration and verification of a water quality model. At least two data sets are collected during river conditions of low flow and high temperature. These conditions, because of the low D.O. levels which occur then, are considered to be the most critical for river habitats. The field surveys include hydraulic, physical and chemical analysis of the river including time-of-travel as determined by dye injection, measurement of cross sectional area, dissolved oxygen, temperature, salinity, sediment oxygen demand, chlorophyll a, nitrogen series, phosphorus series, BOD_5 and ultimate BOD. Extensive analysis of effluents entering the river is also done during field surveys. Nonpoint sources of water pollution are also estimated if they are thought to be significantly affecting the river's water quality.

The next step involves utilizing the data sets to calibrate and verify a computerized water quality model. Model calibration is accomplished by varying parameter factors until the model output matches the field survey results for BOD, temperature, D.O. and other parameters. The computerized river model is considered verified when the model which was calibrated by use of the first data set is run under the flow and temperature conditions of the second data set and the model output matches the BOD and D.O. data collected during the second field survey. The models most often used are QUAL-2E and WASP4. The modeling sometimes shows a need for additional data. This results in a third and, occasionally, a fourth field survey to collect the necessary data.

II. Lake Monitoring. The Lakes Assessment Section of the DEP Division of Environmental Assessment coordinates the lake monitoring program. Data is stored in Foxpro databases and is available to staff on the departmental computer network in read-only format.

The Maine lake monitoring program includes the following components:

A. Volunteer Lake Monitoring Program (VLMP)

Contacts: Linda Bacon, DEP BLWQ, Division of Environmental Assessment, (207) 287-7749 and Scott Williams, VLMP, (207) 225-2070.

The purpose of the Voluntary Lake Monitoring Program is two-fold. It provides transparency data on a large number of lakes, which are used to identify water quality trends. Additional lakes are currently being sampled for dissolved oxygen and other parameters. The VLMP provides the largest core of data for lake assessment. Lake ecology and watershed education is the second goal of the program.

The VLMP has been incorporated as a private organization. The DEP maintains control of data management and provide technical assistance to the program. The VLMP provides data on water clarity (Secchi disk) measured at least twice per month for 5 months of the year. Additionally, dissolved oxygen profiles (1 meter) are measured on some lakes. The DEP has published a manual entitled "Standard Field Methods for Lake Water Quality Monitoring" to assist groups wanting to perform additional testing.

B. Diagnostic Study Lakes

Contact: Roy Bouchard, DEP BLWQ, Division of Environmental Assessment, (207) 287-7798

The vulnerability index, in combination with the volunteer monitoring program, has identified lakes with potential need of diagnostic analysis. The State has not undertaken any new diagnostic studies. Some limited, privately-funded diagnoses have been performed on such lakes as East Pond. Trends of declining water quality have been evident on several lakes in Maine, such as Mousam Lake. Diagnostic studies would allow determination of the nature of problems, external sources of phosphorus loading, the extent of internal loading and the feasibility of potential solutions.

C. Special Study Lakes

Contacts: Roy Bouchard, Division of Environmental Assessment, (207) 287-7798, and Barry Mower (Lake George Study), DEP BLWQ, Division of Environmental Assessment, (207) 287-7777

The DEP monitors a number of lakes to provide answers to specific questions. For example, the Division of Environmental Assessment has monitored zooplankton and phytoplankton populations at Lake George in Canaan since 1987. The Department of Marine Resources has a program to re-establish sea-run alewives, and plans to stock alewives in several productive lakes in Central Maine. The Lake George study was undertaken to determine if stocking of this efficient planktivore will encourage undesirable blue-green algal blooms by depleting the zooplankton community. A reduction in the number of Cladocera was noted after alewives were stocked, however there were no apparent changes in algae as measured by Secchi disk transparency, total phosphorus and chlorophyll a. Sampling was completed in 1995. Final results are not yet published.

D. Lakes Bioassessment

Contact: Linda Bacon, DEP BLWQ, Division of Environmental Assessment
(207) 287-7749

Beginning in 1996, routine lake sampling has included collecting phytoplankton and surface sedimented diatoms. These samples are being analyzed as funding permits. Additional chemical parameters are also being collected and analyzed (e.g. cations, anions, and DOC). These results will be used to establish bioassessment tools for lakes over the next 5-7 years.

III. Estuarine/Marine Monitoring

Contact: John Sowles, DEP BLWQ, Division of Environmental Assessment, (207) 287-6110

The largest monitoring program on the Maine coast is that conducted by the Department of Marine Resources, which is concerned with bacteria levels in shellfish propagation areas and with marine biotoxins. Marine bacteriology is conducted in accordance with the protocols of the National Shellfish Sanitation Program to protect public health. Although most of the bacteria monitoring is to verify acceptable conditions within shellfish areas, some monitoring is in conjunction with pollution abatement projects.

Monitoring of dissolved oxygen, temperature, salinity and nutrients is being conducted in Maine's coastal waters to further describe the oxygen content of those waters and the effects of discharges and eutrophication. D.O. depressions have been documented in harbors with restricted water circulation. The DEP continues monitoring toxic contamination along Maine's coast, focusing on tissue contamination in blue mussels and lobsters, and contaminant accumulation in sediments. Much of this work presently focuses on establishing background levels of contaminants. This work is done through the Surface Water Ambient Toxics Program and Gulfwatch Project.

Coastal Volunteer Monitoring

Contacts: Kathleen Leyden, Maine State Planning Office, (207) 287-3144, or Esperanza Stancioff, University of Maine Cooperative Extension at (207) 594-2104

About 1,000 volunteers in 25 groups are monitoring marine and estuarine waters and freshwater feeder streams in Maine. Most of these groups receive financial support, training and ongoing technical assistance from the Maine State Planning Office/Maine Coastal Program and the University of Maine Cooperative Extension. While the primary objective for most of these groups is to restore closed shellfish growing areas, others are collecting baseline data, monitoring swimming beaches and helping local officials to identify pollution sources. Volunteers also perform watershed pollution source surveys. The majority of the groups have active student participation in their monitoring program. Nineteen Clean Water/Partners in Monitoring groups have established labs at high schools and share sampling and laboratory tasks between students and adult volunteers.

The standard sampling regime for most of these groups includes temperature, salinity, dissolved oxygen, fecal coliform, and in some areas, turbidity and pH. DO profiles and storm event monitoring have also been undertaken by volunteers in some areas. The sampling season is random with respect to tidal stage and meteorological condition and conducted bi-weekly from April through October/November (weather permitting.) Standard methods are used by all groups and field and lab procedures are documented in "Clean Water: A Guide to Water Quality Monitoring". Groups write individual quality assurance/quality control plans and qa/qc checks are conducted throughout the monitoring season. Approximately 300 estuarine/marine stations and 200 river/stream stations are being sampled through this effort. Coastal monitoring groups store their data on MURPHY, the citizen monitoring database developed by the Friends of Casco Bay. Efforts are currently underway by the state of Maine to store and analyze this data and to report on coastal trends.

Tools Needed to Improve Assessment Abilities

1. Biomonitoring: It is recommended that the USEPA make a stronger commitment to the incorporation of biomonitoring information in the 305(b) report for all states. This tool has been proven to be one of the most powerful to detect the spectrum of water quality and habitat impacts to our waters. Guidance, with associated funding, will yield improved assessment capabilities. Maine expects to expand this type of monitoring to the extent possible.

Support for implementation and trial of regional lake bioassessment methods and development of estuarine/coastal bioassessment methods will be necessary if states are to fulfill EPA's expectations for bio-criteria use. This will require a number of multi-year projects supported at the State and Regional level to field test reliable metrics and biological indicators.

2. Data management: The DEP has a major need for an improved data management system for both ambient water quality data. It must be user friendly, automatically calculate and display summary data, have useful report retrievals and statistical analysis capabilities, have built in logic to determine attainment status at both the Federal and State levels, and be linked to the state Geographic Information System. It would be even more useful to have such a system available to all agencies in the state to facilitate data sharing (e.g. STORET). Some of the historic data is already in databases or spreadsheets and could be reformatted and transferred electronically to a new system, however, the bulk of data collected on rivers and streams resides only on paper.

Maine needs to refine its use of EPA's WaterBody System to facilitate production of the 305(b) report.

Maine needs to develop a capability to coordinate water quality assessment activities and data acquisition with other state agencies and citizen monitoring groups, thus eliminating duplication of efforts, maximizing assessment effort and facilitating data sharing. There are many entities in the state doing this type of work, some of which submit copies of the data to us and some of which we probably don't even know exist. The 1996 and 1998 305(b) reports have used this data more extensively, however, increased use is foreseen if support can be directed to these groups. Increased inter-agency coordination and efficient data management will allow us to better assess the status of our waters.

3. Landscape scale assessment: The linkage between watershed scale information, regional geographic and demographic data, and lake modeling must be strengthened. In particular, drainage line and polygon coding via GIS is needed to update routing models (such as our Vulnerability Index) that predict lake trophic response. This information would allow much improved estimation of the sensitivity of individual lakes and lake systems to watershed disturbance thus providing better prioritizing methodology for NPS and watershed management.

Continued refinement of the Watershed Pollution Potential Index is needed, especially in the area of land use evaluation, including satellite image interpretation backed up by ground verification for use classification. Assessment abilities should also extend to more traditional watershed evaluations. EPA should restructure program criteria for CWA Sections 319 and 314 (at a minimum) to allow watershed surveys, thus ensuring that 319 and TMDL projects are adequately designed, major watershed problems are targeted and statewide prioritization of projects is facilitated. In particular, allowing increased use of 319 funding for watershed and NPS surveys, growth and development analyses and targeted water quality evaluations (to estimate the sensitivity of waterbodies to NPS changes) would enhance our related programs.

4. NPS Assessment: The DEP needs to accelerate monitoring of NPS effects, especially for small streams. Additionally, assessment of central technologies (BMPs) is needed to determine effectiveness of central measures.

Chapter 2 - Assessment Methodology and Summary Data

Methodology

This section of the report describes the methodology used to analyze water quality data for attainment status.

I. **Rivers, Streams and Marine Waters.** To assess what portion of Maine's rivers, streams and brooks meet the goals of the Clean Water Act (CWA), this report uses bacteriological, dissolved oxygen and other water quality criteria, fish/shellfish consumption, and aquatic life criteria contained in the Maine water quality standards.

A. **Bacteria**. The criteria used to determine the suitability for recreation in and on the water are based on bacteriological data. The interpretation of bacteriological data has required the establishment of several protocols.

1. The standards for determining attainment of the CWA goals are geometric means of 142 *Escherichia coli*/100 milliliters (mL) and 14 enterococci/100 mL of human origin for freshwater (Class C) and marine estuarine (Class SC) waters respectively. The geometric mean standards for *E. coli* and enterococci are based on a 90% confidence limit (log standard deviation = 0.5) with a sample size of n=12. If necessary, different sample sizes may be interpreted using the appropriate value for a 90% confidence limit. Maine also uses bacteria standards of the National Shellfish Sanitation Act.

2. Maine has adopted instantaneous bacteria standards (949 *E. coli*/100 mL for Class C rivers and streams and 94 enterococci/100 mL for Class SC), however single event exceedences are not typically used to make use attainment decisions.

3. All indicator bacteria are assumed to be of human origin unless there are no known sources of human waste affecting bacteria levels. Some livestock-only impacted waters are assessed as attaining bacteria standards despite high bacteria levels.

B. **Dissolved Oxygen**. To assess dissolved oxygen criteria suitable for the protection and propagation of fish and wildlife, Maine uses an adaptation of the dissolved oxygen (D.O.) criteria proposed by the USEPA (Federal Register, Vol. 50, No. 76, p. 15634, 4/19/85), as well as the dissolved oxygen standards specified in the Maine classification statute. For waters receiving point source discharges, use of computer modeling is also used for assessing D.O. attainment. Class C riverine waterbodies are determined to attain CWA goals of protection and propagation of fish and wildlife if they are found or are predicted to have a D.O. greater than 5.0 mg/L at flows equal to or greater than 7Q10 (the low seven-day flow occurring once in ten years), and 6.5 mg/L at 30Q10. A dissolved oxygen criterion of 70% of saturation is used to assess whether estuarine and marine Class SC waters are attaining the goals of the CWA. Monitoring typically is scheduled to measure the diurnal low (early morning).

C. **Aquatic Community Assessment:** Maine relies upon ambient biomonitoring of the benthic macroinvertebrate community using a standardized methodology to assess the combined impact of toxics, other nonconventional pollutants and habitat. Samples of the benthic macroinvertebrate community are collected by the placement of three wire baskets filled with bank-run gravel (1.5 cm-5.0 cm diameter), in each sampled location for one month. Preferred sampler placement is free-flowing first to seventh order rivers and streams, having at least some discernable velocity and an erodable substrate. Sampling season coincides with the period of highest temperature and lowest flow (mid-July to mid-September), and samplers are left in place for 28 +/- 4 days, within that time period.

Determination of the presence and extent of impact involves quantitative analysis of the organism names and counts. Twenty-three separate measures of benthic macroinvertebrate community structure and function are computed within the electronic database management system. The resulting information is then analyzed using a multivariate statistical model developed by the State that assesses the communities in comparison to statistically derived reference conditions for Maine waters. A probability of the likelihood of membership within one of four groups is computed. These groups correspond to the three water quality classes, and a fourth "class" representing non-attainment of minimum standards. A sampled site is found to be in non-attainment of its assigned class if it is placed in any lower classification (with at least 60% probability) by the model and after passing professional review of the results by program biologists.

D. **Fish/Shellfish Consumption**. Fish and shellfish must also be suitable for human consumption as determined by the State Toxicologist of the Maine Department of Human Services and by the Department of Marine Resources according to the National Shellfish Sanitation Program. Waters with published advisories are determined to be nonsupporting or partial supporting depending on the wording of the advisory. Partial support is used when some limited number or amount of fish/shellfish may be consumed or where a shellfishery is open for depuration harvesting.

II. **Lakes**. Attainment of Clean Water Act goals and designated use support in lakes is assessed using chemical data and other indicators. Detailed descriptions of use assessment can be found in Part III, Chapter 4: Water Quality Assessment of Lakes.

Support assessment is conducted similarly as for rivers, streams and marine waters. Fish consumption during the reporting period is assessed using fish advisories. Attainment of aquatic life support is primarily based on suitability of dissolved oxygen levels in the bottom waters of a lake to support coldwater organisms and other water quality criteria, or severe water level (littoral habitat) fluctuations that affect >25% of the littoral zone. Swimming (recreation in and on the water) is assessed using trophic information (presence or absence of algal blooms, <2m transparency) and available bacteria data. The designated use of drinking water is fully supported if there have been no water supply closures or advisories during the reporting period. The State designated use, 'trophic stability', is assessed by examination of the lake dataset for trends in transparency, phosphorus or chlorophyll 'a'.

Assessment of Attainment

For the purpose of determining attainment of Clean Water Act Goals and designated use support, the following definitions of "Supporting", "Partially Supporting", and "Not Supporting" are applied:

1. **Fish Consumption**

   Supporting: No fish/shellfish consumption advisories in effect.

   Partially Supporting: "Restricted Consumption" fish/shellfish advisory or ban in effect during the reporting period for the general population or a subpopulation that could be at potentially greater risk (e.g., pregnant or nursing women, children). Restricted consumption is defined as limits on the number of fish of one or more species consumed per unit time. Shellfish areas open to depuration harvesting only.

   Not supporting: Advisory or shellfish closure recommending no consumption of one or more species.

2. **Aquatic Life Support**

   Supporting: Rivers and streams that meet Maine's Class C standards for oxygen and all other adopted criteria, attain Maine's draft biocriteria and exhibit no other impairments, including habitat impairments, that would reduce the viability of an indigenous fishery or other aquatic life use, as defined in Maine classification statute. Marine, estuarine waters that meet Maine's Class SC standards for oxygen and all other adopted criteria, and exhibit no other impairments, including habitat impairments, that would reduce the viability of an indigenous fishery or other marine life use, as defined in Maine classification statute.

   Partial support: Lakes that have low dissolved in the hypolimnetic zone. Lakes with significant annual drawdowns.

   Not Supporting: Rivers, streams or brooks that do not attain Maine's draft biocriteria or do not meet criteria for dissolved oxygen, turbidity, toxic contamination, thermal modifications, or other impacts, including habitat that reduce the viability of an indigenous fishery or other aquatic life.

3. **Recreation In and On the Water**

Supporting: River, stream lake or marine, estuarine waters that meet or exceed Maine's Class C or SC standards for bacteria of human origin (see I.A., above).

Partial Supporting: River, stream or marine, estuarine waters that fail to meet geometric mean standards for Class C of SC due to combined sewer overflows. Lakes that have algae blooms. Waters where there has been a temporary beach warning/closure in the reporting period.

Not Supporting: River, stream or marine, estuarine waters that fail to meet geometric mean standards for Class C or SC waters. Waters with permanent beach closures.

4. **Drinking Water Supply**

Supporting: Freshwaters that attain all adopted water quality criteria for human consumption or where conventional water supply treatment will render the water safe.

Not supporting: Freshwaters that do not attain one or more adopted water quality criteria for human consumption.

5. **Secondary contact, Agriculture supply, Navigation, other uses**

Maine does not make an assessment of these uses. Secondary contact is reported the same as swimming (recreation in and on the water). All freshwaters are assumed to be suitable for agricultural supply.

"Evaluated" and "Monitored" status

Overall use support for surface waters based on evaluated or monitored information presented in Table 3.2.1. Maine reports on the use support for 100% of its waters based on either "evaluated" or "monitored" information. "Monitored" waters include those waterbodies where data has been collected for one or more water quality standards described in the Methodology section above, within the past 5 years. Waterbody segments may be variable in size and are determined by hydrologic/geographic considerations (e.g. river reach), designated uses, area of influence from discharge(s) or other defining features that would indicate the extent to which data is expected to be representative. Monitored segments may also include waters for which there is a current, data-verified water quality model available. "Evaluated" waters include those segments for which there is only qualitative information, or where empirical data is greater than 5 years old and there is no known change in the status of discharges or land use that would indicate a change in quality. Initial determination of 'nonattainment' status for a waterbody segment is only made based on monitored data. The nonattainment status of a waterbody will continue beyond the 5 year 'life' of the monitored data until new data and information shows that the waterbody has returned to attainment quality.

Water Quality Summary

About 1.4% of Maine riverine waters are not fully supporting their designated uses. The length of rivers, streams and brooks not attaining full use is 476.4 miles, which is a slight increase over the 1996 assessment report. This probably reflects greater monitoring activity that occurred in this reporting period and the discovery of previously unknown nonattainment segments rather than an overall decline in water quality. This is especially true for the increase in small urban streams reported in nonattainment. Recent aquatic life monitoring has focused on these waters and, not surprisingly, revealed many that did not attain aquatic life standards. River miles with fish consumption advisories have increased slightly. In 1996, Maine reported no fish-kills due to either pollution or water withdrawal events, the first year this has ever occurred in Maine since the state first started recording these events. One small pesticide-caused kill occurred in 1997. Significant improvements have been made on a number of river segments.

Currently, a statewide fish consumption advisory is in effect for all Maine lakes due to mercury contamination. Analysis of other lake water quality factors shows the following. Based on area, 66.0% (1996-70.3%) of Maine lakes fully support designated uses, 15.6% (1996-25.0%) partially support the uses, and 18.4% (1996-5.0%) are fully supporting, but threatened. Of significant Maine lake area, 84.4% (1996-75.0%) meets the GPA classification requirements established by State law; 15.6% (1996-25.0%) does not. The Lakes Water Quality Assessment chapter (Part III, Chapter 4) details GPA classification requirements and use support status determinations. The Waterbody System (WBS) is not used to track attainment status for lakes at this time due to the difficulty of extracting information from our master databases and raw data files and then entering it into the WBS. We currently use a number of FoxPro databases and extraction programs to store data and obtain the necessary attainment statistics to compile this report.

Currently, no marine or estuarine waters fully support their designated uses due to a statewide advisory on the consumption of lobster tomalley (hepatopancreas) because of dioxin contamination. Approximately 378.2 square miles of estuarine and marine waters are not fully supporting their designated uses for reasons other than the lobster tomalley advisory. This is primarily due to bacteria discharges that prevent harvesting or allow only for depuration harvesting.

A summary of the extent to which designated uses of Maine water quality classifications are not being supported is presented in Table 3-2.1. Table 3-2.2 summarizes attainment of the designated uses of State Law and the Clean Water Act. Because some Maine classifications are more stringent than those of the CWA, the sizes of water bodies indicated as attaining classifications in Table 3-2.2 may be larger than those indicated in Table 3-2.1.

Causes and Sources of Non-Attainment of Designated Uses

The causes and sources of non-attainment of water quality standards vary significantly depending on the type of water resource considered. The total sizes of waters not fully supporting uses is broken down by cause categories (Table 3-2.3) and source categories (Table 3-2.4). Figures 3-2.3 and 3-2.4 show the distribution of overboard discharges and combined sewer overflows.

The most significant cause of non-attainment in larger Maine rivers and coastal waters is the presence of priority pollutants, specifically dioxin. Atmospheric deposition of mercury is the most significant problem affecting lakes. Mercury may be equally significant in Maine's rivers however data is insufficient at this time to make that judgement. Non-attainment in smaller rivers, streams and brooks is most often caused by high levels of nutrients (organic enrichment) which results in the depletion of dissolved oxygen. A number of segments behind and below hydroelectric dams have been identified in non-attainment of support of aquatic life. Organic enrichment is also the most significant cause of non-attainment of Maine lakes (other than mercury). Estuaries and marine waters are also heavily affected by indicators of pathogen contamination, but the presence of small overboard discharges is the primary reason for many closures regardless of water quality. Several areas are currently closed due to the lack of sufficient water quality information.

The assignment of source magnitudes is relative and based on the number of sources present in a particular lake watershed. A source magnitude of "Major" is assigned when there is only one known source category in a watershed. Source magnitudes of "Moderate/Minor" are assigned when multiple source categories exist in a watershed. Occasionally, if multiple source categories exist and a predominant source category exists, then the predominant category would be assigned a "Major" magnitude and subsequent source categories would be assigned "Moderate/Minor" magnitudes.

Table 3-2.1 Overall Use Support in Assessed Surface Waterbodies in Maine.

Type of Waterbody: Rivers, Streams, and Brooks (linear miles)

Use Support	Evaluated	Monitored	Total
Fully supporting	21,541	9667[1]	31,208
Fully supporting, but threatened	not determined		
Partially supporting	0	149	149
Not supporting	111	284	395
TOTAL	21,652	10,100	31,752

Type of Waterbody: Lakes and Ponds (acres)

Use Support	Evaluated	Monitored	Total[3]
Fully supporting	215,215	411,031	652,195
Fully supporting, but threatened	22,068	159,385	181,453
Partially supporting[2]	46,151	107,484	153,635
(Partially supporting, mercury advisory)	(309,383)	(677,900)	(987,283)
Not supporting	0	0	0
TOTAL	283,434	677,900	987,283

Type of Waterbody: Estuarine and Marine Waters (square miles)

Use Support	Evaluated	Monitored	Total
Fully supporting	2,173.4	300.0[1]	2,473.4
Fully supporting, but threatened	not determined		
Partially supporting[2]	0.0	49.1	49.1
(Partially supporting, dioxin advisory)	(2801.6)	(50.0[1])	(2851.6)
Not supporting	0.0	329.1	329.1
TOTAL	2,173.4	678.2	2851.6

1 Estimated miles/area of monitored river/stream and estuarine/marine waters.
2. Partial support does not include statewide advisories for mercury in lake fish or dioxin in lobster tomalley.
3. Includes lakes that do not meet the definition of significant used elsewhere in this report that have not been assessed but are assumed to be fully supporting uses other than fish consumption.

Table 3-2.2 Individual Use Support Summary for Surface Waters in Maine

Type of Waterbody: Rivers, Streams and Brooks (linear miles)

Use	Supporting	Supporting, but Threatened[1]	Partially Supporting	Not Supporting	Not Attainable
Fish Consumption	31,481	0	199	72	0
Aquatic Life Support	31,404	0	49	299	0
Swimming	31,508	0	102	141	0
Secondary Contact	31,474.5	0	0	197.5	0
Drinking Water Supply	31,751	0	0	1	0
Agriculture	31,752	0	0	0	0

Type of Waterbody: Lakes and Ponds (acres)

Use	Supporting	Supporting, but Threatened[1]	Partially Supporting	Not Supporting	Not Attainable	Unassessed
Fish Consumption[6]	0	0	987,283	0	0	0
Aquatic Life Support	726,103	158,821	102,359	0	0	0
Swimming	717,262	219,154	50,867	0	.0	0
Secondary Contact	987,283	0	0	0	0	0
Drinking Water Supply[2]	958,776	0	0	0	0	0
ADDITIONAL STATE USES:						
Trophic Stability	734,945	218,296	34,042	0	0	0
Industrial Process & Cooling Water, Hydropower, & Navigation	987,283	0	0	0	0	0

Type of Waterbody: Estuarine and Marine Waters (square miles)

Use	Supporting	Supporting, but Threatened[1]	Partially Supporting	Not Supporting	Not Attainable
Shellfish[3]	2473.4	0	49.1	329.1	0
Shellfish (lobster tomalley only)[6]	0	0	2851.6	0	0
Aquatic Life Support[4]	2,851.1	0	0.5	0	0
Swimming (Square Miles)[5]	2,847.7	0	3.9	0	0

[1] Size Threatened is not a sub-category of size fully supporting.
[2] Waterbody can be used as drinking water source with reasonable treatment ranging from chlorination to filtration and chlorination.
[3] Area estimated by the Maine Department of Marine Resources.
[4] Use category includes propagation of fish, shellfish and wildlife.
[5] Use category includes recreation in and on the water.
[6] Based on statewide fish/shellfish consumption advisory.

Table 3-2.3 Causes of Surface Water Non-attainment in Maine.

Rivers, Streams and Brooks (linear miles)

Cause Categories	Major Impact	Moderate/Minor Impact
Priority Organics	276.9	
Metals	2	
Organic Enrichment	208.3	4.5
Hydrologic modification	27.2	14.0
Pathogen Indicators	168.4	54
Thermal modification		5.0
Taste and Odor	5.0	
Habitat Alteration	0.2	3.5
pH	1.0	

Lakes and Ponds (acres)

Cause Categories	Major Impact	Moderate/Minor Impact
Nutrients	3,259	72,291
Siltation	0	40,118
Organic Enrichment	26,281	56,541
Flow Alteration	65,067	30
Taste and Odor	0	3,845
Metals - Fish Tissue	987,283	0
Turbidity	0	7,865

Estuarine and Marine Waters (square miles)

Cause Categories	Major Impact	Moderate/Minor Impact
Priority Pollutants	2,851.6	
Organic Enrichment	1.4	
Pathogen Indicators	329.1	49.1

Table 3-2.4 Sources of Surface Water Non-attainment in Maine.

Type of Water Body: Rivers, Streams and Brooks (linear miles)

Source Categories	Major Impact	Moderate/Minor Impact
Unknown	4.5	0
Industrial Point Sources	215.9	46.5
Municipal Point Sources	32.0	58
Combined Sewer Overflows	126.0	30.5
Agriculture	132.0	20.0
Animal Feed Operations	3.0	0
Aquaculture	4.0	0
Urban Runoff/Storm Sewers	58.4	10.2
Construction	5.0	0
Resource extraction	3.4	0
Habitat Modification	8.5	0.5
Onsite Waste Treatment (domestic)	35.9	7.5
Flow Regulation	97.3	15.5
Land Disposal (landfills, hazardous waste)	25.5	7.5
In-place Contamination	0	1.5

Type of Water Body: Lakes and Ponds (acres)

Source Categories	Major Impact	Moderate/Minor Impact
Municipal Point Sources	76	4,458
Agriculture	916	52,532
Silviculture	0	29,197
Construction	32	0
Urban Runoff/Storm Sewers	13,448	60,056
Land Disposal	429	2,399
Hydro-modification	65,067	8,057
Sediment Resuspension	550	0
Internal Nutrient Recycling	0	18,080
Natural Sources	23	9,807
Source Unknown	9,087	827
Atmospheric Deposition	987,283	0

Type of Water Body: Marine and Estuarine Waters (square miles)

Source Categories	Major Impact	Moderate/Minor Impact
Industrial Point Source	2851	
Municipal Point/Overboard Discharge	329.1	
Combined Sewer Overflows		49.1
Urban Runoff / Storm Sewers		49.1

Chapter 3 - Water Quality Assessment of Rivers, Streams and Brooks

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The percentage of watercourse miles suitable for fishing and swimming in Maine is highest for small watercourses and lowest for major rivers (Table 3-3.1). This is due to patterns of settlement and industrialization in Maine. Because of the greater potential for development of major Maine rivers, water pollution problems are most severe there. There has been an overall increase in swimmable miles and a slight overall decrease of fishable miles since the 1996 assessment.

Table 3-3.1. Rivers, Streams and Brooks Evaluated for the Interim Goals of the Clean Water Act.

Waterbody Type	Miles in Maine	Miles "Fishable"	Miles "Swimmable"
Major Rivers[1]	1141	887.5 (78%)	1037.5 (91%)
Minor Rivers, Streams, and Brooks	30,531	30,390.8 (99.5%)	30,448 (99.7%)
TOTAL	31,672	31,278.3 (98.7%)	31,485.5 (99.4%)

[1] Major: Those with a drainage area greater than 500 square miles.

Main Stems of Major Rivers

Maine rivers with a drainage area greater than 500 square miles deserve special consideration in assessing ambient water quality. Settlement patterns, as well as the potentially greater opportunities for recreation and habitat, on these 19 major rivers give these waters significant importance to the State. Eleven of these 19 rivers are tributaries of still larger rivers. Five of the 19 rivers (the Allagash, Dead, Fish, East Branch and West Branch of the Penobscot) lie in remote areas and can be characterized as pristine (with the exception of the West Branch, these rivers are classified AA or A). Six of these 19 rivers (the Mattawamkeag, Moose, Piscataquis, Saco, Sandy, and Union) are less densely settled and industrialized than the following group but historically had segments with pollution problems.

Table 3-3.2. Maine Attainment Status: Major Rivers.

River Name	Maine Length (miles)	Fishable[1] miles	Swimmable[2] miles	Fishable/ Swimmable miles	
Androscoggin[3]	124	0	94	0	(0%)
Kennebec[3]	145	89	89	89	(61%)
Dead	22	22	22	22	(100%)
Moose	13	13	13	13	(100%)
Sandy	86	86	86	86	(100%)
Sebasticook	50	48	50	48	(96%)
Penobscot[3]	80	24	73	24	(29%)
East Branch	46	46	46	46	(100%)
Mattawamkeag	48	48	48	48	(100%)
Piscataquis	47	47	47	47	(100%)
West Branch	36	31	33	28	(78%)
Presumpscot	23	16	16	16	(70%)
Saco	81	80.5	80.5	80.5	(99%)
Saint Croix	30	27	30	27	(90%)
Saint John[4]	161	161	161	161	(100%)
Allagash	64	64	64	64	(100%)
Aroostook	69	69	69	69	(100%)
Fish	13	13	13	13	(100%)
Union	3	3	3	3	(100%)
TOTAL MILES	1141	887.5	1037.5	884	
PERCENT OF TOTAL		(78%)	(91%)	(77%)	

[1] Those which attain the criteria for protection and propagation of fish and wildlife.
[2] Those which attain the criteria for recreation in and on the water.
[3] Segments of the Androscoggin (124 miles), Kennebec (56 miles) and Penobscot (56.5 miles) Rivers do not fully attain the interim goal of fishable due to the presence of dioxin in fish tissues. The State Toxicologist has issued an advisory to limit consumption of fish from these rivers.
[4] That portion of the basin upstream of the Hamlin, Maine - Grand Falls, New Brunswick boundary.

The remaining eight of the 19 rivers (the Androscoggin, Aroostook, Kennebec, Penobscot, Presumpscot, Saint Croix, Sebasticook and Saint John) are pristine in their upper watersheds but pass through urban, industrial and agricultural areas in their lower reaches. Prior to the treatment of industrial and municipal wastewater, these eight rivers had serious pollution problems in their lower reaches. The Androscoggin River was once characterized as one of the ten most polluted rivers in the nation.

Significant progress has been made since the 1996 assessment. Most notable is a gain of 115 miles attaining swimmable standards. This is due to several large segments of the Androscoggin and Penobscot Rivers improving their water color quality and the removal of a significant bacteria source originating in New Hampshire that affected a segment of the Androscoggin in Maine.

As shown in Table 3-3.2, 887.5 of 1,141 miles of major river main stems in Maine attain the interim goals of the Clean Water Act. The most significant cause for not fully supporting the uses of the main stem rivers is the presence of dioxin from industrial point sources. Additional problems are caused by discharges of untreated municipal wastewater (CSOs), inadequate sewers or treatment facilities. Each stream segment in Maine which does not attain classification standards is identified in Chapter 4 of Appendix I along with a description of the cause(s) of non-attainment.

Building wastewater treatment facilities has not solve certain water quality problems on Maine's major rivers. Maine cities and larger towns also have problems with their wastewater collection systems. A serious problem is combined sewer overflows (CSOs). The relative importance of nonpoint source pollution is increasing as point source problems are eliminated. A detailed discussion of point and nonpoint control programs may be found in Part II, Chapter 2, of this report.

Small Streams

Small stream segments totaling 218.6 miles are found to be in nonattainment from all causes. This is a slight increase over the 1994 assessment but reflects the inclusion of new waters discovered using new data sources. Despite the increase of nonattainment miles, a number of waters have been improved and removed from the list of nonattainment waters (found in Chapter 4 of Appendix I). These include several segments that previously had toxic problems or discharges of untreated or poorly treated sewage. As in previous years, most documented progress has been made where treatment could be applied to point sources. Treatment of nonpoint source problems with follow-up assessment is needed to document effectiveness of nonpoint source abatement programs.

Water Quality Trends

It is difficult to assess trends between the 1998 report and previous 305b reports, as many new data sources and new methods were employed for this reporting period, causing a number of waterbodies to be listed as nonattainment. The state is improving its NPS assessment capability. Many waters, particularly the small streams where historically there was less monitoring conducted, may have had water quality problems for many years but were not monitored and not reported. Therefore it is hard to conclude what trends exists.

The best information is for large rivers where monitoring is more continuous and comprehensive. These waters show a continued trend toward improvement. The Maine DEP has established a goal to remove dioxin advisories by the year 2002. Paper mills have already incorporated technology to reduce dioxin. This will also yield benefits of reducing color discharges. All communities with CSOs are also engaged in assessment, rehabilitation and treatment to remove or reduce these sources.

A number of segments associated with hydropower facilities have been listed as nonattainment based on information received during the relicensing process of these facilities. Many of these segments are small but the effect of certain facilities on the downstream biota can be profound. The Maine DEP has taken an active role in the relicensing of hydroelectric facilities in the state. New certifications have required re-adjusting flows, usually increasing minimum flows to benefit aquatic life in and below many impoundments. Maine will continue to pursue similar agreements with the operators of hydroelectric facilities scheduled for relicensing in the next few years.

Toxic contamination appears to be a significant concern for the state in coming years. With the repopulation of fisheries on many rivers following waste removal in the 1970's, we are finding that some populations carry significant contaminant burdens. Recent sampling for dioxin has shown decline of this contaminant in fish tissues, however advisories are still continuing for this contaminant. Additional monitoring through the Surface Water Ambient Toxics program may reveal other contamination problems. Mercury contamination is of primary concern due to its widespread presence documented in our lakes. PCB contamination is another area of concern, however, data is incomplete to determine if a health or ecological threat exists at this time.

Chapter 4 - Water Quality Assessment of Lakes

Summary Statistics

Summary statistics for use support and causes or sources of impairment in Maine lakes can be found in Tables 3-2.1 through 3-2.4 in Part III, Chapter Two: Assessment Methodology and Summary Data.

The number of lakes classified as being in non-attainment of their designated uses had been reduced from 243 as of April 1996, to 91 lakes as of April 1998. This reduction reflects an improvement in the methodology for evaluating dissolved oxygen depletions in hypolimnetic waters, the criteria for which may be found in a subsequent section of this Chapter. Of these 91 lakes, only one 76-acre impoundment continues to have a *high magnitude* point source discharge as its major nutrient contributor. The remaining 90 lakes have major nonpoint source contributions. The number of lakes considered 'Fully Supporting but Threatened' has increased considerably over this reporting period as a result of the changes in assessment criteria.

Lake Assessment Program Background

To improve consistency in 305(b) reports nationally, EPA restricted "significant" lakes to publicly owned lakes with public access in 1992. In the State of Maine all surface waters are defined by Statute to be publicly owned (Title 17 M.R.S.A., Section 3860). Great Ponds are defined as inland bodies of water in excess of 10 acres or, if artificially impounded, in excess of 30 acres (Title 38 M.R.S.A., Section 480-B). Public access to Great Ponds over unimproved lands is allowed under Title 17 M.R.S.A., Section 3860, except over land owned by a water company or district when the water from the great pond is utilized as a source for public water. For the purposes of this assessment, "significant" lakes continue to be defined as publicly owned Great Ponds for which bathymetric/morphometric surveys exist, vulnerability modeling has been performed, or for which some trophic data has been gathered. This is a functional definition only and not intended to define relative value or need for protection.

Table 3-4.1 illustrates that even though the number of "significant" lakes account for only 40% of the total lake population in Maine, the sum of "significant" lake acreage accounts for 97% of the State's lake surface area. With the exception of the section entitled "Acid Effects on Lakes" or as otherwise indicated, the remainder of this chapter deals only with 'significant' lakes.

Table 3-4.1. Maine Lake Population Statistics

	Number	Acres
Total Lakes	5788 (100%)	987,283 (100%)
1998 Significant Lakes	2314 (40%)	959,193 (97%)

Maine statutory goals for the management of lakes and ponds (Class GPA) include: stable or decreasing trophic state, freedom from culturally induced algal blooms which impair their use and enjoyment, and no impairment of aquatic habitat. These management goals recognize the existing diversity of trophic state and do not mandate natural or pristine conditions where lake watersheds already had extensive agricultural or residential development prior to adoption of this classification.

Attainment of State Class GPA and the three Federal Clean Water Act Goals ('Protect and Enhance Ecosystems', Protect and Enhance Public Health', and 'Social and Economic' considerations) are evaluated in terms of specific designated uses (or conditions). Table 3-4.1 illustrates the relationship between Federal Goals/Designated Uses and State Designated Uses.

Table 3-4.1a. Federal and State Designated Uses

Federal Clean Water Act Goals **State**	**Designated Use**	**Federal**	
Protect and Enhance Ecosystems	Aquatic Life Support	Y	Y
	Trophic Stability	N	Y
Protect and Enhance Public Health	Fish Consumption	Y	Y
	Primary Contact (swimming)	Y	Y
	Secondary Contact	Y	Y
	Drinking Water	Y	Y
Social and Economic	Agriculture	Y	N
	Cultural/Ceremonial	Y	N
	Industrial Process & Cooling	N	Y
	Hydropower	N	Y
	Navigation	N	Y

Currently, all Maine lakes are considered as only 'Partially Supporting' the designated use of 'Fish Consumption' due to mercury contamination. All but 90 significant lakes are considered as 'Fully Supporting' the remaining designated uses. Those 90 are in 'Partial Support' of at least one of the designated uses. Four hundred ninety-five significant lakes are considered as 'Fully Supporting' uses but future support of at least one use is considered 'Threatened'.

Maine has employed a number of lake water quality assessment techniques to determine designated use attainment status over the past few decades. These assessment tools and assessment criteria continue to evolve as our understanding of lake ecosystems expands and analytical capacities increase. Standard limnological parameters such as the Trophic State Index, Secchi Transparency and dissolved oxygen distribution continue to provide the basis for trend detection, classification of productivity, and aquatic habitat evaluation.

Application of computer models, such as the Vulnerability Index (VI), allow resource managers to predict the effects land use changes over time will have on specific lakes. Two electronic datasets have become available since the last reporting cycle: volumes for each meter of depth in Maine lakes that have bathymetric surveys, and a watershed development ranking system. The former has allowed a volume-weighted refinement to the dissolved oxygen depletion metric previously used. The latter allows a preliminary method to screen natural impacts from anthropogenic effects.

The remainder of this chapter details Maine's lake assessment techniques, results of lake evaluations, lake management issues and lake restoration summaries.

Trophic Status

Contact: Linda Bacon, DEP BLWQ, Division of Environmental Assessment, (207) 287-7749

Lakes can be classified in many ways. For example, they may be classified according to their depth, size, conductivity, hardness, or according to the type of fish assemblages they support. The classification of a lake according to its productivity is known as *trophic* classification. Trophic status is directly related to water column nutrient levels, algal populations and the resulting transparency.

A lake is considered productive or ***eutrophic*** when nutrient levels are high enough to support high levels of algal growth. Conversely, an unproductive or ***oligotrophic*** lake is low in nutrients and thus does not support high algal populations. Algal populations interfere with the transparency of the water so eutrophic lakes generally have lower transparencies than oligotrophic lakes. Lakes with intermediate levels of nutrients and algae are considered ***mesotrophic***. ***Hypereutrophic*** lakes support nuisance algal blooms year round. Lakes having a color resembling weak tea are stained with humic acids and can also be classified as ***dystrophic***. In this report, dystrophic lakes fall under one of the other classifications (eutrophic, mesotrophic or oligotrophic).

The Maine Department of Environmental Protection determines the trophic state of a lake by using a combination of Secchi disk transparency, Chlorophyll a, Total Phosphorus concentrations and best professional judgement. When adequate data exists, Trophic State Indices (TSIs) calculated from each of the previously mentioned parameters will range from 1 to approximately 120. An overall TSI, calculated from the average of 2-3 parameter TSIs, provides the most reliable trophic estimate. Relatively few lakes, however, have enough data to allow this calculation.

Table 3-4.2 illustrates how TSI values compare to trophic parameters in the determination of trophic state. No Maine lakes support nuisance algal blooms year round, thus hypereutrophic status is not included in this table.

Table 3-4.2. Numerical Criteria for Evaluation of Trophic Status in Maine

Parameter	Trophic Status: Oligotrophic	Mesotrophic[1]	Eutrophic
TSI[2]	0-25	25-60	>60 &/or repeated algal blooms
SDT[2]	> 8 M	4-8 M	< 4 M
CHL a	< 1.5 ppb	1.5 - 7 ppb	> 7 ppb
Total Phosphorus[2]	< 4.5 ppb	4.5 - 20 ppb	>20 ppb

[1] No repeated algal blooms (SDT minimum < 2.0 M.)
[2] If color is > 25 Standard Platinum Units (SPU) or not known, chlorophyll a concentration (CHL a) and best professional judgment must be used to assign trophic category.

This report requires a summary of trophic classification for Maine's significant lakes. This summary is compiled using the best information available. TSIs are considered the most accurate; in lieu of a TSI, actual parameter distributions are used. When little or no standard trophic data are available but information exists regarding a supported fishery, or, modeling based on morphometry has been done, a trophic assignment is made using best professional judgement of either DEP lake biologists or Maine Department of Inland Fisheries and Wildlife (DIFW) fisheries biologists. When a DEP determination is not available, the DIFW assignment is used with the recognition that their trophic assignment reflects productivity of the whole ecosystem rather than just the water. This occasionally results in a rating slightly more productive that what the chemistry might reveal. Regardless, all of these approaches are considered valid for the purposes of this report and further characterization of the DIFW approach is included toward the end of this section.

Table 3-4.3 summarizes overall trophic status of significant Maine lakes. No lakes have been assigned to the "dystrophic" category. Maine defines dystrophy as high color [>50 Standard Platinum Units (SPU)] due to humic acids often accompanied by depressed dissolved oxygen levels, a definition not truly exclusive of other trophic categories. Degree of dystrophy is considered when evaluating lake data however, trophic status assignment continues to be based on primary productivity evaluations (DEP) or whole ecosystem productivity (DIFW). For example, Threecornered Pond in Augusta is classified in this report as eutrophic but could also be classified as dystrophic.

Table 3-4.3. Trophic Status of Significant Publicly Owned Maine Lakes		
Status	Number of Lakes	Acreage of Lakes
Total	2,314	959,193
Assessed	1,723	925,721
Oligotrophic	136	120,231
Mesotrophic	993	643,915
Eutrophic	594	161,575
Hypereutrophic	0	0
Dystrophic	N/A	N/A
Unknown	591	33,472

Of significant lake acres, 80% have been assigned trophic status by DEP, 16.5 % have been assigned trophic status by DIFW and 3.5% remain unassigned. Table 3-4.4 displays the trophic rating assigned by DEP for 755 lakes by major river basin. The remaining 968 significant lakes, as evaluated by DIFW, are described in Table 3-4.5. Trophic status is not included for 2.8% of the total lake acreage because these lakes did not meet the "significant" criteria.

Table 3-4.4. Trophic Status of 755 Significant Maine Lakes by River Basin (DEP Evaluation)

	Acres		
Major River Basin	Oligotrophic	Mesotrophic	Eutrophic
Saint John	2,840	57,962	14,761
Penobscot	21,915	147,460	3,636
Kennebec	7,238	154,002	25,552
Androscoggin	4,742	72,333	2,743
Eastern Coastal	32,080	139,195	10,540
Western Coastal	32,170	36,635	1,753
All Basins	100,985	607,587	58,985
Number of Lakes	60	591	104
% Significant Lake Area (959,193 acres)	10.5	63.3%	6.1%
% Total Lake Area (987,283 acres)	10.2%	61.5%	6.0%

Table 3-4.5. Trophic Status of 968 Significant Maine Lakes (DIFW Evaluation)		
Class	Number of Lakes	Acres
Oligotrophic	76	19,246
Mesotrophic	402	36,328
Eutrophic	490	102,590
Total	968	158,164

Control Methods
Contact: Roy Bouchard, DEP BLWQ, (207) 287-3901

Existing State programs for controlling pollution of lakes generally fall into three categories: Regulation, Planning, and Technical Assistance and Guidelines. The DEP has abated many of the major sources of pollution to numerous Maine lakes through statutes, regulations, permit review, and lake restoration projects. The major threat to maintaining the present lake water quality is changing land use. The greatest change has been the transition from predominantly forested land to numerous small residential developments, with significant cumulative impacts on water quality. A heightened public awareness of the vulnerability of lake water quality has resulted in recognition of nonpoint sources of pollution (NPS - primarily nutrients and sediments) as a priority for action.

Control methods include installation and maintenance of agricultural conservation practices, erosion control on private and commercial properties, and reduction of shoreland zone groundwater pollution. Awareness of the need for effective silvicultural management is also increasing in Maine, not only as it affects water quality of Maine lakes and streams, but also for habitat diversity and maintenance of long-term productivity. State agencies have begun to place more emphasis on training and education. Agriculture continues to be a major source of enrichment to some lakes. Despite a general decline in the agricultural sector of the Maine economy, it can still be the catalyst for new lake water quality problems.

Before the EPA Clean Lakes (314) Program was zero funded, it was significant in furthering the Maine goal of eliminating culturally induced algal blooms from Maine lakes. The Federal CWA, Section 319 Nonpoint Source Control Program enhanced the effectiveness of the Section 314 Clean Lakes Program and other lake protection activities. The current emphasis on water quality protection, including the implementation of Best Management Practices (BMPs) to reduce nutrient loading, complements Maine's phosphorus control efforts. Section 319 watershed projects have been completed on Sebago Lake, Unity Pond (Twenty-five Mile Stream), Taylor Pond and Boyden Lake. Watershed projects are currently underway on Damariscotta Lake, China Lake, Range Pond, Thompson Lake, Cobbossee Lake, Webber Pond and Threemile Pond. The following lakes have 319 funded demonstration projects: Ellis (Roxbury) Pond, Wilson Pond (Wilton), Pleasant Lake (Island Falls), Mattawamkeag Lake, China Lake, Crystal Pond (Turner), Daigle Pond and Worthly Pond (Peru).

I. Regulation

A. Water Classification

Contact: Dave Courtemanch, DEP BLWQ, Division of Environmental Assessment
(207) 287-3901

The Maine statutory classification of lakes and ponds, Class GPA, includes a stable or decreasing trophic state, freedom from culturally induced algal blooms which impair use and enjoyment, and no impairment of aquatic habitat (38 M.R.S.A., Article 4-A). The statute also prohibits new point source discharges of pollutants to lakes or tributaries of lakes. Existing licensed sources are allowed to remain only as long as no practical alternative exists. At this time, there are three municipal discharges to lakes (Sanford, Oakland and Corinna). Rangeley's discharge to Haley Pond was removed in 1997. Sanford and Oakland receive tertiary treatment. With the closure of the Eastland Woolen Mill, the Corinna discharge has been reduced to an average flow of only 0.22 mgd. A number of CSOs are also present. The DEP plans to remove the discharge and the CSOs within 5 years.

B. Subsurface Wastewater Disposal

Contact: Department of Human Services, Division of Health Engineering
(207) 287-5338

During the last twenty years, substantial numbers of domestic wastewater discharges to lakes have been removed through application of the Maine Subsurface Wastewater Disposal Rules and the statutory prohibition against discharges.

C. Natural Resources Protection Act

Contact: DEP BLWQ, Division of Land Resources Regulation, (207) 287-3901.

In 1988, the Maine Legislature consolidated a number of resource protection statutes and regulations under the Natural Resources Protection Act (NRPA). The act requires that alterations to shorelines of lakes, streams and wetlands must not have adverse impacts on water quality or aquatic habitat. Wetlands hydraulically connected to lakes are considered by DEP to be part of the lakes in terms of protection of habitat and water quality.

D. Site Location of Development Law

Contact: DEP BLWQ, Division of Land Resources Regulation, (207) 287-3901.

Development of residential and commercial projects and other activities (above certain thresholds) are regulated not only by local governments, but also by the DEP. One of the objectives of review is to require stormwater management and erosion control so as to minimize new sources of sediment and phosphorus to lakes, especially to impaired lakes. Consideration is also given to the potential cumulative impact of proposed developments in the watershed.

E. Shoreland Zoning

Contact: Municipal Codes Enforcement Officer, or DEP BLWQ, Division of Land Resource Regulation, (207) 287-3901.

Maine requires local adoption and enforcement of shoreland zoning ordinance. The shoreland zone includes areas within 250 feet of great ponds; major river; freshwater and coastal wetlands; and tidal waters. The shoreland zone also includes areas within 75 feet of second order and larger streams. The shoreland zoning ordinances regulate significant land use activities such as soil disturbance and filling activities, structure setbacks and vegetative clearing within shoreland areas. Shoreland zoning does not regulate activities throughout the watershed, but is a significant piece of the State's water quality protection program.

A recent change to the Mandatory Shoreland Zoning Act provides an incentive for individuals to relocate nonconforming structures further from the water and plant vegetative buffers, in exchange for a somewhat larger structure than what would normally be permitted. The Department will monitor this provision closely during the next five years to determine its effectiveness.

F. Municipal Land Use Ordinances

Contact: Municipal Codes Enforcement Officer or local Planning Board.

Municipal land use ordinances vary widely across the State in terms of their detail and application concerning lake protection. Adoption of comprehensive plans under the Maine Growth Management Act allows municipalities to set water quality protection goals that form the basis for adoption of specific local programs and regulations. The most common features of these ordinances revolve around local planning board review of subdivisions and standards for road construction. A number of municipalities have also adopted general land use ordinances, which control (or at least set guidelines for) such activities as timber harvesting and general erosion control. An increasing number of ordinances incorporate references to specific lake watersheds with special standards for water quality protection. Municipalities are being encouraged to adopt areal phosphorus allocations for their lake watersheds according to Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development, Revised September 1992. This also forms the basis for state review of projects under the Site Location of Development and Stormwater Laws.

G. Regulation in Unorganized Areas

Contact: Land Use Regulation Commission, (207) 435-6437 (Ashland region),
(207) 695-2466 (Greenville region), (207) 827-6191 (Old Town region),
(207) 764-2053 (Presque Isle region), or (207) 864-5064 (Rangeley region).

In approximately 52% of Maine's land area (and thus for fully half its lakes) the Land Use Regulation Commission (LURC) is the planning and zoning agency regulating development. Permit application reviews specifically consider water quality impacts and are often done on a cooperative basis with DEP, particularly in lake watersheds.

H. Forestry Practices

Contact: Department of Conservation, Maine Forest Service, (207) 287-2791.

The Forestry Practices Act of 1989 and corresponding rules regulate the size of clear-cuts and regeneration standards for these cuts. Most timber is grown and harvested in unincorporated townships of the state under the jurisdiction of LURC. Standards for stream crossings, road and ditch construction and general erosion control are enforced by

LURC and are vital to reducing nutrient and sediment impacts on lakes and streams in the northern and eastern areas of the state. In June 1991, the Maine Forest Service, at the request and with the support of the Department of Environmental Protection, published BMPs for erosion and sediment control in logging operations as part of the State's Section 319 program. These guidelines are adapted from LURC standards and the DEP encourages their use throughout the state in workshops, demonstrations and training sessions. Maine does not require training of timber harvesters in resource protection, but the BMPs are being incorporated into a new certified loggers program sponsored by the timber harvesting industry.

I. Stormwater Management Law

Contact: DEP BLWQ, Division of Land Resources Regulation, (207) 287-3901.

The Stormwater Management Law (38MRSA Section 420D) required the department to identify 'Waterbodies Most at Risk' from Development. The list includes public water supplies; lakes that support sustained and repeated algal blooms; lakes with a documented trend of increasing trophic state; and lakes projected to have increased trophic states within the next 25 years. Under the Stormwater Management Law, development within the watersheds of these lakes that includes 20,000 sq. ft or more of new impervious area or five acres or more of disturbed area, must get a permit from the Department and must meet both quantity and quality stormwater standards. The quality standards adopted by the Board of Environmental Protection require regulated development in these watersheds to either (1) meet the lake watershed's phosphorus allocation (Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development, Revised September 1992), (2) provide 80% TSS removal or (3) provide 50% phosphorus removal and pay a compensation fee for the remaining excess phosphorus discharge.

II. Planning

The management of Maine lakes revolves around maintenance and improvement of water quality. The section on Control Methods describes many of the regulatory tools used to achieve these goals, but DEP is also pursuing several avenues that hold the most promise for long-term benefits.

A. Great Pond Task Force

Contact: Roy Bouchard, DEP BLWQ, Division of Environmental Assessment.
(207) 287-7798.

The Commission on Maine Lakes was directed by the Maine Legislature to assess the threats to lake water quality and make recommendations to combat these. As a result of the Commission's report, legislation created a Great Pond Task Force. This task force has developed new management strategies including guidelines governing surface uses of lakes, and will improve lake protection. Legislation passed in 1998 established the Lake Assessment and Protection Program. This program is intended to strengthen DEP programs in Shoreland Zoning, Natural Resources Protection Act compliance, lake assessment, research, and education. In addition, it has substantial resources devoted to providing support for volunteer lake monitoring.

B. State and Local Coordination

Contact: Roy Bouchard, DEP BLWQ, Division of Environmental Assessment. (207) 287-7798.

Regulations are applied at two levels: State and local (municipal). Because of the geographical extent of the state and the varied nature of threats to water quality, limited state staff must concentrate on high priority problems, compliance inspections and enforcement. In the case of lakes, ensuring compliance with current state regulations to control nonpoint source pollution often receives lower priority than major point source discharges to rivers and marine waters. However, watersheds of lakes that have restoration projects, a history of water quality problems or are considered 'Lakes at Risk' under the Stormwater Management Law (see Section I under Regulation, above) receive substantial attention from DEP staff.

Because the majority of land use decisions affecting lake water quality are regulated locally, the DEP relies on the application of municipal ordinances to be the first line of defense. DEP provides guidance to towns and landowners for individual land use decisions. DEP experiences have shown that the effectiveness of ordinances and regulations rely on two things: the availability of technical information to town officials, developers, and individual landowners, and the education of the public in general. Because of these observations, we have emphasized planning for watershed management (particularly phosphorus control) over the long term - usually a ten to fifty year period and technical assistance for municipal projects.

In addition to the above, the Land Use Regulatory Commission currently operates under a comprehensive plan which places lakes in its jurisdiction into one of five categories. These categories define the goals for managing development, and set standards for density and compatible uses which reflect sensitivity to water quality changes.

C. Comprehensive Planning Legislation

Contact: DEP BLWQ, Division of Watershed Management, (207) 287-3901.

In 1991, the Maine Legislature repealed the comprehensive planning mandate and related funding. This mandate has been replaced with a voluntary comprehensive planning bill. Towns that receive funds under the voluntary program are required to protect water quality in great pond watersheds from long-term and cumulative increases in phosphorus related to development. These towns must also develop management goals for great ponds with regard to shoreline character, surface water use, public access and protection of resources of State significance. The DEP technical assistance unit is available to towns interested in the comprehensive planning process. The DEP provides planning manuals, watershed maps, and the water quality data needed for towns to pursue the planning process for their lakes. The staff stresses inter-community communications in this process, especially where towns share lake watersheds.

D. Lake Watershed Management in Unorganized Territories

Contact: Land Use Regulation Commission, Planning Division, (207) 287-2631.

In 1990, LURC implemented a new lake management program by adopting an "Amendment to the Comprehensive Land Use Plan Regarding the Development and Conservation of Lakes in Maine's Unorganized Areas" and associated rule changes. This program includes more explicit consideration of lake water quality protection and focuses on limiting phosphorus loading to lakes from future development. The lake management program also enables development of "Lake Concept Plans". These plans provide a cooperative and integrated view of landowners' future development plans. The overall goal of concept plans is to encourage long-range planning, based on resource characteristics and suitability, thereby providing an opportunity to manage the cumulative impacts of development, including water quality, while also enabling expedited permitting of approved components of the Plan. Several lake concept plans are currently being developed with different landowners.

III. Technical Assistance and Guidelines

Almost every State agency with natural resources program responsibility has one or more technical assistance functions that directly or indirectly protect lake water quality.

A. Best Management Practices

Contact: DEP BLWQ, Division of Watershed Management, (207) 287-3901.

In addition to standards for development review, Maine has developed a variety of BMPs under the Nonpoint Source Management Program that will be of substantial benefit to lake water quality. Completed BMPs include:

1) Erosion and Sediment Control Handbook for Maine Timber Harvesting Operations
2) Best Management Practices, Strategy for Managing Nonpoint Source Pollution from Agricultural Sources and Best Management System Guidelines
3) Best Management Practices for Maine Agricultural Producers, Protecting Groundwater from Nutrients and Pesticides
4) Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices
5) Stormwater Quality BMPs
6) Erosion and Sediment -Transportation
7) Marina BMPs (marinas/boating).

Many of these BMPs may eventually be incorporated into regulations and ordinances. In addition to the BMP manuals developed, DEP now has a Nonpoint Source Training and Resource Center that provides training and resources to Maine's development and natural resource-based industries, governmental agencies and the general public. Initially the center will work with groups who have a high potential for contributing to non-point source pollution.

B. Androscoggin River Pollution Prevention Project
Contact: Bob Collins, (207) 582-7602.

The Androscoggin River Watershed Pollution Prevention project was originally an outgrowth of a partnership between International Paper Co. and DEP beginning in 1991 to focus on pollution prevention in the watershed. In 1993, with the assistance of an overall coordinator, local Pollution Prevention teams (P2) were formed with each of 10 cities and towns and DEP facilitators to identify and prioritize water quality issues and develop and implement projects to correct the problems. Numerous projects have been accomplished. Currently, following the loss of the overall coordinator, the Project has evolved into a number of independent elements loosely integrated through the Watershed Steering Committee and includes 6 municipal teams, a lake association, an community environmental education partnership, and 3 pulp and paper mill teams. There is an annual Androscoggin River Watershed Conference that has become the focal point for sharing information and planning activities for all the groups working on restoration of the watershed. As an outcome of the 1997 conference, many of these groups have met with others, including environmental groups, twice to see about forming an Androscoggin River Watershed Council, which would provide a more structured forum to coordinate work within the watershed.

C. Education and Outreach
Contact: Barbara Welch, DEP Bureau of Land and Water Quality, (207) 287-7682.
[Subsequent reporting cycles: Christine Smith, DEP BLWQ, (207) 287-3901].

The future of lake water quality in Maine depends in great measure on how well DEP promotes evolving guidance for protection. Recognizing that public outreach and education are the cornerstones of water quality protection, an educational campaign begun in 1989 emphasizes lake related issues. Completed brochures include: Protecting Maine Lakes, An Overview; Controlling Lake Phosphorus from Existing Sources; Protecting Maine Lakes from Phosphorus Pollution; A new planning guide for Cities and Towns, Comprehensive Planning for Lake Protection, Town Ordinances for Protecting Maine Lakes, and Acid Rain and Maine Lakes. Three recent additions are Septic Systems; How They Work and How to Keep Them Working, Maine Lakes Protection; Using the Phosphorus Control Method to improve a Subdivision, and Maine's Lakes Plants. This ambitious brochure production program has already reached thousands of people.

Each year State Planning Office (SPO) and Cooperative Extension Service (CES) hosts a Water Quality Monitoring Fair. The Fair offers classes on QA/QC, how to set up watershed surveys, options for invertebrate surveys, and much more.

Cooperative projects with Maine Soil and Water Conservation Districts (SWCDs) for education and landowner contacts in lake watersheds are increasingly important. One such project with the Cumberland County SWCD produced a very popular and useful series of Fact sheets on erosion and sedimentation control and BMPs. Included in the series are the following:

1) Water Quality: How it works,
2) Erosion on Shorefront Property,
3) Erosion Control for Homeowners,
4) Vegetative Streambank Stabilization,
5) Vegetated Phosphorus Buffer Strips,
6) Trees, Shrubs, Vines and Groundcovers,
7) Fertilizer Basics,
8) Riprap for Shoreline Protection,
9) Riprap for Streambank Protection,
10) Temporary Check Dams,
11) Silt Fencing and Hay Bale Barriers, and
12) Vegetative Stabilization for Sand Dunes and Tidal Areas, and
15) Stormy Day Survey.

Other SWCDs have also produced special purpose pamphlets aimed at water quality protection.

SPO is also involved in the cooperative education and outreach projects by furthering homeowner's awareness and action to reduce NPS. The first campaign focused on Eight Simple Steps to Clean Water. The 1998 campaign focuses on importance of buffers.

Water quality videos and curriculum materials are also distributed to schools across the State. DEP has formed a coalition with 27 other non-profit organizations, state agencies, university faculty and businesses to promote environmental education in Maine, and to develop better delivery systems to teachers and schools. In addition to educational work, a technical assistance unit has been formed to work with municipalities and developers to ensure future developments are designed to limit negative effects on lake water quality. Staff from all L&W divisions make presentations throughout the year to CEO's, planning boards, developers, and consultants on land use and water quality issues.

Water Festivals are another avenue DEP uses to reach students and teachers. At least once a year, nearly one thousand grammar school children and their teachers attend day long events centered around water: its value and function and how to protect it. The festivals are staffed and funded by up to 25 different groups-government business and non-profits. DEP also participates in regional and state Envirothons for High School students.

The NPS Training Center has established:

Video lending library
Publications library
Training Sessions

12 types of training curriculums
1,937 participants

Voluntary Contractor Certificate Program

Seven new publications

Training Center Informational Pamphlet
Maine Nonpoint Source Training Newsletter (4 issues)
A Developer's Guide to Stormwater Law
Information Sheet on the Stormwater Law
Information Sheet on the Voluntary Contractor Certification Program
Information Sheet on the Erosion and Sedimentation Control Law
Pamphlet for Lawn and Garden Centers on the Erosion Control Law

D. Phosphorus Control

Contact: Jeff Dennis, DEP BLWQ, Division of Watershed Management, (207)287-7847

Methods to control phosphorus export from development, such as installation of phosphorus control wet-ponds, infiltration systems and vegetated buffer strips, are gaining acceptance. Maine has developed a method for addressing phosphorus-loading impacts to lakes (Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development, Revised September 1992). This method is utilized for reviewing development projects under the Site Location of Development Law, and is also being used by a number of towns. The technology has been developed by the DEP into a workable system for adoption by municipalities and developers in all lake watersheds. A unique feature is the ability of this system to target the necessary level of nutrient control in individual developments by incorporating long-term water quality protection goals for each waterbody. The methods manual and technical training program are available on a statewide basis through the DEP, cooperating Regional Planning Agencies and SWCDs.

A pilot project was carried out in the Town of Dedham using the phosphorus method from the planning stage to tracking implementation of phosphorus controls. The project is detailed in a report entitled "Lake Watershed Evaluation and Tracking system, Dedham, Maine" (May 1992). The report includes recommendations on projecting and planning for growth, tracking and analyzing patterns of development, incorporation of the phosphorus method into ordinances, and long-term maintenance of phosphorus controls.

Effective control of pollutant sources in lake watersheds requires the exercise of local governmental authority. Small developments and cumulative land use changes, do not fall under State jurisdiction, yet comprise the majority of new nonpoint impacts on lakes. DEP has developed a comprehensive lake vulnerability database and corresponding watershed maps to assist municipalities, developers, and other agencies in the implementation of the phosphorus control methodology. A packet of information is available for most of the lakes in the state, and is provided to towns along with technical assistance on request. In addition to the above mentioned phosphorus control design standards, a comprehensive planning manual for lake watersheds and model ordinances have been designed to aid in local phosphorus control efforts and to complement the Maine municipal comprehensive planning process.

E. Stream Assessment Methodology

Contact: Jeff Dennis, DEP BLWQ, Division of Watershed management, (207) 287-7847

The DEP recently completed a proposal for the development of a new assessment method for small streams and embayments to estimate potential risks from nonpoint source pollution. The method will be used as a screening tool to focus limited resources on those watersheds that are most at risk. The nonpoint source pollution potential index will make use of existing Geographic Information System (GIS) data layers supplemented by field data and an estimate of resource value. The first pilot project using the index is proposed in the Casco Bay Watershed.

F. Erosion Control for Road Construction and Maintenance

Contact: Maine Department of Transportation (MDOT), Office of Environmental Services, (207) 287-5735

The Maine Department of Transportation (MDOT), Office of Environmental Services now emphasizes project planning for erosion control in sensitive lake watersheds. The Rural Roads Center offers training and information to municipal officials, not only in the traditional areas of road construction and maintenance, but also in planning for erosion control and resource protection. Current work by the MDOT on alternative seed mixes, application techniques and application timing is an example of changes in customary procedures needed to safeguard water quality in sensitive watersheds. The MDOT funded a study during the last reporting cycle, to determine the phosphorus export coefficient for runoff from rural Maine highways, and to compare run-off from paved/medium use roads and gravel/low use roads. The study was conducted by the United States Geological Survey in conjunction with DEP and the final report is in preparation.

G. Agricultural Management

Contacts: U.S Department of Agriculture Natural Resources Conservation Service, Maine Department of Agriculture, County Soil and Water Conservation Districts

The Agricultural Stabilization and Conservation Service (ASCS) of the United States Department of Agriculture (USDA) manages Federal financial assistance to private landowners through the Agricultural Conservation Program. Funds are available for erosion and sediment control practices, and nutrient and agricultural waste management systems related to NPS threats to surface and groundwater, water management and water conservation. Technical assistance is supplied by USDA Natural Resources Conservation Service (NRCS) personnel in cooperation with each local Soil and Water Conservation District.

The 1985 Farm Bill contained provisions known as the Food Security Act. The bill required landowners receiving USDA money to develop a conservation plan for erosion control on highly erodible land by 1992, and to implement that plan by January 1, 1995. Noncompliance with this bill meant a loss of all USDA funds. In 1990, the Farm Bill was amended by the Food, Agriculture, Conservation and Trade Act to update various requirements, especially those related to wetlands. In Maine, management practices to control soil erosion and manure, nutrient and pesticide runoff are included in every conservation plan. Planning is emphasized in heavily farmed lake watersheds.

Examples of agricultural controls in lake watersheds include advanced management systems for collecting, storing and spreading manure. The management and spreading of nutrients is done according to a specific management plan in such a way and at times that the crop can make maximum use of the nutrients applied. Manure, soil and crop tissue tests are used to monitor the status of the soil, and to update the management plan if necessary. These integrated crop management practices are being demonstrated in many counties. Additional practices, such as pasture management and livestock exclusion from streams, have been added to the host of established erosion control methods. Economical alternative livestock watering sources need to accompany pasture management proposals to be viable to farmers.

Through the Conservation Reserve Program, a substantial acreage of highly erodible land has been removed from potato production for ten-year periods. Most of these ten-year contracts were signed between 1986 and 1990. In addition, crop rotations with oats and other grains, along with runoff management practices such as nutrient control basins, have resulted in significant decreases in the discharge of silt, nutrients and pesticides.

It is a continuing challenge to find innovative and economical ways to control nonpoint source pollution in the farm community, and to increase the number of farmers cooperating with their local SWCDs. Effective new or revised practices need to be constantly demonstrated on real farms under today's conditions to overcome the deep reluctance of farmers to abandon practices passed down through generations. This is the objective of CWA Section 319 demonstration grants.

H. Watershed Protection Grants

Contact: DEP BLWQ, Division of Watershed Management, (207) 287-3901.

Additional projects bearing on lake water quality are funded under Section 604(b) of the CWA through the competitive grants program of DEP. Projects funded in 1993 included the Range Ponds Watershed NPS/BMP Project, Norway Lakes Special Assessment Protection District, Lake Christopher Watershed Survey, Long Pond NPS Assessment Network, Lincolnville Lakes Evaluation Project, and vegetated buffer strip educational material. Projects selected for 1994 include the Thompson Lake Watershed NPS Survey and Assessment, and the Volunteer Lake Monitoring Program.

In 1995, projects included NPS surveys of Crystal and No Name Ponds, a Septic System Phosphorus Loading to Lakes Project, and the Volunteer Lake Monitoring Program. In 1996, projects will include NPS Surveys of Little Wilson, Pleasant, and Round Ponds, and Tripp Lake, and the Volunteer Lake Monitoring Program.

In 1998, projects include Canton Lake Watershed NPS Survey, Sebasticook Lake in Watershed NPS Survey, Sand Pond Watershed NPS Survey, Watchic Pond Watershed NPS Survey, Mousam Lake Watershed NPS Survey and Volunteer Lake Monitoring Program.

In addition to these projects, Section 604(b) funds a lakes Biologist at the DEP who provides technical assistance and information to the public and, develops and undertakes lakes projects for the Department.

I. Nonpoint Source Priority Watersheds Program

Contact Don Witherill, DEP BLWQ, Division of Watershed Management, (207-287-3901)

In 1997, the Maine Legislature enacted a law that authorizes the development of "a comprehensive watershed protection program" (5 MRSA §3331(7)). The program's purpose is to prevent or reduce nonpoint source (NPS) pollutant loadings entering water resources so that beneficial uses of the lakes, rivers, streams, estuaries and groundwater are maintained or restored. The law directs the Maine Land and Water Resources Council (MLWRC), consisting of the commissioners from the State's natural resource agencies, to coordinate the activities of agencies involved in watershed management. The Maine Watershed Management Committee, with representatives from state and federal agencies and private interest groups with a statewide interest in watershed management, serves as staff support to the Council.

Through the Maine NPS Priority Watersheds Program, State and Federal agencies work with local groups to promote local support for improving water quality. This often includes a watershed survey or assessment of the NPS impacts from surrounding land uses. The survey may be followed up with the development of a watershed management plan that presents actions necessary to achieve an improvement in water quality. The watershed management plan and/or the survey results are then used to prioritize and implement best management practices (BMPs) to reduce or eliminate NPS pollution in the water resource, educate local landowners and promote planning for water quality at the local level.

Restoration, Rehabilitation and Protection Efforts

Contact: Roy Bouchard, DEP BLWQ, Division of Environmental Assessment, (207) 287-7798

The DEP selects restoration and protection projects based on the severity of problems, feasibility (technical and financial) of alternatives and on local support. This last element has been increasingly important as projects become more complex, require more volunteer effort, focus on nonpoint source control, and involve the development of municipal policies. Each of the projects has an active lake association working on education and fund raising. Recent projects have included nonpoint source surveys carried out by volunteers under the direction of the DEP. Agricultural NPS control has been the focus of the NRCS and SWCDs in several restorations. Increasingly, District staff expertise has been utilized for non-agricultural technical assistance, as in the case of the current China Lake project, in close cooperation with the NPS Control Program. Projects also stress ongoing management of new development and NPS controls.

Table 3-4.6 summarizes rehabilitation techniques used in past and current restoration project lakes. It should be noted that both "Watershed Treatments" and "Other Lake Protection/Restoration Controls" include practices used to abate pollution in many lake watersheds before water quality declines to such a point where restoration is initiated. For example, a property owner may obtain a permit under the State's Natural Resources Protection Act - Permit by Rule program to apply riprap to 100 feet of shoreline.

Table 3-4.6. Lake Rehabilitation Techniques*.

Rehabilitation Technique	#Lakes	Acres
In-lake Treatments		
Phosphorus Precipitation/Inactivation (Alum treatment)	4	3,344
Dilution/Flushing	3	7,451
Watershed Treatments		
Sediment Traps/Detention Basins	2	8515
Shoreline Erosion Control/Bank Stabilization	4	6,868
Conservation Tillage Used	2	8515
Animal Waste Management Practices Installed	10	17,832
Road or Skid Trail Management	3	5,359
Land Surface Roughening for Erosion Control	1	3,845
Riprapping Installed	3	5,359
Unspecified Type of BMP	13	29,768
Other Lake Protection/Restoration Controls		
Local Lake Management Program in Place	9	22,793
Public Information/Education Program/Activities	7	12,982
Local Ordinances/Zoning/Regulation	7	13,478
Point Source Controls	4	10,845

*Techniques used in restoration project lakes listed in Table 3-4.7.

Table 3-4.7 lists completed restoration projects. (Note: Since there are no current Section 314 lake restoration projects, Table 3-4.8 has been eliminated from this report.) It should be noted that completion of restoration projects is only meant to imply that the tasks originally envisioned in the Maine workplan have been carried out. Our experiences, however, have illustrated that lake restoration is not a permanent, complete or irreversible process. In a number of instances (i.e., Annabessacook Lake, Lovejoy Pond, and Threemile Pond), refinements in assessment techniques or changes in watershed conditions may prompt re-examination of these projects for future additional work. Under "Type", Phase I projects are Diagnostic Feasibility Studies, Phase II projects are Restoration Implementation Projects and Phase III projects are Post Restoration Monitoring Projects.

Currently, Maine's primary management emphasis is placed on lake protection and technical assistance rather than restoration (see previous section, 'Control Methods'). Without support from either State funds or Section 314 of the CWA, no new restoration efforts have been undertaken during the 1996-97 period. Even if restoration funds were available, projects that benefit one or two lakes would divert resources from more vital work. The use of NPS funds for expensive in-lake projects is also difficult to justify given the statewide need for nonpoint source projects. Maine continues to promote and support watershed remediation and local planning/pollution prevention for lakes as a restoration tool.

Table 3-4.7. Completed Maine Lake Restoration Projects.

Lake *(Towns)*	Section 314 Project Type
Annabessacook L. *(Winthrop, Monmouth)*	Phases I and II
Chickawaukie L. *(Rockland & Rockport)*	Phases I and II
China L. *(China & Vassalboro)*	Phases I and II
Cobbossee L. *(Litchfield, Manchester, Monmouth, W. Gardiner & Winthrop)*	Phases I and II
Cochnewagon L. *(Monmouth)*	Phases I, II and III
Estes L. *(Alfred & Sanford)*	Other
Haley P. *(Dallas Plantation & Rangeley)*	Other
Long and Cross L *(St. Agatha, T16 R5, T17 R3,4 &5 WELS)*	Other
Lovejoy P. *(Albion)*	Phase I
Madawaska L. *(Westmanland & T16 R4 WELS)*	Phase I
Pleasant P. *(Litchfield, West Gardiner, Gardiner & Richmond)*	Phases I and II
Sabattus P. *(Greene, Sabattus & Wales)*	Phases I and II
Salmon L. *(Belgrade & Oakland)*	Phases I and II
Sebasticook L. *(Newport)*	Phases I and II
Threemile P. *(China, Vassalboro & Windsor)*	Phases I and II
Togus P. *(Augusta)*	Phase I
Webber P. *(Vassalboro)*	Phases I and II

Assessment of Attainment Status

Contact: Linda Bacon, DEP BLWQ, Division of Environmental Assessment, (207) 287-7749

Basis for Attainment Assessment. The need for lake water quality assessment stems from both the Federal Clean Water Act (CWA) and State of Maine Statutes (Class GPA). The original CWA interim goals of 'Fishable' and 'Swimmable' have been adapted to the following: 1) to 'Protect and Enhance Ecosystems', 2) to 'Protect and Enhance Public Health', and 3) to address 'Social and Economic' considerations. These goals provide a framework under which specific designated uses, defined at both the federal and state levels, are evaluated. Table 3-4.1a is repeated to illustrate the relationship between Federal Goals/Uses and State Uses.]

Table 3-4.1a(repeated): Federal and State Designated Uses

Federal Clean Water Act Goals	Designated Use	Federal	State
Protect and Enhance Ecosystems	Aquatic Life Support	Y	Y
	Trophic Stability	N	Y
Protect and Enhance Public Health	Fish Consumption	Y	Y
	Primary Contact (swimming)	Y	Y
	Secondary Contact	Y	Y
	Drinking Water	Y	Y
Social and Economic	Agriculture	Y	N
	Cultural/Ceremonial	Y	N
	Industrial Process & Cooling	N	Y
	Hydropower	N	Y
	Navigation	N	Y

Five of the designated uses are recognized at both federal and state levels. Two designated uses (Agriculture and Cultural/Ceremonial) have federal origins. Similarly, four additional uses are defined by the state (Trophic Stability, Industrial Process/Cooling, Hydropower, and Navigation). It should be noted that Trophic Stability is technically more of a condition than a use. The basis for it being assessed comes directly from the state lake classification standards, which indicates that lakes "*shall have a stable or decreasing trophic state*". Lakes failing to support this condition, are treated the same as lakes having designated use impairments. In addition, this condition aligns with the intent of the CWA goal to 'Protect and Enhance Ecosystems'.

Criteria for Attainment Assessment. It is the responsibility of the State of Maine DEP to define the criteria used to determine the degree to which a lake supports each designated use. The second page of this chapter provides an overview of the physical parameters, chemical parameters and other tools used to make these determinations. Best Professional Judgement is often used in addition to the numeric criteria when there is a paucity of data, when restoration actions have resulted in a reversal of water quality decline, or other knowledge exists to clarify conditions.

There have been a few major improvements in our assessment ability since the 1996 Water Quality Assessment Report. In particular, two new electronic datasets have allowed refinements in our assessment criteria. The first is the establishment of a technique that allows a lake watershed to be assigned to one of six disturbance or development categories. Approximately 675 direct lake watersheds have been evaluated using United States Geologic Survey (USGS) 7.5' topographic maps.

Category 1 generally consisted of:

A) No population concentrations (clusters of >20 buildings in 10 ha.) in the direct watershed
B) Overall estimated dwelling density < 2 per square kilometer.

C) Road access to less than 25% of the shoreline perimeter
D) Less than 50% of the watershed area within 1 mile of a public road
E) No identified farms in the watershed
F) Not an impoundment (e.g. no known water level manipulations >= 3 feet as for hydropower generation)

Lakes that did not meet these criteria were assigned a higher ranking qualitatively. For example, a ranking of 3 violated more than one of the low impact criteria and typically had 25-50% of shoreline developed with cottages. Lakes in category 3 also typically had several dense clusters of houses in the watershed but no "urban areas". Public roads run through most of these watersheds, but at densities such that several areas remain more than 0.5 mile from such roads. Similarly, a ranking of 5 was assigned to lakes with dense shoreline cottage development and most of its watershed area within 1/4 mile of public road (e.g., USGS "improved road"), or that have many dense clusters of houses (villages/urban areas). Assignment to category 6 is based on Best Professional Judgement and is reserved for those few lakes that have some anomalous condition that makes it difficult to apply the criteria.

It is acknowledged that despite a certain amount of subjectivity inherent in the technique, these rankings provide a valuable tool, which allows immediate, reasonably accurate insight regarding development in 675 lake watersheds. Since it is widely recognized that non-point source pollution increases in proportion to watershed development, these development categories allow us to better distinguish between lakes that are naturally productive and those that are likely to have a significant contribution of nutrients from human activity in the watershed. Specifically, these categories have resulted in a decrease in the number of lakes previously considered 'partially supporting' the designated use of Aquatic Life Support. Lakes with depressed dissolved oxygen in their deep waters that also have a low development ranking, are no longer considered as partially supporting because it is likely that the predominant cause(s) of depletion are natural rather than human induced.

The second improvement is the compilation of an electronic dataset that allows the calculation of volume weighted metrics. Most of the 1800 bathymetric maps for lakes had areas calculated for each meter of depth recorded on paper. These numbers have been put into electronic format and algorithms generated to calculate volume of water at or below a specified temperature or level of dissolved oxygen. Volume weighted averages for any profiled parameter, are now easily generated.

The major impact of this new information again involves lakes previously classified as 'partially attaining' the designated use of Aquatic Life Support. This depth/area data table has allowed the calculation of mean volume weighted oxygen in water equal to or less than 18 degrees Centigrade. In previous assessments, the volume of water having low dissolved oxygen was not considered but rather just the depth profile itself. Often the volume of water exhibiting low oxygen did not apply to a significant volume of the cooler bottom waters resulting in a conservative evaluation of dissolved oxygen. The new criteria consider requirements of the more sensitive Salmonid species (Landlocked Atlantic Salmon, Togue, Splake, Brook, Blueback and Sunnapee Trout) for oxygenated, cold water habitat from a volumetric perspective. These assessment improvements will allow additional refinements to be made to a number of additional criteria as time allows (e.g., refinement of Fully Supporting but Threatened designation under Aquatic Life Support and all Trophic Stability designations.)

The following few pages summarize the criteria used to determine attainment status for each designated use. Table 3-2.2 in the previous chapter, includes a use support summary for Maine lakes. Specific assessment criteria used to determine attainment status is listed by designated use in the following pages.

***Designated Use:* Aquatic Life Support** *CWA Goal: Protect and Enhance Ecosystems*

Fully Supporting: Lakes that exhibit no dissolved oxygen (D.O.) impairment, turbidity or extreme water level fluctuations that would reduce the viability of an indigenous fishery or other aquatic life.

Fully Supporting but Threatened: Lakes having a sensitive salmonid fishery (Landlocked Atlantic Salmon, Togue, Splake, Brook, Blueback and Sunnapee Trout) according to the Maine Department of Inland Fisheries and Wildlife, that have exhibited dissolved oxygen levels that would have been categorized as Partially Supporting under the 1996 Aquatic Life Support criteria but do not meet the new 1998 criteria are considered threatened. Also lakes that have had one algal bloom are considered as threatened. [Note: these are interim criteria. Refer to the text for additional information.]

Partially Supporting: Lakes supporting a sensitive salmonid fishery (Landlocked Atlantic Salmon, Togue, Splake, Brook, Blueback and Sunnapee Trout, according to the Maine Department of Inland Fisheries and Wildlife), that exhibit oxygen impairment in colder bottom waters and have a high level of disturbance or development in their watershed may be considered partially supporting aquatic life.

Volume-weighted concentrations of dissolved oxygen are calculated for the coldwater (=< 18 degrees C) portions of all dissolved oxygen profiles obtained during the index period of August 10 to September 10. These concentrations are then averaged resulting in a composite number for each lake. Lakes having a composite oxygen concentration =< 4 ppm that also support a coldwater fishery and a watershed disturbance/development rating of 4 or above, are potential candidates. Best professional judgement is used to screen out any lakes with a) relatively few profiles contributing to the overall mean, b) a small volume of cold water relative to the whole lake volume, c) unusual inconsistencies among profiles, and/or d) little recent data.

[Note: the assessment of oxygen impairment has changed since the 1996 reporting cycle in attempt to screen out lakes that naturally develop anoxic profiles, such as highly colored lakes, kettle hole ponds or moderately productive lakes with a small metalimnion/hypolimnion volume and little watershed disturbance, and to target lakes that support sensitive coldwater species.]

Also considered partially supporting are lakes having severe turbidity (e.g., Graham Lake -source unknown) and lakes that experience extreme water level fluctuations.

Not Supporting: Lakes that have experienced complete loss of all indigenous species due to severe D.O. depletion, severe turbidity, or extreme water level fluctuations due to cultural factors (e.g., dam controlled water level management).

Not Attainable: Lakes that have experienced complete loss of all indigenous species due to severe D.O. depletion, severe turbidity, or extreme water level fluctuations where remediation is not practicable.

***Designated Use:* Trophic Stability** *CWA Goal: Protect and Enhance Ecosystems*

Fully Supporting: Lakes exhibiting stable or decreasing trends in trophic state.

Fully Supporting but Threatened: Lakes whose trophic stability is indicated by vulnerability modeling to be at risk due to anthropogenic activities, lakes that have had one algal bloom, and lakes that exhibit dissolved oxygen levels that meet the 1996 or 1998 low dissolved oxygen criteria.

Partially Supporting: Lakes exhibiting a deteriorating trend in trophic state as indicated by a statistically valid deteriorating trend or best professional judgement.

Not Supporting: N/A

Not Attainable: N/A

***Designated Use:* Fish Consumption** *CWA Goal: Protect and Enhance Public Health*

Fully Supporting: No fish consumption advisories in effect.

Fully Supporting but Threatened: Statistical modeling predicts that a particular type of lake or geographical area is more likely than other types of lakes or lakes in other areas, to have a fish consumption advisory in the future.

Partially Supporting: "Restricted Consumption" fish advisory or ban in effect during the reporting period for the general population or a subpopulation that could be at potentially greater risk (e.g., pregnant women, children). Restricted consumption is defined as limits on the number of fish of one or more species consumed per unit time. The limit on number consumed often varies with fish size.

Not Supporting: "No Consumption" advisory or ban in effect for the general population for one or more fish species.

Not Attainable: "No Consumption" advisory or ban in effect for the entire human population and all fish species; no practical remediation for the source of contamination in the foreseeable future.

***Designated Use:* Primary Contact (swimming)** *CWA Goal: Protect and Enhance Public Health*

Fully Supporting: Lakes that do not exhibit repeated (at least two seasons) intense algal blooms.

Fully Supporting but Threatened: Lakes indicated by vulnerability modeling to be at risk for algal blooms due to anthropogenic activity; lakes that have experienced one recorded algal bloom; lakes exhibiting dissolved oxygen levels that meet the 1996 or 1998 low dissolved oxygen criteria; lakes for which BPJ suggests a deteriorating trend; lakes that have a statistically valid deteriorating trend.

Partially Supporting: Lakes in which swimming is impaired during part of the recreational season due to culturally induced algal blooms. Bloom conditions are defined as Secchi Disk Transparency measurements of less than 2 meters in lakes having color less than 30 Standard Platinum Units (SPU). Lakes having color of 30 SPUs or greater are considered impaired if other trophic data or professional judgment indicates that transparency is restricted due to high algal productivity and that the elevated productivity is due to anthropogenic alterations.

Not Supporting: Lakes in which the use of swimming is totally lost due to culturally induced algal blooms.

Not Attainable: Lakes having algal blooms that are so severe that remediation is not practicable.

***Designated Use:* Secondary Contact** *CWA Goal: Protect and Enhance Public Health*

Secondary Contact is considered to be fully supported as a designated use in all Maine lakes. There has not been any evidence to the contrary, therefore no specific attainment criterion for assessment exists.

***Designated Use:* Drinking Water** *CWA Goal: Protect and Enhance Public Health*

Maine lakes fully support the designated use of drinking water supply. No drinking water supply closures or advisories have been in effect during the reporting period and no treatment beyond "reasonable levels" has been necessary.

***Designated Use:* Agriculture** *CWA Goal: Social and Economic*

The suitability of lake water for the designated use of agriculture is considered to be fully supported in all Maine lakes. Because there has not been any reason to assume otherwise, no specific attainment criterion for assessment of these uses exists.

***Designated Use:* Cultural/Ceremonial** *CWA Goal: Social and Economic*

The suitability of lake water for designated 'cultural and ceremonial' uses is considered to be fully supported in all Maine lakes. Because there has not been any reason to assume otherwise, no specific attainment criterion for assessment of these uses exists.

***Designated Use:* Industrial Process & Cooling** *CWA Goal: Social and Economic*

The suitability of lake water for the designated use of industrial process and cooling water is considered to be fully supported in all Maine lakes. Because there has not been any reason to assume otherwise, no specific attainment criterion for assessment of these uses exists.

***Designated Use:* Hydropower** *CWA Goal: Social and Economic*

The suitability of lake water for the designated use of hydroelectric power generation (quality not quantity) is considered to be fully supported in all Maine lakes. Because there has not been any reason to assume otherwise, no specific attainment criterion for assessment of these uses exists.

***Designated Use:* Navigation** *CWA Goal: Social and Economic*

The suitability of lake water for the designated use of navigation is considered to be fully supported in all Maine lakes. Because there has not been any reason to assume otherwise, no specific attainment criterion for assessment of these uses exists.

Partially Supporting Lakes

Contact: Linda Bacon, DEP BLWQ, Division of Environmental Assessment, (207) 287-7749.

The criteria used to evaluate designated use attainment status are addressed in the previous section. All Maine lakes are considered as Partially Supporting the designated use of fish consumption due to mercury contamination. The overall percentage of lake acres Partially Supporting other designated uses has decreased from 25% (in 1996) to 16%. The overall number of lakes has decreased from 243 in 1996 to 90 in 1998. These lakes partially support one or more of three designated uses: Aquatic Life Support, Primary Contact (swimming), and/or Trophic Stability. The overall decrease in Partially Supporting lakes results from a reduction in the number of lakes considered as such for the designated use of Aquatic Life Support (189 lakes in 1996 versus 32 lakes in 1998). Partial Support of a designated use is often referred to as impairment of that use.

Partial Support of Fish Consumption. All Maine lakes are considered as Partially Supporting fish consumption due to mercury contamination. On May 18, 1994, the Maine Department of Human Service's Bureau of Health issued an advisory warning for pregnant women, nursing mothers, women who may become pregnant, and children under 8 years of age not to consume fish from lakes and ponds in the state. Other people were advised to limit consumption of fish from these waters to 6-22 meals per year, depending on fish size. This advisory was issued following the assessment of fish from 125 lakes in 1993 and 1994 under the EPA funded Regional Environmental Monitoring and Assessment Program (REMAP).

Further investigation has allowed this advisory to be modified. In 1997, advisories categorized fish into warm water species (bass, pickerel, perch, sunfish, crappie) and cold water species (trout, salmon, smelt, cusk). Pregnant women, nursing mothers, women who may become pregnant, and children under 8 years of age are warned not to eat warm water species and to restrict consumption of cold water species to 1 meal per month. Other individuals have no consumption limit on cold water fish but are advised to limit consumption of warm water fish to 2-3 meals per month, depending on fish size. Additional information may be found in the subsequent section, Toxics.

Partial Support of Aquatic Life. As outlined in the previous section, lakes are considered in 'Partial Support' of Aquatic Life if they support a coldwater fishery and develop low hypolimnetic dissolved oxygen likely due to anthropogenic influences, or, if water level drawdowns impact habitat. The metric used to assess dissolved oxygen has been refined to allow volume-weighted calculations of hypolimnetic dissolved oxygen and the screening of lakes for watershed disturbance. Volume-weighted concentrations of dissolved oxygen are calculated for the coldwater (=< 18 degrees C) portions of each profile obtained during the index period of August 10 to September 10. These concentrations are then averaged resulting in a composite number used for assessment purposes. When this composite concentration is =< 4 ppm, the lake supports a coldwater fishery (according to DIFW) and levels of development in the watershed are high, then best professional judgement is used to screen out any lakes with a) relatively few profiles contributing to the overall mean, b) lakes with a small volume of cold water relative to the whole lake volume, c) lakes with unusual inconsistencies among profiles, and/or d) lakes with little recent data.

Prior to this assessment cycle, dissolved oxygen profiles were evaluated with no direct regard to water volume, levels of watershed disturbance or fish species. This conservative approach allowed a first cut evaluation of oxygen. It included a very large number of lakes having naturally low dissolved oxygen as well as lakes having a small hypolimnetic volume. The refinement decreased the number of lakes having dissolved oxygen depletion from 187 to 22 lakes. It also allows a high degree of confidence that the assessment has identified lakes with impacts that are in part from anthropomorphic sources that would impact a sensitive cold water fishery.

Eight lakes have been added as partially supporting Aquatic Life because of habitat alterations due to water level drawdowns bringing the total number of such lakes to ten. It should be noted that the acreage of these 10 lakes is almost 2.5 times the acreage of the 22 lakes identified as having a dissolved oxygen issue.

Partial Support of Primary Contact. The designated use of Primary Contact is evaluated in terms of suitability for swimming. Maine is fortunate to have many clear lakes. The average transparency for Maine lakes is more than 15 feet. A few lakes develop planktonic algal populations that can decrease transparencies to below 6.6 feet. When algal populations reduce the transparency to below 6.6 feet, the lake is considered to be supporting an 'algal bloom'. Lakes experiencing this condition are less desirable for swimming as compared to others. An odor often accompanies this condition and tiny, visible strands of algae often remain on swimmers making primary contact aesthetically unappealing. Because of this, algal blooms often negatively effect local business and local property values. [Note: Technically, Algal blooms violate the CWA Social/Economic goals but because there is no suitable designated use under which to assess bloom status under that goal, bloom assessment remains under Primary Contact.]

Currently 53 lakes are considered to be partially supporting 'Primary Contact'. This number has remained fairly stable over the past decade. In 1996, 51 lakes fell into this category. The current number reflects the removal of one lake and the addition of three others to the list. Two of these lakes are also in Partial Support of Aquatic Life Support.

Partial Support of Trophic Stability. Nineteen lakes are considered as partially supporting the designated use of 'Trophic Stability'. Only three lakes were in partial support of this use in 1996. This increase is a result of an improvement in trend detection ability with the use of statistical analysis. It is likely that a number of these lakes would have been assessed as such in 1996 had statistics been used over that cycle. The visual assessments and best professional judgement previously employed, was more conservative at judging trends in the transparency data. Five of these lakes are also partially supporting Primary Contact and 3 also partially support Aquatic Life. Two lakes, China Lake and Unity Pond, are in partial Support of all three designated uses (Aquatic Life Support, Primary Contact, and Trophic Stability).

Summaries for designated use support are included in Table 3-2.1 and Table 3-2.2 in Part III, Chapter Two: Assessment Methodology and Summary Data. Causes and Sources of non-attainment are listed in Tables 3-2.3 and 3-2.4 of the same section. Table 3-4.9 summarizes attainment status of significant lakes by major drainage basin. Lakes are considered Impaired if they are assessed as partially supporting for any designated use. Lakes with multiple impairments may be listed in more than one column.

Table 3-4.9. Attainment Status for Designated Uses (other than fish consumption)[5] in Significant Lakes by Major Drainage Basin: number (acreage).

Basin	Lakes Fully Supporting Designated Uses[3]	Lakes Partially Supporting Designated Uses[1] Primary Contact / Swimming[2]	Aquatic Life Support	Increasing Trophic Trend
St. John	237(77,987) [3 (164)]	12 (11,386)	4 (7,838)	2 (2,583)
Penobscot	720 (243,461) [7 (1,731)]	4 (1,144)	4 (16,868)	1 (280)
Kennebec	410 (151,456) [8 (1,152)]	23 (27,303)	7 (41,910)	8 (14,146)
Androscoggin	186 (65,675) [7 (1,257)]	4 (2,348)	4 (15,193)	2 (2,132)
E. Coastal	453 (204,625) [6 (2,264)]	6 (8,390)	3 (8,378)	3 (2,651)
W. Coastal	215 (62,303) [7 (992)]	4 (288)	10 (12,172)	3 (2,250)
All Basins	2,225 (805,568)[4] [40 (11,526)]	53 (50,859)	32 (102,359)	19(34,042)

[1] Lakes in this category are often referred to as being 'Impaired'. Lakes may be listed in one or more subcategories.
[2] Lakes that have experienced two or more seasons with algal blooms.
[3] Subset of lakes that have experienced only one season of algal bloom(s) is included in brackets.
[4] Four lakes totaling 61 acres not currently assigned to any drainage basin are included in the total.
[5] All Maine lakes are designated as partially supporting fish consumption due to a statewide fish consumption advisory that includes a ban for sub-populations.

Causes and Sources of Impairment. An analysis of the causes and sources of water quality impairment of these lakes is summarized in Part III, Chapter 2 of this report and by waterbody in Chapter 6, Table 5, of Appendix I. It should be noted that in most cases this is based on personal knowledge of staff and as such does not reflect detailed evaluations of each lake or waterbody. Furthermore, assignment of nonpoint source categories to "high" or "moderate" status can obscure the true level of impact of a particular source category. This is especially true for those lakes for which several sources, including natural ones, are unknown at this time. In several watersheds, notably those having diagnostic studies or restoration projects conducted, fairly detailed assessments have revealed the diverse nature of nonpoint source impacts and their changing nature through time. A number of non-attainment lakes are substantially affected by internal nutrient recycling which may be the result of historic, but not necessarily current, land use effects.

Of all significant lakes, four unnamed lakes (61 acres) are not currently assigned to any waterbody making it difficult to include them in automated major drainage basin summaries. The dataset lists a town for each of these but no UTM or Latitude/Longitude. Maine has a large number of unnamed lakes and as a result, there are a few lakes in the dataset that have missing information.

Of the 5,788 lakes in the state, 2314 are considered 'Significant' and have been assessed under this reporting cycle. Most of the remaining 3,474 lakes are small (less than 10 acres) and account for less than 3% of the lake surface area. Most of the lakes that have not been assessed are very likely to fully attain GPA standards and fully support their designated uses with the exception of fish consumption. This is due to low rates and densities of development in many of the watersheds, especially those of the more remote lakes. The extent to which water quality is altered by transient land use changes (e.g., clear-cut forestry practices) has not been assessed, particularly in remote areas. Most of the 5,788 lakes are believed to attain bacteriological standards for the protection of swimmers and biological standards for the protection of habitat.

Fully Supporting but Threatened Lakes
Contact: Linda Bacon, DEP BLWQ, Division of Environmental Assessment, (207) 287-7749

Lakes are considered as Fully Supporting their designated uses but Threatened when at least one of a number of conditions occur. The number of lakes considered 'Threatened' over this cycle has increased substantially since the 1996 reporting cycle. In 1996, 300 lakes were considered threatened as compared to 495 lakes in 1998. Again, this is a result of refinements made to one of the metrics used to assess attainment of Aquatic Life Support. The lakes considered to be in partial support of Aquatic Life in 1996 that met the Fully Supporting criteria in 1998, are considered as Threatened for the three designated uses of Aquatic Life Support, Swimming, and Trophic Stability. The 1996 dissolved oxygen criteria was originally designed to assess the potential for internal recycling of phosphorus from the sediments in addition to potential effects on the fishery. The Partial Support of Aquatic Life (fishery) metric was refined in time to be included in this assessment. However, the Internal Recycling component has yet to be developed. Thus, until criteria for the designation of Threatened status for each designated use is refined (Aquatic Life Support, Primary Contact and Trophic Stability), the 1996 dissolved oxygen is being used. This approach results in a large number of lakes considered as Threatened for all three of these uses.

Another thing to keep in mind when reviewing this report is that a particular lake is only considered once in the overall assessment. In other words, if a lake has been designated as Partially Supporting one designated use, it will not be considered in the discussion of Threatened lakes even if it is considered threatened for another use. For example, lakes considered as Partially Supporting Aquatic Life are most often considered Threatened for other uses, but are not directly discussed or tallied as such. Similarly, lakes in Partial Support of Trophic Stability would be considered threatened for Primary Contact. In the final tally, a lake is counted in the assessment category in which it receives the worst designation.

<u>Threatened for Aquatic Life Support</u>. One hundred seventy-six lakes are considered Threatened for Aquatic Life Support for at least one of two reasons. As mentioned in the preceding paragraph, if a lake had been considered as Partially Supporting Aquatic life in 1996 but was removed as a result of refinements to the assessment metric, it is considered Threatened because some dissolved oxygen loss is documented. Forty lakes were designated as Threatened because

one algal bloom has occurred. Six lakes satisfied both conditions for the Threatened designation. These criteria are expected to be refined to include volume and presence of a sensitive species for the next reporting cycle.

Threatened for Primary Contact. All 495 having an overall Threatened designation are considered Threatened for this designated use because certain conditions put it at risk for algal blooms. Three means are employed to designate Threatened status for this use. If a lake had been considered as Partially Supporting Aquatic life in 1996 but was removed as a result of refinements to the assessment metric, it is considered Threatened because significant dissolved oxygen loss is documented. This dissolved oxygen loss can lead to phosphorus release from the sediments and internal recycling of phosphorus to surface waters which is then available for algal reproduction and possibly algal blooms. Again, 176 lakes are considered Threatened for this designated use because of low dissolved oxygen.

Forty lakes were designated as Threatened because one algal bloom has occurred. The occurrence of one algal bloom indicates that the lake has nutrient levels that are high enough to support algal blooms when conditions are just right. Eight of these lakes satisfied the previous condition as well.

Three hundred seventy lakes are considered Threatened for Primary Contact because vulnerability modeling has predicted an increase in phosphorus over a 50 year period. The Maine Vulnerability Index is a broad-based predictive model that uses the hydrological characteristics of a lake and rate of watershed development to predict the rate at which mean lake phosphorus concentration will increase over time as a result of watershed development. Since the index relies on many broad assumptions, its information is of limited value on a lake-specific basis. It does, however, evaluate a large number of lakes with a limited database. Since its assumptions are consistent, it gives a valuable relative indication of how significant the future cumulative impact of development on Maine lakes may be. Fourteen of these lakes have had one algal bloom as well, and seventy-three were identified as having low dissolved oxygen according to the 1996 criteria. Four lakes were determined to be threatened using all three means of determination.

Threatened for Trophic Stability. Lakes may be considered Threatened for this designated use when certain conditions put it at risk for a deteriorating trophic state. The same three means used to designate Threatened status for Primary Contact are used to determine threatened status for Trophic Stability. Thus, all 495 lakes considered Threatened for primary contact are considered threatened for Trophic Stability.

It is anticipated that new criteria will be developed for the next reporting cycle that will allow a more targeted assignment of Threatened status. Threatened Maine lakes are listed by major drainage basins in Table 3-4.11.

Table 3-4.11. Fully Supporting But Threatened Significant Lakes by Major Drainage Basin.

Major Drainage Basin	Number of Lakes	Acreage of Lakes
Saint John	17	19,094
Penobscot	70	29,028
Kennebec	88	24,000
Androscoggin	59	30,628
East Coastal	127	58,234
West Coastal	134	20,129
All Basins	495	181,113

Acid Effects on Lakes

Contact: Linda Bacon, DEP BLWQ, Division of Environmental Assessment, (207) 287-7749.

Assessment of lake acidity has not been a priority for Maine's limnological investigations over the past 8 years. Most of the information in this section stems from projects undertaken in the 1980s thus many of the numbers are the same as in past assessments. Discussion under this section (Acid Effects) is not limited to Significant lakes because many of the lakes investigators have identified as having low pH are between 1 and 10 acres. All numbers should be considered estimates, as the raw data from some of the studies is not readily available. It is anticipated that a sampling update will occur over the next reporting cycle. A comprehensive treatise on the effects of acidic deposition on Maine's waters, including lakes, can be found in the EPA-sponsored text: "Acid Deposition and Aquatic Ecosystems: Regional Case Studies", edited by Donald Charles and published in 1991 by Springer-Verlag (ISBN 3-540-97316-8).

Estimates place the number of non-dystrophic Maine lakes which are currently acidic (Acid Neutralizing Capacity or ANC < 0 micro-equivalents CaCO3/l) at less than 100. Although all Maine surface waters that have had their acid-base chemistry analyzed show increased non-marine sulfate concentrations resulting from acidic deposition, only a portion of known acidic lakes can be considered as having been predominantly affected by atmospheric deposition.

During the 1980s, the effects of acidic deposition were the focus of numerous projects. The 1984 EPA Eastern Lake Survey (ELS) population (225 lakes) was chosen such that statistical inferences about the extent of acidic deposition effects could be made for lakes throughout the state. ELS projected that between 8 and 21 Great Ponds were acidic in the State of Maine. The DEP has evaluated lake populations (pH and ANC) potentially susceptible to the effects of acidic precipitation: 91 high elevation lakes in chemically resistant bedrock were assessed in the High Elevation Lakes Monitoring (HELM) project, and, 128 seepage lakes in or associated with mapped aquifers were assessed in the Aquifer Lakes Pilot Survey (ALPS) project. Data have also been obtained from the EPA Long Term Monitoring (LTM) lakes at the University of Maine/DEP Tunk Watershed Site (8 lakes including lakes in adjacent sites) and from numerous University of Maine projects focusing on effects of acidic precipitation (188 lakes). In addition, the DEP has evaluated alkalinity data on 640 lakes as part of routine sampling to assess trophic status. We have not made any effort to enumerate lakes vulnerable to acidity other than focusing the HELM and ALPS studies on lake populations at high risk. It is likely, however, that we would categorize all lakes situated in areas of bedrock and surficial geology having low to no acid neutralizing capacity, as being vulnerable to acidity.

More than 1,125 lakes (approximately 3/4 of lake surface area) have been assessed for acidity, predominantly by using measures of pH and ANC. There are about 60 acidic lakes (ANC < 0) comprising a total surface area of 707 acres (1.0% of the lakes and 0.06% of the lake surface area in the state). Twenty acidic lakes are at least ten acres or greater in size and are considered "significant"; the remainder are at least 1 acre in size. According to the Eastern Lake Survey, there are probably only a few unsampled acidic lakes greater than ten acres in size. There are likely some (probably less than 50) additional non-dystrophic acidic drainage and seepage lakes in the 1 to 10 acre size range. Table 3-4.13 summarizes acidity assessment efforts in Maine lakes. .

Table 3-4.13. Acid Effects on Maine Lakes*.

	Number of Lakes	Acreage of Lakes	%Acreage
Assessed for Acidity	1,125	approx. 74,000	75%
Impacted by High Acidity	60	707	0.06%
Vulnerable to Acidity	unknown	unknown	unknown

*Totals include all lakes in the state, not only 'significant' lakes.

Sources of acidity include acidic deposition, naturally occurring organic acids and a combination thereof, as determined by an assessment of dissolved organic carbon (DOC) and non-marine sulfate concentrations. Acidic, low DOC (< 5 mg/L) drainage and seepage lakes are acidic largely due to acidic deposition and account for approximately 60% of acidic lakes. Acidic, high DOC drainage lakes are acidic due to a combination of naturally occurring organic acids and acidic deposition, and account for approximately 10% of acidic lakes. Acidic, high DOC seepage lakes (approximately 30%) are acidic primarily due to naturally occurring organic acids. No low DOC lakes are known with a pH less than 4.9 suggesting that organic acidity is necessary to depress pH to values of less than 5.0. Table 3-4.14 illustrates source estimates for high acidity in Maine lakes.

Table 3-4.14. Sources of High Acidity in Maine Lakes*.

	Lakes Impacted	
Source of Acidity	Number	Percent
Acid Deposition	36	(60%)
Natural Sources	18	(30%)
Combination of Above	6	(10%)

*Totals include all lakes in the state, not only 'significant' lakes; total area impacted is estimated as 707 acres - we have not attempted to determine acreage for each source category due to the unavailability of data.

The extent of aluminum mobilization due to increased acidity is dependent on the presence or absence of substances which bind aluminum such as, DOC and fluorine. Greatest aluminum toxicity has been observed between a pH of 5 and 6 and only a few of the numerous ionic species are biologically toxic. Table 3-4.15 lists 58 acidic lakes categorized by the total aluminum concentration in ug/l. Total aluminum was determined on filtered (0.4 um), acidified samples according to EPA protocols established for the ELS/LTM projects. No consideration is given to the form of aluminum, however, and a significantly lesser amount would be considered biologically available. Since 40% of the acidic lakes have high levels of DOC, it can be inferred that biologically available aluminum is less likely to attain toxic levels in those lakes

Table 3-4.15. Aluminum Distribution in Acidic Lakes in Maine.

Total Aluminum (ug/l)	Number of Acidic Lakes
< 100	39
100 - 200	4
200 - 300	5
> 300	10

Historical data on fisheries is limited for all but a handful of the acidic lakes. Temporal shifts in fish populations have been observed in some lakes, but there is no clear association between these shifts and acidic deposition. Although a number of the acidic lakes are fishless, none have been shown to have lost their fish due to acidification. Thus all are considered to be fully supporting uses. Many of the fishless lakes are small and isolated, or exist at high elevations, with poor breeding habitat.

Paleolimnological investigations in New England have shown that some lakes apparently have become more acidic over the past 5 or so decades. Most are inferred to have had a pH of less than 6 before the rise in burning of fossil fuels. Therefore, only lakes that currently have a pH less than 6 are considered to be at risk. Existing data suggest that at current levels of acidic deposition, fewer than 100 Maine lakes are potentially at risk of further acidification. However, the only long-term data from lakes with a pH between 5 and 6 suggests that their acid neutralizing capacity has increased since 1982.

No attempt has been made to mitigate the effects of acidic deposition or potential toxic mobilization for the following reasons:

1) only a small percentage of surface water has been acidified by acidic deposition,
2) lakes affected by acidic deposition are typically small in surface area,
3) paleological evidence suggests that those lakes with depressed pH attributable to acidic deposition were historically low in pH as a result of inherent watershed characteristics,
4) no alteration of fish populations can be attributed to acidic deposition at this time, and
5) since a significant number of the acidic lakes are dominated by organic acidity, alteration of the buffering system (e.g., by the addition of lime) would drastically change the natural ecosystem.

Toxics
Contact: Barry Mower, DEP BLWQ, Division of Environmental Assessment, (207) 287-7777

Fish, water and sediment samples were collected from 125 Maine lakes and ponds (108,423 acres) in 1993 and 1994 as part of the EPA funded Regional Environmental Monitoring and Assessment Program (REMAP). The study lakes were selected from a population of about 1800 surveyed lakes and ponds with significant sport fisheries using EPA's EMAP protocol. Significant levels of mercury were found in both warm and cold water fish. The average concentration was 0.45 ppm with fish from several lakes exceeding the US Food and Drug Administration action level of 1.0 ppm and 81 (83,071 acres or 77% of the sampled lake acreage) exceeding the state level of concern of 0.43 ppm.

Consequently on May 18, 1994, the Maine Department of Human Service's Bureau of Health issued an advisory warning pregnant women, nursing mothers, women who may become pregnant, and children under 8 years of age not to consume fish from lakes and ponds in the state. Other people were advised to limit consumption of fish from these waters to 6-22 meals per year, depending on fish size. Larger older fish generally have higher contaminant levels; a meal is considered to be 8 ounces.

Further investigation has allowed this advisory to be modified. In 1997, advisories categorized fish into warm water species (bass, pickerel, perch, sunfish, crappie) and cold water species (trout, salmon, smelt, cusk). Pregnant women, nursing mothers, women who may become pregnant, and children under 8 years of age are warned not to eat warm water species and to restrict consumption of cold water species to 1 meal per month. Other individuals have no consumption limit on cold water fish but are advised to limit consumption of warm water fish to 2-3 meals per month, depending on fish size.

Trends
Contacts: Linda Bacon, DEP BLWQ, Division of Environmental Assessment, (207) 287-7749 [Subsequent reporting cycles: Melissa Evers, DEP BLWQ, Division of Environmental Assessment, (207) 287-3901].

Lake transparency trends evaluated over the 1998 reporting cycle reflect a combination of best professional judgement in the visual examination of data as well as results from a preliminary statistical analysis performed on the dataset. Results from both approaches will be included and compared in this report because this reporting period represents a time of transition from a somewhat subjective Best Professional Judgement (BPJ) approach to a more objective mathematical approach. Future reports are likely to reflect a combination of the two with the mathematical screening done first followed by a BPJ examination of other trophic data and collection techniques to assure mathematical results are not result of some data anomaly. A number of data density and statistical power questions need to be resolved over the next reporting cycle.

An adequate density of data existed to perform the nonparametric Kendall Tau analysis on 139 lakes. The previously obtained visual BPJ results were compared to the statistical results. The statistical approach yielded a greater number of lakes (17%) that had significant negative or positive trends. In other words, the visual approach was more conservative, the eye having a lesser ability to pick out trends and very dependant on plotting options chosen.

Of the 674 lakes having transparency data on record, 139 lakes had adequate data for the statistical analysis of trends. Another 151 had BPJ examination of the data to determine if a preliminary trend could be detected. The remaining 384 lakes did not have enough data to make either a BPJ or statistical determination of trend. A total of 47% of significant lake acres have been assessed for trends. Statistical trend analysis was performed on 22% of Maine's significant lake acres with the trends assessed by BPJ on the remaining 25% of lake acres.

Table 3-4.16 illustrates the results of trend analysis using both methods of determination. According to these results, the majority of significant Maine lake acreage on which trends have been assessed appear to have stable water quality (40.6%). Less than 6.5% of significant lake acreage is designated as having an improving or declining trend. It must be stated that although statistics were used to determine significance of trends, the overall population of lakes on which the analysis was conducted is not a probability based population but rather biased toward larger lakes in populated areas of the state. Caution must be used when extrapolating these results to other lakes in the state.

Table 3-4.16. Water Quality Trend Determinations for 289 Significant Maine Lakes [# lakes/acres (%)].

Type of Trend Analysis:	BPJ		Statistical		Totals	
Trend Category						
Improving	11 / 2,683		37 / 33,118		48 / 35,801	(3.7%)
Stable	131 / 232,991		86 / 156,359		217 / 389,350	(40.6%)
Declining	9 / 5,074		16 / 21,335		25 / 26,409	(2.8%)
Totals	151 / 240,748	(25%)	139 / 210,812	(22%)	290 / 451,560	(47%)

Chapter 5: Estuary and Coastal Assessment

Contact: John Sowles, Director, Marine Environmental Monitoring and Research Program
(207) 287-6110

Background

The purpose of 305b report is to determine the degree to which water quality supports the designated uses of Maine's Marine and Estuarine Classifications, identify causes of impairment, and describe the type and quality of the data. Therefore, the foundation of this report is based on the State of Maine Surface Water Classification Program (38 M.R.S.A. §465-B), Standards for Classification of Estuarine and Marine Waters. Three standards exist for classification of estuarine and marine waters.

Class SA waters - Class SA shall be the highest classification and shall be applied to waters which are outstanding natural resources and which should be preserved because of their ecological, social, scenic, economic or recreational importance.

A. Class SA waters shall be of such quality that they are suitable for the designated uses of recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish and navigation and as habitat for fish and other estuarine and marine life. The habitat shall be characterized as free-flowing and natural.
B. The estuarine and marine life, dissolved oxygen and bacteria content of Class SA waters shall be as naturally occurs.
C. There shall be no direct discharge of pollutants to Class SA waters.

Class SB waters - Class SB waters shall be the 2nd highest classification.

A. Class SB waters shall be of such quality that they are suitable for the designated uses of recreation in and on the water, fishing, aquaculture, propagation and harvesting of shellfish, industrial process and cooling water supply, hydroelectric power generation and navigation and as habitat for fish and other estuarine and marine life. The habitat shall be characterized as unimpaired.
B. The dissolved oxygen content of Class SB waters shall be not less than 85% of saturation. Between May 15th and September 30th, the numbers of enterococcus bacteria of human origin in these waters may not exceed a geometric mean of 8 per 100 milliliters or an instantaneous level of 54 per 100 milliliters. The numbers of total coliform bacteria or other specified indicator organisms in samples representative of the waters in shellfish harvesting areas may not exceed the criteria recommended under the National Shellfish Sanitation Program Manual of Operations, Part I, Sanitation of Shellfish Growing Areas, United State Department of Food and Drug Administration.
C. Discharges to Class SB waters shall not cause adverse impact to estuarine and marine life in that the receiving waters shall be of sufficient quality to support all estuarine and marine species indigenous to the receiving water without detrimental changes in the resident biological community. There shall be no new discharge to Class SB waters which would cause closure of open shellfish areas by the Department of Marine Resources.

Class SC waters - Class SC waters shall be the 3rd highest classification.

A. Class SC waters shall be of such quality that they are suitable for recreation in and on the water, fishing, aquaculture, propagation and restricted harvesting of shellfish, industrial process and cooling water supply, hydroelectric power generation and navigation and as a habitat for fish and other estuarine and marine life.

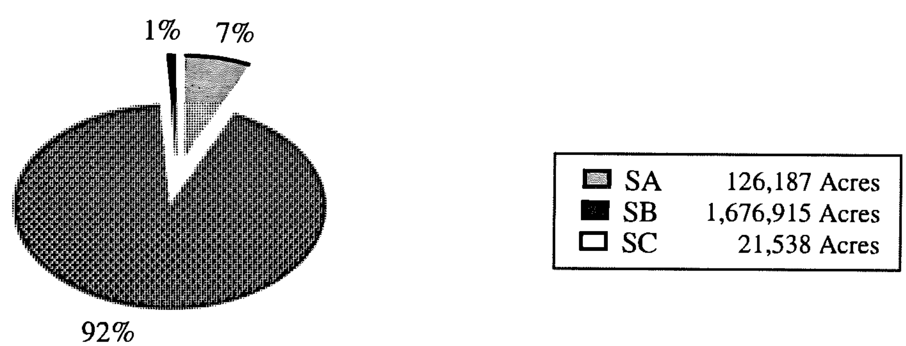
B. The dissolved oxygen content of Class SC waters shall be not less than 70% of saturation. Between May 15th and September 30th, the numbers of enterococcus bacteria of human origin in these waters may not exceed a geometric mean of 14 per 100 milliliters or an instantaneous level of 94 per 100 milliliters. The numbers of total coliform bacteria or other specified indicator organisms in samples representative of the waters in restricted shellfish harvesting areas may not exceed the criteria recommended under the National Shellfish Sanitation Program Manual of Operations, Part I, Sanitation of Shellfish Growing Areas, United States Food and Drug Administration.

C. Discharges to Class SC waters may cause some changes to estuarine and marine life provided that the receiving waters are of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

Areal distribution of the three marine classes is shown in Figure 3-5.1. below.

Figure 3-5.1.

Percentage and Acres of Estuarine and Marine Waters by Each Classification



Sources of Monitoring Data

Maine's coastal waters extend 3 miles from its shore. Overlapping jurisdiction within the State government results in monitoring conducted by various parties including the Maine Departments of Marine Resources and Environmental Protection. In addition, several non-governmental organizations monitor their local waters for various purposes.

The Maine Department of Marine Resources (DMR) monitors for indicators of human pathogens (fecal and total coliforms) and biotoxins (Paralytic Shellfish Poisoning). The purpose of the MDMR monitoring is to protect human health by managing shellfish harvest areas.

The Maine Department of Environmental Protection (DEP) has focussed most of its effort on monitoring coastal systems to better understand local geographical and ecological patterns to guide management of regulated activities. The DEP looks at toxic contaminants in biological tissues and sediment and oxygen and nutrients in the water column. Recently, tracking coastal habitat loss has begun.

Over the past decade, a number of very successful non-governmental organizations (NGOs) have assisted both State agencies fulfill their missions by monitoring specific coastal areas. (See Case History - Casco Bay Estuary Project) Water quality information on shellfish beds, swimming areas, and whole bays is being provided through active partnerships between agencies and NGOs.

Casco Bay Estuary Project

Contact: Katherine Groves, Director (207) 780-4820 or kgroves@usm.maine.edu

Background: In 1990, Casco Bay was included in the U.S. Environmental Protection Agency's National Estuary Program, established in 1987 to protect nationally significant estuaries threatened by pollution, development, or overuse. As a result of this designation, the Casco Bay Estuary Project (CBEP) was formed to develop a Comprehensive Conservation and Management Plan (CCMP) to protect and restore Casco Bay.

Casco Bay Plan: The Casco Bay Plan, the CCMP for Casco Bay, was developed through a five-year collaborative process involving a host of stakeholders. It outlines a series of actions designed to meet the goals of the project. CBEP is working to carry out these action items, focusing on five overriding goals deemed crucial to the health of the Bay:

- Minimize the loading of pathogens, toxics, nutrients, and sediments from stormwater and combined sewer overflows to Casco Bay;
- Open and protect shellfish and swimming areas impacted by water quality;
- Minimize adverse environmental impacts to ecological communities from the use and development of land and marine resources;
- Reduce toxic pollution in Casco Bay; and
- All members of the Casco Bay community act as responsible stewards to protect Casco Bay and its watershed.

Project Management: The Casco Bay Estuary Project has a Director and a 23-member Board of Directors responsible for overseeing the project. The CBEP seeks to involve a broad spectrum of interests in environmental management and decision making by including federal, state, local, business, industry, and nongovernment representatives on its Board.

Project Activities: The Casco Bay Estuary Project plays an active role in issues that affect the Bay. Some of the CBEP activities include:

- Educating boat owners about environmentally sound marine practices
- Mapping clam flats in Casco Bay
- Analyzing lobster and mussel tissue for toxics
- Providing technical assistance to help open clam flats
- Working to eliminate overflows from combined sewers and stormwater systems
- Developing a habitat fund to help protect significant wildlife habitat
- Conducting dissolved oxygen studies to determine water quality health
- Conducting lobster population studies in the Fore River
- Supporting water quality monitoring activities in the watershed
- Educating homeowners about environmentally friendly practices in the home
- Constructing and operating an air deposition station in the watershed to gain information about airborne pollution entering the Bay.

Results from these monitoring sources provide the basis for determining attainment of classification and designated uses. Since several of the designated uses are protected by attainment of other uses (e.g. navigation, industrial process and cooling supply), for the purposes of this report, designated uses have been divided into two broad use categories; protection of human health and protection of aquatic life. Within each of these two categories, applicable monitoring results are summarized and conclusions drawn regarding attainment.

Human Health

Shellfish Harvest Area Closures (Propagation and Harvest of Shellfish)

The Department of Marine Resources is responsible for ensuring the safety of harvested shellfish. They are responsible for closing areas of shoreline which have been determined to be contaminated with elevated levels of bacteria or toxics. Closings are based on water samples collected in shallow water along the shore. As of 1998, there were 238 closed shellfish areas, up from the 230 reported in 1996. The actual area of closure was approximately 210,600, down from the 244,780 acres reported in 1996. An additional 31,400 acres were conditionally opened, some of them representing areas formerly prohibited.

Table 3-5.1. Shellfish Areas

Total Flats and Waters:	1,825,000 acres
Supporting (approved):	1,583,000 acres
Partially supporting: (conditional or restricted)	31,400 acres
Not supporting (prohibited):	210,600 acres

(See Appendix II, Table 7, for a list of closed areas)

Fish Consumption Advisories (Fishing)

Since 1992 a human health consumption advisory exists coast wide against the consumption of tomalley. In 1996, based on new monitoring data, the advisory was expanded to the sportfish sector to include bluefish and striped bass. In this sense, the entire Maine coast is in partial/moderate support of use due to the striped bass, bluefish, and tomalley consumption advisories.

Swimming Beach Closures (Recreation in and on the Water)

For several reasons, monitoring waters for swimming has not been a coastal priority. Rather, effort has been directed at ensuring that all licensed activities be sufficiently treated to protect swimmer health. Maine's swimming standard is based on Enterococci. POTW discharge limits are based on fecal coliform. This apparent incongruity is in the end consistent. Fecal coliforms are still accepted indicators of human pathogens. POTWs are licensed to a geometric mean of 15 or an instantaneous max of 50 per 100 to ensure adequate disinfection. Furthermore, a large sampling effort conducted in the early 1990s showed that both fecal coliform and Enterococci counts were well below human health standards in all a few areas of the coast where sources were know to exist. Nevertheless, several areas are monitored where there is strong public interest and/or threatened by an overflow or malfunction. Areas monitored and the number of closures are listed in Table 3-5.2.

Table 3-5.2. Beaches Monitored/Managed for Swimmer Protection (not comprehensive)

Beach	Location	Responsible Party	Closure Days
Acadia National Park	Mt. Desert	Nat'l Park Service	0
East End Beach	Portland	City of Portland	20 due to CSOs/malfunction
Peaks Island (3)	Portland	City of Portland	3 Permanent Closures due to raw sewage.
Willard Beach	South Portland	City of So. Portland	0
Ogunquit Beach	Ogunquit	Town of Ogunquit	0
Old Orchard Beach	Old Orchard	Town of Old Orchard	0

Health of Aquatic Life

Attainment of Dissolved Oxygen Standards

During 1996 and 1997, 21 estuaries and embayments were surveyed for oxygen and salinity. A weak relationship was found between landside human population density and oxygen levels. However, assigning cause of low oxygen solely to human activities is probably simplistic if not inaccurate. Although some estuaries contain oxygen levels that do not meet the dissolved oxygen standards of their assigned classification, it was concluded that most of these readings were a result of natural processes. This has led the DEP to review the appropriateness of statutory dissolved oxygen standards for estuarine and marine waters.

Table 3-5.3. Violations of Dissolved Oxygen Standard

SA – Standard is "As naturally Occurs"
No violations of the standard were found.

Water Body	% Saturation	Cause
SB – Standard is 85%		
Broad Cove Cumberland	83.9	
Johnson Cove-Chebegue	73.1	
Cape Small Hbr.	84.3	
Dyer Cove-Cape Elizabeth	81.5	
Maquoit Bay	82.3	
New Meadows Marina	47.9	Fish
Peabbles Cove	74.9	Decomposing seaweed
Princess Pt Yarmouth	75.4	
Perrys Landing	83.8	
Royal River	84.2	
Royal Yankee Marina	73.2	
Seaborne Yarmouth	84.2	
Two Lights CE	83.4	
Whartons Pt	78.2	
Custom Hs Wharf	63.8	
Bear Island	83.7	
Little Flying Pt.	84.9	
Small Pt	84.3	
SC – Standard is 70%		
Fore River– Custom House Wharf	48.9	
Antoine Creek	68.7	

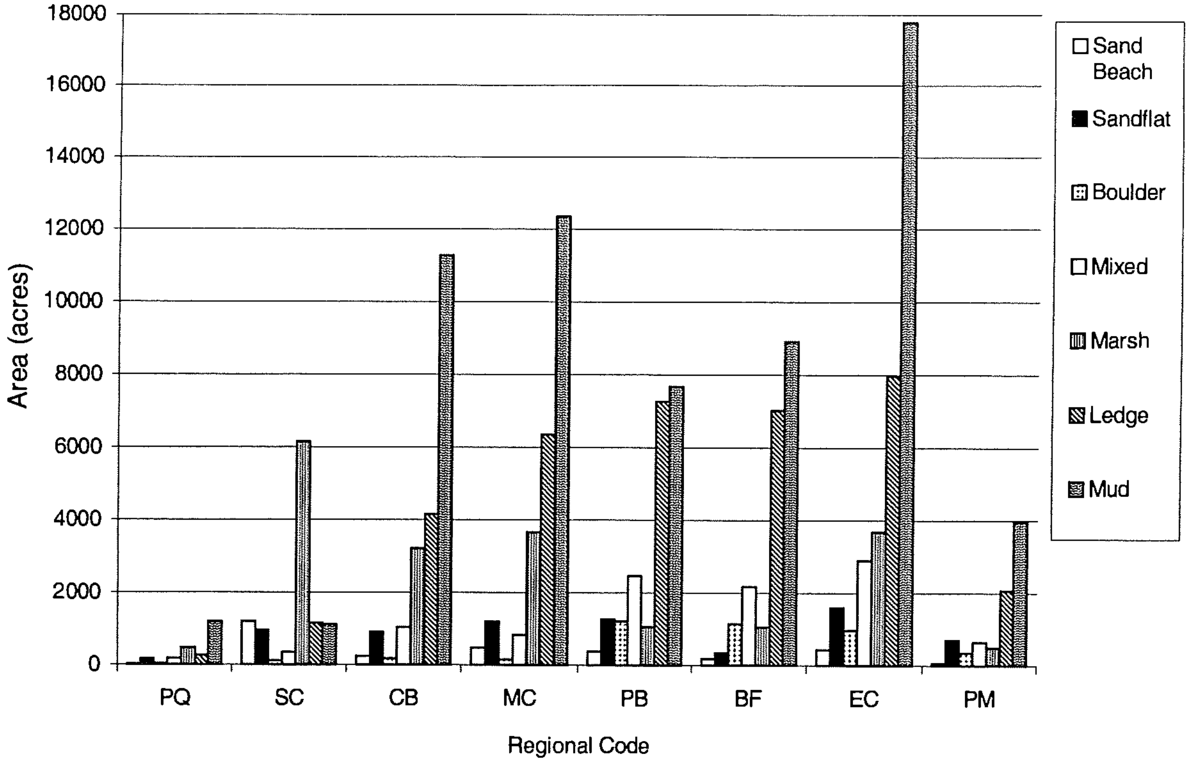
Nutrient Enrichment
Adverse effects of nutrient enrichment or eutrophication in Maine coastal water have not been documented. However, several instances suggest that Maine could experience the negative effects of nutrient enrichment if care is not taken. Phytoplankton blooms are occasionally seen in summer months in small poorly flushed embayments. Shorefront owners and fishermen reporting seeing more filamentous fouling algae on mooring lines, rocks and mudflats. Lethally depressed oxygen levels resulted in mass mortalities of benthic organisms in Maquoit Bay in 1988 and again in Saco Bay in 1990. In both instances, the prevailing opinion was that these were a result of an algae bloom either being blown into or growing in the areas. With the Maine's coastal population increasing, there is reason to be concerned that coastal eutrophication could produce unwelcome effects.

As a part of the 1996 Dissolved Oxygen Study (above), 16 waters were monitored for chlorophyll, nitrogen and phosphorus. Results of that survey show that indeed, near shore, phosphorus is limiting with a transition to nitrogen limitation as one move seaward to higher salinities. Results of this limited survey also showed that, in general, nutrient and chlorophyll levels were found well below levels where ecological uses are affected.

Table 3-5.4. Total Acres of Intertidal Habitat in Maine By Region

Regional Code	Sand Beach	Sandflat	Boulder	Mixed Course and Fines	Marsh	Ledge	Mud
Piscataqua (PQ)	13	160	36	175	477	262	1192
South Coast (SC)	1192	954	117	338	6149	1156	1119
Casco Bay (CB)	244	904	174	1035	3206	4155	11283
Mid Coast (MC)	473	1187	145	829	3661	6343	12354
Penobscot Bay (PB)	375	1270	1213	2455	1048	7264	7676
Blue Hill, Frenchman Bay (BF)	174	339	1146	2164	1059	7023	8920
East Coast (EC)	425	1591	965	2896	3683	7971	17776
Passamaquoddy Bay (PM)	69	698	355	639	495	2069	3982
Total	2963	7102	4150	10530	19778	36243	64302

Figure 3-5.2. Intertidal Habitat in Coastal Maine by Region



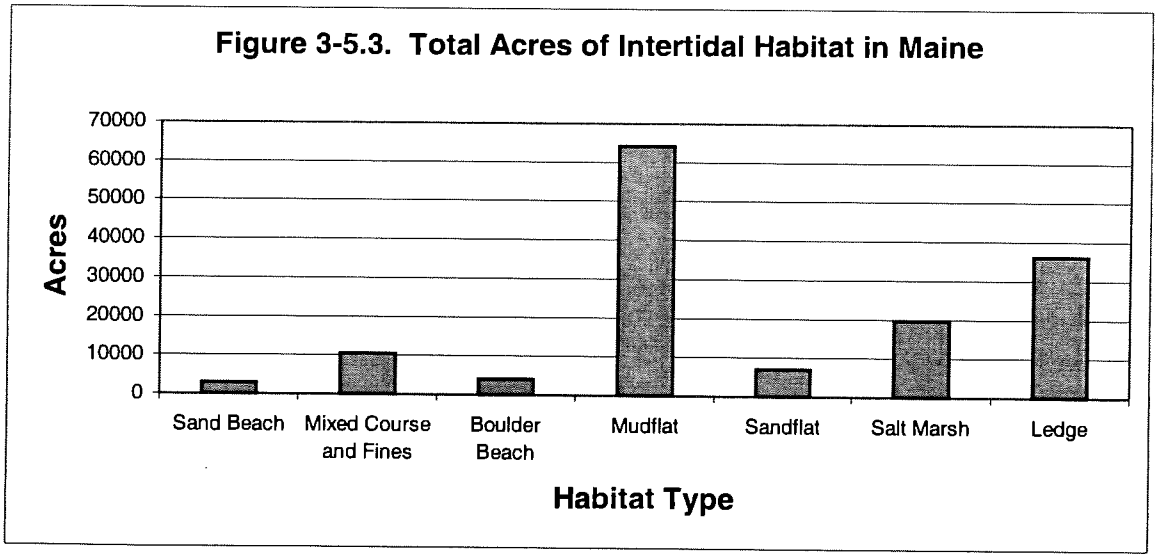
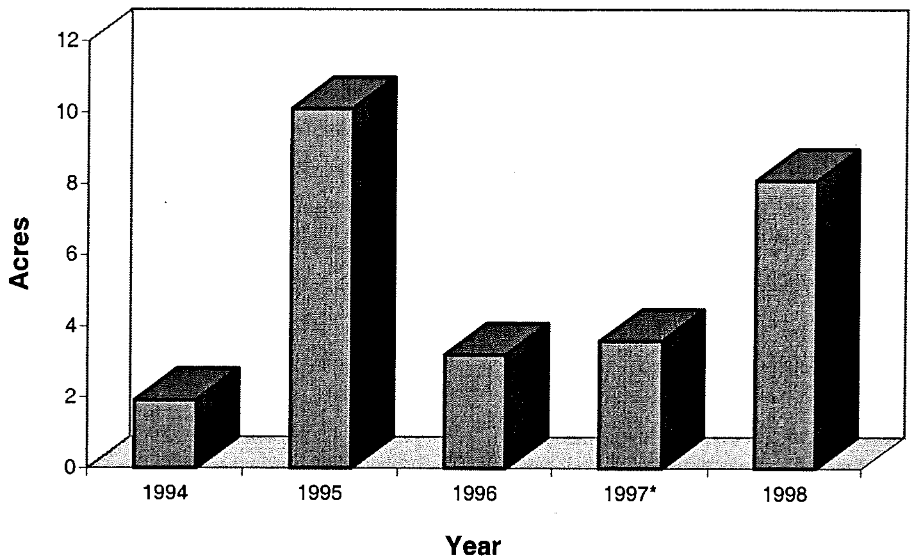


Table 3-5.5. Total Acres of Intertidal Habitat Impounded or Filled in Maine Coastal Wetland from 1994-1998

1994	1995	1996	1997 *	1998
1.9	10.1	3.2	3.6	8.1

* application still pending

Figure 3-5.4. Total Amount of Intertidal Habitat Impounded or Filled for Lobster Pounds in Maine from 1994-1998



* application still pending

Toxic Contamination

In 1986, DEP's Marine Environmental Monitoring Program identified toxic contaminants as its initial priority. Since that time, several other efforts have monitored toxic contaminants along Maine's coast. These include the Surface Water Ambient Toxics Monitoring Program, Gulfwatch of the Gulf of Maine Council, Casco Bay Estuary Project and the Dioxin Monitoring Program. Monitoring toxic contaminants in surficial sediments, blue mussels and lobster tissues has been emphasized.

Sediment: Although a quantitative characterization has never been done, some general patterns are obvious. With a few exceptions, these studies indicate that levels of heavy metals, chlorinated compounds, and hydrocarbons are higher in fined grained sediments and in areas below high human densities, such as the mouths of major rivers and ports. Polycyclic aromatic hydrocarbons (PAHs) are especially high where petroleum is handled: marine terminals, marinas, and urban areas. Polychlorinated biphenyls (PCBs), tributyl tins (TBT) from antifouling paints and DDT products, though not available for 20 years, continue to be present coastwide though more so near centers of commerce and industry. Dioxins in sediments have only been monitored in Casco Bay, where higher concentrations correspond to the mouth of the Presumpscot River and the eastern portion of the bay which appears to be a depositional area of the Kennebec River.

Biological effects from sediment contamination has been poorly assessed. From literature values, it appears that in a few areas levels are comparable to those in other studies where biological effects were noted (Long, Edward R. and L.G. Morgan, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NOS OMA 52, Seattle, Washington).

Blue mussel soft tissue has been analyzed from 63 sites along the Maine coast over a period of ten years. Lobster muscle and hepatopancrease have been analyzed from 18 sites along the coast in 1994, 1995, and 1996. Results thus far have shown that levels of toxic contaminants measured are, with the exception of lobster (see Consumption Advisories above), well within the general human population screening values used to protect human consumers.

The Marine Environmental Monitoring Program recently established *normal baseline reference concentrations* for different contaminants in mussel. When compared to these reference concentrations, some sites had contaminant levels above the Maine coastal norm. Most, however, did not. Those that were elevated generally were the most heavily developed ports and harbors and the mouths of major industrial rivers. Based on sediment and tissue analyses, areas of concern include six areas of Maine's coast (Table 3-5.6).

Table 3-5.6. Marine and Estuarine Areas of Concern for Toxic Contamination.[1]

Location	Area
Piscataqua River Estuary	2,560 acres
Fore River	1,230 acres
Back Cove	460 acres
Presumpscot River Estuary	620 acres
Boothbay Harbor	410 acres
Cape Rosier	80 acres

[1] Based on professional judgement. Empirical evidence to conclude non-attainment or adverse impact is lacking. Biological standards must be developed to assess attainment and monitoring must be conducted to assess impact.

Chapter Six: Wetlands Assessment

Background

Wetlands are among the Maine's most diverse and valuable natural resources, comprising fully 25 percent of the State's land area. There are over 5 million acres of freshwater wetlands in Maine, including forested and shrub swamps, bogs, freshwater meadows, marshes and floodplains. Tidal wetlands, such as flats, salt and brackish marshes, aquatic beds, bars and reefs make up about 157,500 acres. Wetlands perform numerous functions which are essential to both human society and the ecological balance of the natural world. Wetlands serve as natural water storage areas which help to lessen flood impacts by absorbing flowing water and reducing its velocity. They also play a vital role in maintaining lake, river and stream levels, and serve as hydrologic links between surface water and ground water aquifers. By trapping sediments and associated pollutants, wetlands often help to protect water quality, and also stabilize shoreline areas which would otherwise be vulnerable to erosion from wave action and currents. Wetlands support a vast array of fish and wildlife, including many endangered and commercially important species. In addition, the aesthetic values of wetlands are enjoyed by millions of Maine residents and visitors through recreational activities such as sport fishing, hunting, canoeing, hiking and wildlife viewing.

Federal Regulatory Framework

Wetlands are regulated by the U.S. Army Corps of Engineers (ACE) and EPA under Section 404 of the Clean Water Act, which established a permit program for discharge of dredged or fill material into waters of the United States, including wetlands. Federal regulations state that a Section 404 permit cannot be issued unless the proposed project complies with guidelines set forth in Section 404(b)(1), Guidelines for Specification of Disposal Sites for Dredged or Fill Material. These guidelines require avoidance of adverse impacts to wetlands by selecting the least environmentally damaging practicable project alternative. Applicants must also take "appropriate and practicable steps" to minimize environmental damage. Once the avoidance and minimization steps have been completed, compensation may be required for any remaining unavoidable wetland loss. Examples of compensation include restoration of previously degraded wetlands and creation of new wetlands on upland sites.

In addition, Section 401 of the Clean Water Act requires applicants to obtain a certification or waiver from the appropriate State water pollution control agency for Federally permitted or licensed activities that may result in a discharge to waters of the United States, including wetlands. The State agency may review the proposed project with respect to State water quality standards, and may grant or deny certification. States may also place conditions on water quality certifications, or may waive their certification authority. For activities within a State's coastal zone, Section 307(c) of the Coastal Zone Management Act requires applicants to obtain a certification or waiver that the activity complies with the State's coastal zone management program.

State of Maine Wetlands Regulatory Program in the Organized Townships

Contact: Jeff Madore
Maine DEP Bureau of Land and Water Quality
Division of Land Resource Regulation

The State of Maine regulates activities in wetlands under the Natural Resources Protection Act (NRPA). Effective September 29, 1995, changes in the NRPA (P.L. 1995, Chapter 460) made it more consistent with the Federal Section 404 wetlands regulatory program. Maine's Wetland Protection Rules (Chapter 310 of the NRPA) were also amended accordingly effective July 4, 1996. Concurrent with the revisions to the NRPA, ACE instituted a Programmatic General Permit (PGP) with review thresholds comparable to those of the State's program. To streamline the wetland regulatory process, Maine DEP and ACE have adopted a joint permit application form. A single application may now be submitted to DEP to obtain both State and Federal permits, including Section 401 Water Quality Certification. While ACE issues a separate permit, DEP staff coordinate with the federal agencies on reviewing applications, and ACE has agreed to meet the State's mandated processing times for most projects. Section 401 certification is issued simultaneously with permits approved under the NRPA by DEP.

The following summarizes major points of Maine's current wetland regulatory program:

- There is no longer a 10 acre size threshold for freshwater wetlands in the NRPA. All wetland areas are regulated.

- An exemption exists for alterations that affect less that 4,300 square feet (approximately 0.1 acre) of freshwater wetland, depending on the wetland type and location, unless the affected area of wetland is in a Shoreland Zone based on local Shoreland Zoning requirements.

- An exemption exists for forest management activities, including associated road construction or maintenance. This NRPA exemption, which has some restrictions, did not change under the new law.

- The exemption in State law for agricultural activities has been modified to be consistent with the Federal exemption. The new exemption applies to altering a freshwater wetland for the purpose of "normal farming activities such as clearing of vegetation for agricultural purposes if the land topography is not altered, plowing, seeding, cultivating, minor drainage and harvesting, construction or maintenance of farm or livestock ponds or irrigation ditches, maintenance of drainage ditches and construction or maintenance of farm roads". The exemption does not apply to alterations of other protected natural resources such as rivers, streams and great ponds.

- Activities adjacent to a freshwater wetland no longer need an NRPA permit unless the wetland consists of or contains either peatlands, or at least 20,000 square feet of open water or marsh vegetation. These areas do not include artificial ponds or impoundments unless they are alterations of other protected resources, such as streams.

- The definition of significant wildlife habitat now includes significant vernal pools as defined and identified by the Department of Inland Fisheries & Wildlife.

- A three-tiered review process has been established based on the size of the proposed wetland alteration:

  Tier I. For projects affecting up to 15,000 square feet of wetland, where the wetland is not considered to be of special significance (defined under 38 MRSA Section 480-X(4)). Maximum review time is 30 days. Information required is relatively simple, and professional assistance is generally not needed to complete the application.

  Tier II. For projects affecting between 15,000 square feet and 1 acre of wetland, where the wetland is not of special significance. Maximum review time is 60 days. If the proposed alteration is greater than 20,000 square feet, additional application requirements pertain, including a functional assessment and possible compensation.

  Tier III. For projects affecting wetlands of special significance, or those affecting greater than 1 acre of wetland. A full review occurs, with a maximum review time of 120 days. Tier III projects are generally the most complex due to analysis of project alternatives and compensation requirements to mitigate for lost wetland functions.

Cranberry General Permit

During the spring of 1996, the Department developed a new cranberry cultivation general permit, which was subsequently approved by ACE for use in applying for the federal cranberry general permit. The joint application was also approved by the Downeast RC&D Cranberry Work Group, which was comprised of industry stakeholders. Effective September 1997, however, ACE rescinded its cranberry general permit. Cranberry project applicants may still use DEP's application form, but federal approval is subject to the normal PGP process.

Compensatory Mitigation

In 1997, the 118th Legislature enacted P.L. 1997, Chapter 101, An Act Concerning Compensation Under the Natural Resources Protection Laws. The law authorizes DEP to establish a program providing for compensation of unavoidable wetland losses due to proposed alteration activities. Under this law, the Department may require the design, implementation and maintenance of a compensation project. In lieu of such a project, the Department may allow an applicant to purchase credits from a mitigation bank, or to pay a compensation fee. Approval of a compensation project must be based on the wetland management priorities identified for the watershed in which the project is located. The law further requires that the Compensation Fee Program be developed in consultation with the State Planning Office and other state and federal agencies, and prohibits the Department from approving a compensation project funded wholly or in part from compensation fees until the program has been agreed to by the federal resource agencies.

Wetlands Regulatory Program in Maine's Unorganized Territories

Contact: Marcia Spencer-Famous
Maine Department of Conservation
Land Use Regulatory Commission

The Maine Land Use Regulation Commission (LURC) uses a land use planning approach to regulate activities within wetlands in unorganized portions of the State. Wetland alterations are often handled within the context of a building, development, shoreland alterations, or other type of permit. All areas within the jurisdiction are zoned into management, development and protection subdistricts. The Wetlands Protection Subdistrict (P-WL) is used to regulate activities within wetlands. There are three different types of P-WL:

1. P-WL1 includes Wetlands of Special Significance;

2. P-WL2 includes scrub shrub and other non-forested freshwater wetlands, excluding those covered under P-WL1; and

3. P-WL3 includes forested freshwater wetlands, excluding those covered under P-WL1 and P-WL2.

LURC's regulatory system is based on mapped wetlands. Mapping, which is in the process of being completed, is based on National Wetlands Inventory maps and includes all wetlands greater than 15,000 square feet. In general, all mapped wetlands are regulated, and unmapped wetlands are not regulated unless a wetland delineation is required. The exceptions to this are (1) streams draining 50 square miles or less (some are mapped, some are not, but all are regulated), and (2) projects disturbing more than one acre of land (either wetland or upland) require all wetlands in the project area to be delineated, with all identified wetlands becoming jurisdictional.

Permitting is based on a three-tiered system similar to the Maine Department of Environmental Protection under the Natural Resources Protection Act. LURC's rules incorporate standards for avoidance, minimal alteration, water quality, erosion control, compensation, and no unreasonable impact. The thresholds for the level of tier review are tied to the size of the wetland impact and the type of wetland.

Tier 1: Used for projects impacting from 4,300 sq. ft. to 15,000 sq. ft. P-WL2 or P-WL3 wetlands. Applies standards for avoidance, minimal alteration, water quality, erosion control. No wetland delineation, functional assessment, or compensation required.

Tier 2: Used for projects impacting 15,000 sq. ft. to 43,560 sq. ft. P-WL2 or P-WL3 wetlands that do not contain critically imperiled or imperiled natural communities. Applies standards for avoidance, minimal alteration, water quality, erosion control, and compensation. Requires alternatives analysis and wetland delineation, and may require functional assessment and compensation.

Tier 3: Used for projects impacting any area of P-WL1 wetland, 15,000 sq. ft. to 43,560 sq. ft. of P-WL2 or P-WL3 wetlands containing critically imperiled natural communities, or 43,560 sq. ft. or more of P-WL2 or P-WL3 wetlands. Applies standards for avoidance, minimal alteration, water quality, erosion control, compensation, and no unreasonable impact. Requires alternatives analysis, and usually functional assessment. May require wetland delineation and compensation.

At present, DEP and LURC have dual jurisdiction over wetlands in unorganized areas, and DEP may also be consulted as a review agency on larger projects. Legislation is now being introduced to shift regulatory responsibility for wetland impacts in the unorganized territories entirely to LURC's jurisdiction. LURC does not yet have a system for simplifying permitting of small projects involving wetlands, but hopes to in the near future. LURC is currently developing a method of reducing the level of tier review for a selected group of minor wetlands-related activities. The intent is to simplify the permitting process in a way that is similar to DEP's permit-by-rule. Although wetland impacts have not been tracked in the past, LURC is discussing with the State Planning Office a way to track wetland impacts using the current permitting system. Wetland impacts due to land management road construction submitted with forest operations notifications are now being tracked in a separate database.

Development of Wetland Water Quality Standards

Under the Clean Water Act, States are required to develop programs to evaluate the chemical, physical and biological integrity of the Nations waters, including wetlands, and to adopt water quality standards to restore and maintain that integrity. The steps involved in applying water quality standards to wetlands include:

1. Inclusion of wetlands in the definition of "State waters";
2. Designating uses which meet the goals of Section 101(a)(2) of the Clean Water Act;
3. Adopting criteria sufficient to protect designated uses; and
4. Application of State antidegredation policy to wetlands.

Wetlands are implicitly included in Maine's definition of "Waters of the State" under the Protection and Improvement of Waters Act, 38 M.R.S.A. Section 361-A(7) as follows:

"...any and all surface and subsurface waters that are contained within, flow through, or under or border upon this State or any portion of the State, including the marginal and high seas, except such waters as are confined and retained completely upon the property of one person and do not drain into or connect with any other waters of the State, but not excluding waters susceptible to use in interstate or foreign commerce, or whose use, degradation or destruction would affect interstate or foreign commerce."

Maine currently does not have wetland-specific designated uses or criteria, however DEP is developing bioassessment tools for wetlands with the goal of establishing a long-term monitoring program and biological criteria. Once established, wetland biocriteria may be incorporated into State water quality standards. Since existing standards for surface waters do not reflect the range of natural conditions exhibited by wetlands, they are not adequate as a basis for licensing decisions. In Maine, Section 401 water quality certification is issued by DEP concurrently with wetland alteration permits approved under the Natural Resources Protection Act. DEP also evaluates potential wetland impacts during the review process for hydropower and National Pollutant Discharge Elimination System (NPDES) license applications. The development of wetland biocriteria would enhance the Department's ability to assess project impacts under these programs.

As part of the effort to develop wetland biocriteria, Maine DEP has actively participated on EPA's Biological Assessment of Wetlands Workgroup (BAWWG). BAWWG was formed in 1997 to improve methods and programs to assess the biological integrity of wetlands. The group consists of invited wetland scientists from Federal and State agencies and universities, and is coordinated by the EPA Office of Wetlands, Oceans and Watersheds in partnership with the EPA Office of Science and Technology. Ongoing BAWWG topics include development of assessment methods, study design, data analysis techniques and wetland classification. BAWWG also provides a forum for peer review and collaborative projects. In 1998, EPA New England formed the New England Biological Assessment of Wetlands Workgroup (NEBAWWG) to develop a regional wetland biomonitoring network, to sponsor and oversee regional state pilot projects, and to coordinate with and complement efforts of other biomonitoring groups. Maine NEBAWWG members include staff from DEP, the Maine Natural Areas Program (MNAP), the State Planning Office and the Land Use Regulatory Commission.

INTEGRITY OF WETLAND RESOURCES

Biological Assessment of Freshwater Wetlands

Contact: Jeanne DiFranco
Maine DEP Bureau of Land and Water Quality
Division of Environmental Assessment

Current wetland assessment methods commonly used in Maine include the U.S. Army Corps of Engineers Highway Methodology[1] and the New Hampshire Method[2]. The Highway Methodology is a qualitative, descriptive approach designed to characterize wetland functions and values for the Federal wetland permitting process. The New Hampshire Method was designed to provide basic information about wetland functions and values for planning, education and inventory purposes. It is useful for comparing a number of wetlands within a local study area, generally a town or watershed, but is not recommended for assessing individual wetlands, for impact analysis, or in legal proceedings.

While these methods are important tools for wetland planning and management, they do not directly measure the ecological health of wetlands or the effects of human activities on wetland biota. Moreover, since criteria are designed to be flexible and incorporate human value judgements, results are subjective and often highly variable depending on the evaluator and focus of the assessment. For many purposes, supplemental methods that employ a more rigorous scientific approach are needed. Biological assessment provides a direct, objective measure of wetland condition and can be used to evaluate impacts from human activities.

The following are potential applications of wetland bioassessment that are not adequately addressed through current methods:

Detecting ecological impairment for screening-level inventories, site-specific impact assessments and long-term trend analysis;

Diagnosing physical, chemical and biological stressors, including toxics, nutrient enrichment, non-point source pollution, hydrologic changes, and introduced species;

Evaluating the effectiveness of wetland protection activities;

Developing performance standards for restoration and mitigation projects;

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[1] USACOE. 1995. The Highway Methodology Workbook Supplement: Wetland Functions and Values, A Descriptive Approach. U.S. Army Corps of Engineers New England Division. 32 pp. NEDEP-360-1-30a.

[2] Ammann, A.P., and A. Lindley Stone, 1991. Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire. New Hampshire Department of Environmental Services. NHDES-WRD-1991-3.

Identifying ecological linkages among wetlands and other water bodies to refine water quality modeling;

Developing and supporting wetland biocriteria and water quality standards; and

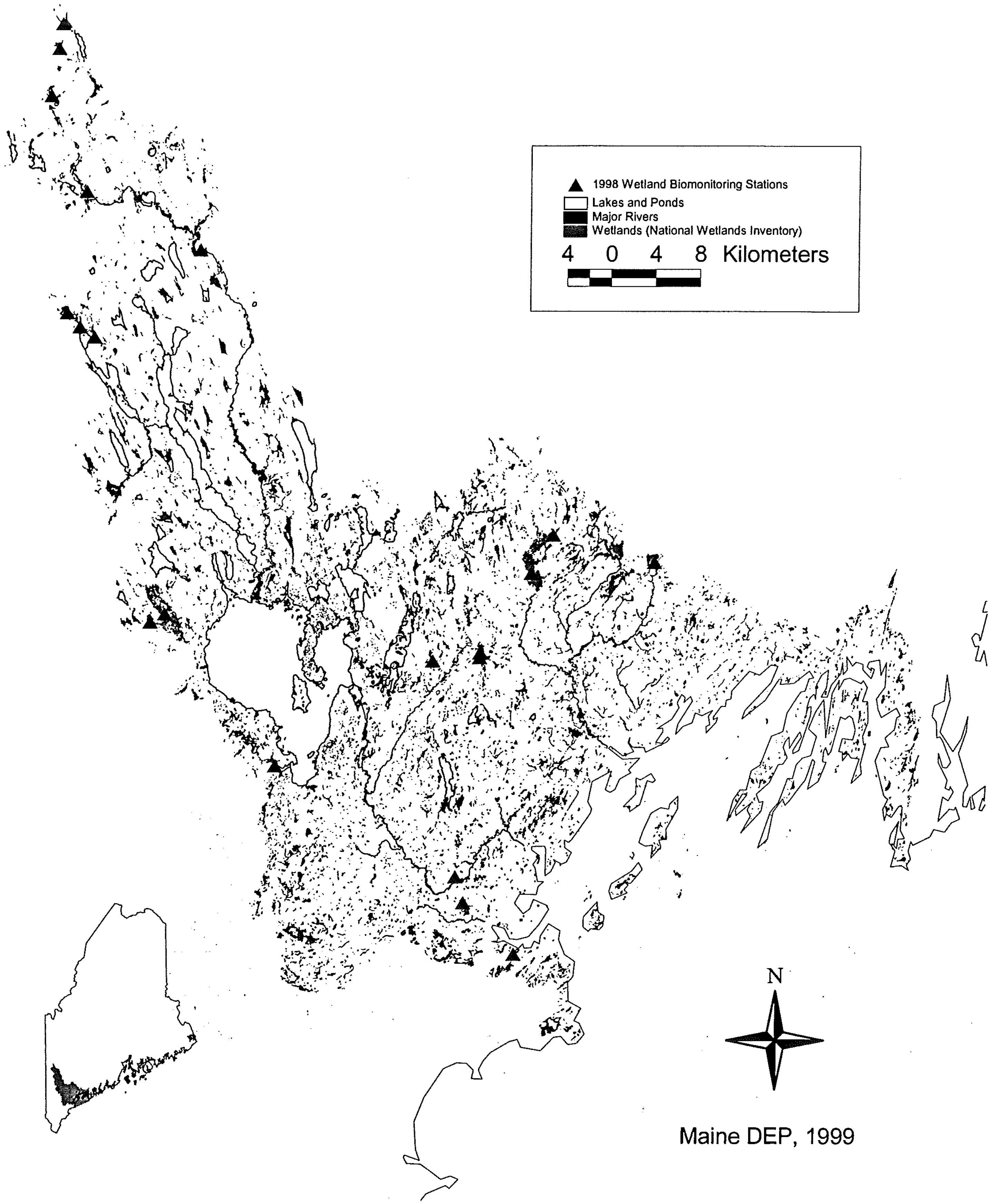
Tracking wetland condition for the Maine Water Quality Assessment Report to Congress required under Section 305(b) of the Clean Water Act.

Maine DEP's Biomonitoring Program is in the process of developing methods to evaluate the biological integrity of freshwater wetlands. With support from EPA, the Department has undertaken a pilot study in the Casco Bay watershed to develop biological sampling protocols, and to identify potential indicators of wetland condition. The project is part of a regional wetland assessment initiative coordinated by the EPA Region I New England Biological Assessment of Wetlands Workgroup (NEBAWWG).

The Casco Bay watershed is located in southern Maine where development pressure and threats to wetlands are high, and therefore provides an ideal location to examine the effects of human activities. The watershed encompasses a wide range of wetland types and potential sources of wetland impact. The pilot project will compliment ongoing planning and assessment efforts, including the Casco Bay Estuary Project, to gain a more comprehensive understanding of wetland systems. A multi-agency wetland prioritization project is also currently underway in the watershed, and may provide a tool to focus future biological assessment activities.

Study wetlands were selected using existing spatial data, professional knowledge and field surveys to include a range of human disturbance, including potential reference (minimally-disturbed) sites. Initial fieldwork for the pilot project began in August 1998. During the first season, Maine DEP staff collected aquatic macroinvertebrates, water samples and sediment from 20 wetlands **(Figure 3-6.1.)**, and recorded habitat data and dominant plant species. Researchers from the University of Louisville also sampled algae and diatoms as part of a collaborative project supported through an EPA Headquarters Cooperative Agreement. Data will be analyzed to identify wetland attributes that show predictable changes in response to human activities such as development. These attributes will later be tested on a broader geographic scale for potential use as biological metrics. DEP plans to continue the pilot project during 1999. The methods developed during the pilot project will support the creation of a statewide wetland bioassessment program consistent with the objectives of the Clean Water Act to assess and track the ecological health of wetlands, and to evaluate impacts from human activities

Casco Bay Watershed
1998 Wetland Biomonitoring Stations



Maine DEP, 1999

Guidelines for the Functional Assessment of Maine's Coastal Wetlands

Contact: Alison Ward, NOAA Coastal Management Fellow
Maine DEP Bureau of Land and Water Quality
Division of Environmental Assessment

The State of Maine has strong coastal management laws under the Wetland Protection Rules, Natural Resources Protection Act, and Water Classification Program that are designed to reduce impacts caused by commercial and private development in marine environments. However, currently there is no standard assessment methodology to assess the potential effects of permitted activities on coastal intertidal and sub-tidal habitats. After reviewing all the comments and scientific data, approval or denial of an application is based on the permit reviewers "best professional judgment" to evaluate threats to marine environments. This decision is often based on inadequate and inconsistent biological assessments that provide little insight into the functions and values of the habitat that may be lost upon development and/or modifications.

In October 1997, a NOAA Coastal Management Fellow was hired by Maine DEP to develop a coastal wetland assessment methodology for Maine. The two year project is a collaborative effort between Maine DEP, Maine and New Hampshire Sea Grant, Maine State Planning Office and Maine Department of Marine Resources.

The primary objectives of the project are to improve the permitting process through education, development, and use of functional assessment guidelines. The guidelines, when implemented, will provide information on the ecological functions; commercial, recreational, social and educational values; species composition; physical, chemical and geological characteristics; seasonal fluctuations; and aesthetics. Sampling protocols for each type of marine habitat will be included. In addition, a natural history guide will be developed for licensing staff that will include the distribution and quantity of Maine coastal habitats, the potential functions and values of each undeveloped environment and management guidelines.

To date, a draft assessment protocol has been written and distributed to licensing staff and Maine marine environmental consultants. Comments from consultants were gathered, reviewed and incorporated into the second draft. As of December 1998, a second draft was distributed to two consultants for review and testing. By the summer of 1999, a final draft functional assessment will be completed along with educational material on the value and sensitivity of Maine marine intertidal and sub-tidal habitats. In addition, a database modeled after the assessment protocol will be developed to track wetland impacts and consolidate marine biological data from functional assessments statewide.

Extent of Wetland Resources

Contact: Mike Mullen
Maine DEP Bureau of Land and Water Quality
Division of Land Resource Regulation

With the implementation of the changes to the Natural Resources Protection Act (NRPA), Maine DEP is now tracking permitted wetland losses through an application tracking system. When applications for freshwater wetland alterations are logged in, the amount of fill or area to be altered is also entered by wetland type and geographical location. This system will enable the Department to monitor and report on annual wetland losses. DEP permitted wetland impacts for the period between September 1995 and October 1997 are summarized in Table 3-6.1. below.

Table 3-6.1. Summary of DEP Permitted Freshwater Wetland Impacts and Required Compensation: September 29, 1995 – October 1, 1997.[1]

	Tier I	Tier II	Tier III	Total
Applications Received	273	57	65[5]	395
Acres Impacted[2]	57.59	33.51	178.92[6]	270.02
Acres Restored	0	2.71	18.39	21.10
Acres Enhanced	0	24.50	21.33	45.83
Acres Created	0	4.69	18.52	23.21
Acres Preserved[3]	0	57.68	261.94	319.62
Total Acres of Compensation[4]	0	89.58	320.18	409.76

Notes:
1. Does not include impacts or compensation associated with Maine Department of Transportation projects or projects permitted by the Land Use Regulatory Commission.
2. Certain impacts involving removal of trees or other vegetation (such as for utility lines) often are not deemed to affect wetland functions and values, therefore no compensation is required.
3. May include areas restored, created or enhanced.
4. Additional forms of compensation, including installation of wet detention ponds and enhancement of wildlife travel corridors, riparian zones and buffers may occur in upland areas.
5. Includes withdrawn, modification and condition compliance applications.
6. Almost 80 acres is attributable to one large cranberry cultivation project in Washington County.

Source: Report to the Maine Legislature's Joint Standing Committee on Natural Resources, Freshwater Wetlands Permitting Under the Natural Resources Protection Act: A Program Review Final Report Pursuant to P.L. 1995, Chapter 460. Maine Department of Environmental Protection, January 1998.

ADDITIONAL WETLAND PROTECTION ACTIVITIES

The following activities were funded wholly or in part by the U.S. Environmental Protection Agency through the Clean Water Act Section 104(b)3 Wetland Protection Grant Program:

Wetland Conservation Plan

Contact: Jackie Sartoris
Maine State Planning Office

The State Planning Office (SPO) is nearing completion of a State Wetland Conservation Plan which will address regulatory, program and policy issues, and will make recommendations for future goals related to wetlands. In 1994, SPO convened the Wetlands Conservation Plan Task Force to guide development and implementation of the Plan. The Task Force included State and Federal agency staff, business members and conservation groups. The first priority of the Task Force was to respond to a 1993 Legislative Resolve which required DEP and SPO to explore the feasibility of assuming jurisdiction over federal wetlands regulation, and to report on other options for streamlining the wetland permitting process. In response to the Resolve, the Task Force formed a wetlands regulatory workgroup. The efforts of the regulatory workgroup resulted in the changes to the State's wetland regulatory program summarized above. The Task Force subsequently formed three additional workgroups to develop goals for wetland inventory, wetland assessment, and wetland mitigation. The Wetland Conservation Plan is due to be released in May 1999.

Casco Bay Watershed Pilot Project

Contact: Liz Brown
Maine State Planning Office

Starting in 1994, both wetlands planning and watershed management in Maine have taken significant steps forward with the initiation of work on the State Wetland Conservation Plan and the creation of the Division of Watershed Management at Maine DEP. The Wetland Conservation Plan effort led to a recognition that watershed level planning for wetlands is needed, which in turn led to the Casco Bay Watershed Pilot Project (CBWPP).

Work on the CBWPP is approximately halfway to completion. When finished, it will provide landscape-level assessment of wetland functions generated through two separate approaches. One approach is being carried out by the US Fish and Wildlife Service. Using a GIS system based on National Wetland Inventory (NWI) maps annotated with the addition of landscape position modifiers, the U.S. Fish and Wildlife Service is providing a wetlands characterization of the watershed based on landscape position and hydrologic regime.

The second approach is being carried out by a state interagency group with input from a Steering Committee made up of federal, state, and local representatives. In this second approach, the

NWI maps are used as the base of a geographic information system which also includes soils, hydrography, population, FEMA flood zone mapping, roads, and cultural feature layers. A series of queries are applied to the GIS, and result in wetlands identified as likely to perform specific wetland functions. Additional queries are being developed to target possible restoration and enhancement sites. Fieldwork to determine the accuracy of data and maps compiled through these processes was undertaken during the 1998 field season. The two approaches will be compared to determine if results are significantly different.

During the early part of 1999, the Steering Committee will develop wetland priorities using the pilot project watershed characterization described above, input from local groups, and water quality priority information developed by the Maine Watershed Management Committee. From the identified wetlands, forty will be chosen for full-blown functional assessments during the 1999 field season.

Ecological Assessment of Central Interior Maine

Contact: Andy Cutko
Maine Natural Areas Program
Maine Department of Conservation

In 1997, the Maine Natural Areas Program (MNAP) received funding from the U.S. Environmental Protection Agency and The Nature Conservancy to identify rare plants, rare animals and exemplary natural communities within a 2.2 million-acre region of central Maine. MNAP implemented surveys for rare plants and exemplary natural communities, and allocated funds to the Maine Department of Inland Fisheries and Wildlife (MDIFW) to implement surveys for rare animals.

MNAP and MDIFW staff conducted a landscape analysis of the study area, using air photos and other natural resource information to determine sites likely to contain exemplary natural communities and rare species. MNAP staff and contractors visited 46 sites over two years, and MDIFW staff and contractors visited over 100 sites. Data were entered into the State's Biological and Conservation Database. As a result of these surveys and concurrent evaluations of Central Interior peatlands:

- 20 new natural community occurrences were added and 5 were updated;
- 16 new rare plant occurrences were identified and 28 were updated; and
- 36 new rare animal occurrences were identified.

One of the more noteworthy findings was the identification of the only circumneutral fen (a globally rare natural community type) within the Central Interior region. In addition, MDIFW biologists found nine new Central Interior locations of the globally rare New England bluet damselfly (Enallagma laterale), previously known from only one Maine location, and two new locations of the globally rare extra-striped dragonfly (Ophiogomphus anomalus).

The results of this study are available in a report published by MNAP in January 1999. Not surprisingly, several sites (large peatlands in particular) were found to support rare animals, rare plants and exemplary natural communities. Using the broad criteria of habitat size, rarity and quality, the report identifies and describes eight of the "highest priority" sites within the Central Interior region, and lists eight of the "other high priority" sites.

Source:
"An Ecological Assessment of Central Interior Maine", a report submitted to the US Environmental Protection Agency, Region I by the Natural Areas Division, Maine Department of Conservation. Andy Cutko, Principal Investigator. January, 1999.

Vernal Pool Initiatives

Contact: Aram Calhoun
University of Maine, Orono

Under Maine's revised wetland regulations, significant vernal pools have been included in the definition of "Significant Wildlife Habitat". This designation will provide greater regulatory protection for vernal pools. The provision cannot be implemented, however, until criteria for "significant" pools are defined and the pools are identified by the Maine Department of Inland Fisheries and Wildlife (MDIFW).

A number of activities related to the management and protection of vernal pools have been made possible through the creation of a half-time wetland staff position shared by the Switzer Foundation with Maine Audubon. Duties of this position include small wetland research, BMP development, outreach and technical assistance. The position is also responsible for coordinating a vernal pools volunteer monitoring program and the North American Amphibian Monitoring Program (NAAMP). The following summarizes major vernal pool initiatives since 1996:

- In 1996, "A Citizens Guide for Locating and Describing Vernal Pools in Maine" was published. The manual was used as part of a pilot project to train volunteers to locate and describe vernal pools. Two study areas were included, one in southern Maine (South Berwick and York), and one in the central portion of the state (Edinburg). Sixteen volunteers participated in vernal pool surveys. The two pilot study areas were also surveyed by professional biologists in 1997 to test the effectiveness of aerial photographs and National Wetland Inventory maps for pre-identifying pools, and to identify potential features to designate pools as "significant". A one-year pilot project to characterize vernal pools in northern Maine was initiated in 1998.

- Best Management Practices (BMPs) for timber harvesting activities near vernal pools are currently being finalized. During summer of 1999, a New England-wide initiative is planned to develop regional BMPs for development adjacent to vernal pools.

- In 1997, 61 amphibian calling survey routes for volunteer monitors were established. Protocols for the surveys were adopted from the North American Amphibian Monitoring Program (NAAMP).

- A vernal pool assessment document is currently in development.

Scarborough Marsh Volunteer Assessment Project

Contact: Rob Bryan
Maine Audubon Society

In 1997, the Maine Audubon Society published the "Maine Citizens Guide to Evaluating, Restoring and Managing Tidal Marshes". The guide is intended for use by local planners, conservation commissions and interested individuals. Maine Audubon has also conducted a series of training workshops for volunteer tidal marsh stewards, and is currently coordinating a volunteer assessment project for the Scarborough Marsh Estuary. Project goals include:

- To raise citizen awareness of threats facing tidal marshes and increase local grassroots support for tidal marsh conservation and restoration

- To collect baseline data on tidal restrictions and invasive plants for use by cooperating agencies and organizations

- To prioritize restoration opportunities with the Scarborough Marsh Estuary

The project will involve key organizations at the local, State and Federal levels, including the Scarborough Conservation Commission and the Maine Department of Inland Fisheries and Wildlife.

Chapter 7: Public Health and Aquatic Life Concerns

Fish Consumption

Contact: Barry Mower, DEP BLWQ, Division of Environmental Assessment
(207) 287-7777

Since 1982, DEP has been conducting fish tissue analyses to determine whether fish are safe for human consumption. The compound of greatest concern in Maine surface waters has been dioxin. In 1984 through 1986 as part of the EPA National Dioxin Study, fish from several Maine rivers below industries were found to be contaminated with dioxin and furan (2367-TCDD and 2378-TCDF). Based on these limited data, fish consumption advisories were issued by the Department of Human Services. In 1988, the Maine Legislature established the Maine Dioxin Monitoring Program to assess the extent of the problem in Maine. This program required DEP to collect sludge and fish below no more than 12 industrial or municipal wastewater discharges to be monitored for dioxin and furan.

Fish tissue analysis in 1996-7 for dioxin and furan showed a decline from earlier levels. However, advisories remain on the Androscoggin River, Kennebec River below Skowhegan, and Penobscot River below Lincoln as well as for lobster tomalley along the entire Maine coast. Advisories due to dioxin have been added for the Salmon Falls River and the East and West Branches of the Sebasticook River. In 1997 the Maine legislature re-authorized the Dioxin Monitoring Program through 2000.

More recently, mercury and polychlorinated biphenyls have been recognized as serious contaminants in certain waters and the state has revised its fish consumption advisories accordingly (Table 3-7.1). As part of the EPA funded Regional Environmental Monitoring and Assessment Program (REMAP), fish, water and sediment samples were collected from 125 Maine lakes and ponds in 1993 and 1994. Significant levels of mercury were found in both warm and cold water fish. In 1994 the Maine legislature enacted Maine's Surface Waters Ambient Toxics (SWAT) monitoring program to determine human and ecological risk from toxic contaminants in both freshwater and marine ecosystems. Results through 1997 indicate that Maine has more contamination than previously known. Mercury levels in fish from rivers and streams are generally the same as fish from lakes in the REMAP project. Lobster tomalley has been found to be contaminated, but the meat is within background levels. Maine is also detecting significant levels of co-planar PCBs in tissue samples. Since these compounds have similar toxicological properties as dioxin, Maine now calculates advisory thresholds on the combined risk of dioxins and co-planar PCBs.

The Little Madawaska River (Caribou) and tributaries from the Madawaska Reservoir Dam downstream to Grimes Road, Greenlaw Stream (Caribou and Limestone) and tributaries, and Red Brook (Scarborough) do not meet Maine's water quality standards due to PCB contamination.

A 2.5 mile stretch of the Royal River in Gray and Yarmouth does not attain Maine's Water Quality Standards. The cause is contaminated groundwater leaching from the McKinn Site, a former waste oil and solvent collection and transfer site which operated between 1964 and 1977. The site is now a Maine Designated Uncontrolled Hazardous Substance Site and Superfund National Priorities List site. Despite operation of a Groundwater Extraction and Treatment System from 1990-1995, the State water quality criterion for trichloroethylene (TCE) for water and organisms are exceeded in the river.

Another public health concern is shellfish consumption. The Maine Department of Marine Resources (DMR) regularly determines bacteria levels in shellfish harvesting areas as required by the National Shellfish Sanitation Program. Harvesting areas which are closed due to pollution are patrolled by State and local marine wardens to prevent illegal harvesting of shellfish, thereby protecting consumers (Appendix II, Table 7).

Sediment Contamination

Contact: Barry Mower, DEP BLWQ, Division of Environmental Assessment
(207) 287-7777

Waterbodies in Maine with sediments known to be contaminated by toxics are listed in Table 3-7.2. Although the sediments of these waterbodies are known to be contaminated with hazardous materials, the DEP is unsure of how this relates to the overall water quality of each. For this reason, the list of waterbodies contaminated by sediments is not reflected in the water quality attainment status (Appendix I).

Table 3-7.1 Maine 1997 Fish Consumption Advisories

Consumption Advisory for ALL Inland Surface Waters Due to Mercury

☞ *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., a 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 limits for cold water species.

Specific Freshwater Fish Consumption Advisories

WATERBODY	SEGMENT	MAX CONSUMPTION LEVEL	CHEMICALS OF CONCERN
Androscoggin River	Gilead to Merrymeeting Bay	6 meals/yr	PCBs & dioxin
Kennebec River	Madison to Edwards Dam	1-2 meals/mo	PCBs & dioxin
	Edwards Dam to the Chops	NONE	PCBs & dioxin
Penobscot River	Below Lincoln	1-2 meals/mo	PCBs & dioxin
Salmon Falls River	Below Berwick	6 meals/yr	PCBs & dioxin
E Br Sebasticook R.	Below Corinna	1 meal/mo	PCBs & dioxin
W Br Sebasticook R.	Below Hartland	2 meals/mo	PCBs & dioxin
Little Madawaska R & tributaries	Madawaska Dam to Grimes Mill Road	NONE	PCBs
Green Pond, Chapman Pit, Greenlaw Brook	All waters (Loring Air Force Base)	NONE	PCBs
Red Brook	All waters (Scarborough)	6 meals/yr	PCBs

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 lobster). A*ll 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, women who may become pregnant and children less than 8 years old*, are advised to limit the 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.

Table 3-7.2. Waterbodies in Maine with Sediments Contaminated by Toxics.

Date Sampled	Waterbody	County	Extent	Pollutant	Source
1977	Silver Lake		16 acres	Copper	CuSO4
1985	Riggs Brook		0.5 mile	PCBs	salvage
1987	Dennys River		0.1 mile	PCBs	salvage
1987	Cooks Brook		2 miles	Cadmium	plating
1988	Annabessacook Lake	Kennebec	400 acres	Dimethyl formamide toluene & TCE	Landfill Superfund
1988	Quiggle Brook		6 miles	Chlorinated solvents	recycling Superfund
1989	Piscataquis		1.5 miles	TRIS & other	textile mill

	River			organics	
1991	Androscoggin River		124 miles	Dioxins	Pulp mill
1997	Androscoggin Lake	Kennebec	unknown	Dioxins	Pulp mill
1993	Embden Pond	Somerset	unknown	Lead [1]	unknown
1993	Portland Lake	Aroostook	unknown	Lead [1]	unknown
1993	Keewaydin Lake	Oxford	unknown	Lead [1]	unknown
1993	North Pond	Oxford	unknown	Lead [1]	unknown
1993	Varnum Pond	Franklin	unknown	Lead [1]	unknown
1993	Forest Lake	Cumberland	unknown	Lead [1]	unknown
1993	L. Range Pond	Androscoggin	unknown	Lead [1]	unknown
1993	Knight Pond	York	unknown	Lead [1]	unknown
1993	Balch and Stump Ponds	York	unknown	Lead [1]	unknown
1993	Wells Pond	Oxford	unknown	Lead [1]	unknown
1993	Bauneg Beg Lake	York	unknown	Lead [1]	unknown
1993	Bubble Pond	Hancock	unknown	Lead [1]	unknown
1993	Long Pond	Hancock	unknown	Lead [1]	unknown
1993	Little Ossipee L.	York	unknown	Lead [1]	unknown
1993	Togus Pond	Kennebec	unknown	Lead [1]	unknown
1994	Alligator Pond	Piscataquis	unknown	Lead [1]	unknown

1. Source: REMAP data for sediment samples equal to or exceeding NOAA effects range median (Long, Edward R. and L.G. Morgan, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NOS OMA 52, Seattle, Washington.)

Aquatic Life Impacts

Contact: Susan Davies, DEP BLWQ, Division of Environmental Assessment, (207) 287-7778.

The water quality standards for the State of Maine include explicit narrative criteria pertaining to the condition of the aquatic life. Aquatic life impacts are identified through the use of a multivariate statistical model developed by analyzing the State's large standardized database of samples of the benthic macroinvertebrate community. The protocol for data collection and analysis and for the detection of classification violations has been standardized and functional since 1993 but has yet to pass through all administrative procedures to become formal regulations. A detailed account concerning the use of biological information and the development of biological criteria in Maine may be found in "Maine Biological Monitoring and Biocriteria Development Program" by S.P. Davies, L. Tsomides, D.L. Courtemanch and F. Drummond, Maine Department of Environmental Protection, Augusta, Maine, 1995.

The specific aquatic life language in the standards is drafted in such a way as to provide for the use of existing benthic macroinvertebrate community assessment approaches in order to determine attainment of the narrative standards (Table 3-7.3). Linear discriminant functions have been developed to discriminate between three aquatic life classes, in terms of the aquatic biota they are capable of supporting. The decision-making protocol involves the computation of an array of indices and measures of benthic macroinvertebrate community structure and function. The resulting mosaic of information is then subjected to linear discriminant analysis, from which a probability of the likelihood of membership within one of four classes is computed. These classes correspond to the narrative standards of the three aquatic life classes in the water quality classification law, and a fourth "class" representing non-attainment of minimum standards.

Bioassessment Summary

The Biological Monitoring Program has established about 260 biomonitoring stations on 84 rivers and streams since 1983. Many of these stations have been assessed only once in the period of record, while several have been revisited annually. The State began a watershed based assessment strategy in 1994 which directs scheduling of sampling to coincide with the NPDES relicensing schedule. Following full implementation, this approach will allow for re-visits to reaches of concern within major catchments every five years.

The Biological Monitoring Program has also identified 72 (28%) stations that do not attain the aquatic life standards of their assigned water quality classification according to results of the biocriteria model. Twenty-nine of these stations (designated NonAttainment) do not attain any State standard and are therefore listed as not attaining minimum "fishable" standards. This is a small overall decline from the 1996 report (31). Several of the non-attainment stations have had water quality management interventions that have remedied the aquatic life classification violations and so are not listed in Appendix I. Major reasons for non-attainment include impoundment, low or manipulated flow, and point and non-point source pollution. Maine has expanded the use of bioassessment to urban and small agriculturally affected waters in the last two years. This effort has identified a number of "new" nonattaining waters.

Table 3-7.3. Maine's Water Quality Classification System for Rivers and Streams, With Associated Biological Standards.

Class	Management	Biological Standard
AA	High quality water for recreation and ecological interests. No discharges or impoundments permitted.	Habitat natural and free flowing. Aquatic life as naturally occurs
A	High quality water with limited human interference. Discharges restricted to non-contact process water or highly treated wastewater equal to or better than the receiving water. Impoundments allowed.	Habitat natural. Aquatic life as naturally occurs.
B	Good quality water. Discharge of well treated effluent with ample dilution permitted.	Habitat unimpaired. Ambient water quality sufficient to support life stages of all indigenous aquatic species. Only non-detrimental changes in community composition allowed.

C	Lowest water quality. Maintains the interim goals of the Federal Water Quality Act (fishable/swimmable). Discharge of well treated effluent permitted.	Ambient water quality sufficient to support life stages of all indigenous fish species. Change in community composition may occur but, structure and function of the community must be maintained.

Fish Kills
Contact: David Courtemanch, DEP BLWQ, Division of Environmental Assessment, (207) 281-7789.

Fish kills in Maine have been on the decline for many years as treatment has been imposed and BMPs implemented for agricultural practices. In 1992, Maine finally achieved a perfect record with no pollution-related fish kills. The State has not been able to maintain that record, however, the number of incidents per year has been very low. In this 1996-97 reporting cycle, 1 fish kill was reported (Table 3-7.4). This kill was caused by agricultural pesticides.

Table 3-7.4. Pollution-Related Fish Kills in Maine: 1996 and 1997.

Waterbody	Town	Date	Species	Estimated Number	Cause
Whitney Brook	Bridgewater	7/26/97	mixed	~1000	Manex

Section 303(d) Waters
Contact: David Courtemanch, DEP BLWQ, Division of Environmental Assessment, (207) 287-7789.

Section 303(d) of the Clean Water Act requires that Maine identify waterbody segments which do not or will not meet state water quality standards even after the implementation of technology-based controls for both point sources and non-point sources of pollution. This list includes not only waterbody segments which do not attain water quality standards, but also those which are in attainment but are considered to be threatened. The 303(d) process subsequently requires the establishment of Total Maximum Daily Loads (TMDLs) or other control methods in order to assure the attainment of water quality standards.

The State is required to identify priority waters for which it will develop TMDLs within the next two years and to include a 13-year schedule for completion of all TMDLs. Considerations are primarily geographic, but pending NPDES permits and treatment plant construction proposals are also considered. TMDLs for point sources may consist of discharge limitations, while those for non-point sources may include activities that control factors causing non-attainment. Some waters were given extended dates if the data used for listing was not considered current, allowing the State time to resample these waters. It should be noted that all freshwaters are listed because of the consumption advisory for mercury, however, the State recommends that the USEPA conduct any TMDL for such sources.

In the development of the 303(d) list, the 1998 305(b) Water Quality Assessment report, including the 304(l) lists, the 314(a) Clean Lakes list and the 319 State Non-Point Source Assessment were all reviewed. Some waterbodies included on these lists generally do not attain water quality standards because of activities that have no technology-based controls. Lakes selected for the list include those lakes identified on the water quality assessment as failing to meet GPA standards due to repeated blue-green algal blooms or a demonstrated trend of increasing trophic state. Also included are some lakes which are viewed as particularly threatened and for which a TMDL process may be appropriate.

Appendix II contains the 303d list of waterbodies and the priority waterbodies are identified. Eight tables are included in the list: 1. Rivers and streams requiring TMDLs, 1a. Rivers and streams not requiring TMDLs, 1b. CSO affected waters, 2. Lakes requiring TMDLs, 3. Marine waters requiring TMDLs, 4. Rivers and streams removed from the previous list, 5. Lakes removed from the previous list , and 6. Marine waters removed from the previous list.

PART IV

GROUND WATER ASSESSMENT

Chapter 1 - Overview

Public interest in ground water focuses primarily on its use as a drinking water supply for humans and livestock and as a source of process water for industry. More than 60% of Maine households draw their drinking water from ground water supplied from private or public wells, or springs. Ground water is the source of approximately 98% of all the water used by households with individual supplies. In addition, nearly 60% of the water needed for Maine livestock is provided by ground water. Industrial ground water use is slightly less than the volume withdrawn for drinking water. Federal requirements for surface water treatment are increasing the shift to ground water use for public water supplies.

Ground water is withdrawn from two basic types of aquifers in Maine: unconsolidated glaciofluvial deposits (stratified drift or sand and gravel aquifers), and fractured bedrock. The stratified drift deposits are the most favorable for development of large volume water supply wells, but these deposits are limited in size and distribution (less than about 10% of the state). An estimated 44% of ground water withdrawals occur in the southern part of the state, in Cumberland and York counties, according to U.S. Geological Survey (USGS) figures in 1985. In these counties the geology is favorable (major sand and gravel aquifers), and water demand is high due to the heaviest concentration of people and businesses. Bedrock aquifers underlie the entire state. They are also used for domestic, commercial, industrial and agricultural purposes, and for small public supplies such as schools, restaurants, and summer camps.

Generally, the ground water supply in Maine is adequate. The total withdrawal of ground water by all water users is less than one percent of the annual ground water recharge each year. The remaining annual ground water recharge is lost through evapotranspiration or discharges to ponds, lakes, rivers, and streams.

A significant portion of Maine's ground water may be threatened by contamination, particularly in unforested areas (approximately 11% of the State). During the last decade, numerous wells in Maine have been made unpotable by nonpoint source pollution. As public concern about ground water quality increases, more widespread monitoring and detection of contamination can be expected. The Maine Environmental Priorities Project has identified drinking water quality, including private and public well supplies, as a high risk issue ("Maine Environmental Priorities Project, Report from the Steering Committee, Consensus Ranking of Environmental Risks Facing Maine", January, 1996). Because of slow ground water flow rates and low biological activity, ground water contaminants are extremely persistent. Centuries may be required for natural processes to restore some contaminated ground water to potable standards.

In 1989, the State adopted the Maine Ground Water Management Strategy to articulate its ground water protection policy. In 1990, the State also formulated its Nonpoint Source Pollution Management Plan. This plan identifies the major sources of nonpoint source pollution to Maine's ground water and surface water and proposes to implement pollution prevention programs.

Major impediments to effective ground water protection in Maine are (1) absence of a complete ground water quality database to assess the extent of degradation, (2) lack of data to quantify the impact of some nonpoint pollution sources, (3) inadequate State and Federal funding for ground water research and ground water protection programs and (4) general public unfamiliarity with key ground water concepts and issues. Public misconception about ground water is probably the major factor contributing to degradation of this resource. The State of Maine will continue to work with the USEPA to address these issues through Maine's Comprehensive Ground Water Protection Program, the Source Water Protection Program, and other initiatives.

Chapter 2 - Assessment of Ground Water Quality

Ground water in Maine is classified by its suitability for drinking water purposes. Under the Maine Water Classification Program, ground water is classified as either potable (GW-A) or unpotable (GW-B). Water is unpotable when the concentrations of chemical compounds detected exceed either the Maximum Contaminant Levels (MCL) or the Maximum Exposure Guidelines (MEG) as defined in the Rules Relating to Drinking Water administered by the Maine Department of Human Services (DHS). Although there are many localities where ground water is unpotable and highly contaminated, no ground water is currently classified GW-B. The state is not currently attempting to designate non-attainment areas.

Detailed quantitative estimates of the statewide extent of ground water contamination are not currently available. In addition, current information about ground water contamination in Maine does not necessarily portray the situation accurately. This information reflects contaminants that have been looked for, where they have been looked for, and where they have been found. Further, the number of wells contaminated by a specific pollution activity does not necessarily reflect its overall ground water pollution potential since some activities (e.g. agriculture) occur in sparsely populated areas with few available wells to monitor.

Ground Water Monitoring

Monitoring of ground water in Maine is either site-specific or generalized. Monitoring at a particular site is generally done to gather data on water quality impacts of particular activities, and may or may not be research-related. Most of the ground water data collected in Maine is the result of permit conditions, enforcement agreements or impact assessments. This information is scattered in a number of state agencies including the DEP Bureaus of Land and Water Quality, and Remediation and Waste Management; the Department of Transportation, Water Resources and Hazardous Waste Section; the Department of Human Services (DHS), Division of Health Engineering, the DHS Environmental Health Unit, DHS Health and Environmental Testing Laboratory; and the Department of Agriculture, Food and Rural Resources, Board of Pesticide Control. Other information is collected by the Department of Conservation, the U. S. Geological Survey, and the Maine Geological Survey (MGS), (also known as the Natural Resource Information and Mapping Center/Geology). The data are stored on paper or in computer files. Many of these data are potentially useful for research purposes but are not easily accessed by either the public or by other agencies. This access problem is the subject of a three-phase study of ground water data management, the first two parts of which are completed. Phase II resulted in specific and detailed recommendations for a more efficient and accessible system. This effort is concurrent with the EPA - Maine data management pilot study aimed at improving data communication between the EPA, Maine, and other state or federal agencies.

The terms "generalized monitoring" or "ambient monitoring" are intended here to refer to large area, long-term monitoring conducted to obtain trend information on ground water quality or quantity. The MGS and the U.S. Geological Survey (USGS) generally carry out such monitoring under one of several cooperative agreements. The USGS maintains a statewide network of ground water observation wells to track changes in water quality and quantity. The data thus derived are incorporated into the maps and reports generated by the program and have proven invaluable to town planning boards and State efforts such as the registration of underground oil storage tanks and site reviews of various land use proposals.

Within the DEP, site-specific ground water monitoring data are obtained either by Department staff, permit-holders, or as a result of enforcement agreements. Ground water samples are generally tested in commercial laboratories according to EPA or DEP standard methods. The Bureau of Land & Water Quality requires ground water monitoring at project sites that are subject to its jurisdiction when the existing or proposed activity either poses a risk to ground water quality or quantity or an adverse impact has already occurred.

Activities that are considered a risk to ground water quality or quantity include: quarries, borrow pits, metallic mineral mines, fuel storage/handling areas (wood waste and petroleum), golf courses, infiltration basins and wastewater treatment lagoon/spray irrigation areas. Also of concern are subdivisions utilizing large-volume or community subsurface wastewater disposal systems, or nitrate-reduction (e.g. peat-matrix) systems. Geologic settings considered to be particularly susceptible to adverse impacts are those located over mapped sand and gravel aquifers, shallow-to-bedrock areas within sensitive lake watersheds are also generally required to monitor ground water.

While ground water monitoring data from these project sites have generally been reviewed on a case-by-case basis, efforts are underway to accomplish a comprehensive analysis and compilation of this information. Objectives of this analysis are to determine the consistency of monitoring program requirements between sites engaged in the same activity, to determine the extent of compliance with ground water quality/quantity standards, and to determine whether monitoring parameters required for a particular activity are appropriate. Based on these determinations, it is expected that required monitoring programs for project sites might be amended or eliminated. In addition, it is planned that ground water monitoring data for these facilities will be incorporated into a database to facilitate access to, and management of, this information.

Similarly, the DEP Bureau of Remediation and Waste Management (BRWM) requires periodic sampling and/or reports from hazardous waste storage facilities and generators. Additional sampling may also be required under the terms of enforcement agreements. The samples are generally tested in commercial laboratories according to EPA standards. BRWM field staff sample ground water to determine ground water quality impacts associated with uncontrolled hazardous waste sites, oil or fuel spills from stationary or mobile sources and from approved hazardous waste or hazardous materials storage facilities. BRWM requires ground water monitoring at all licensed landfills. Monitoring of upgradient and down gradient wells for detection parameters is required at a minimum. Detection parameters are considered reliable indicators of potential effects of the landfill on ground water. Facilities are required to monitor for an extensive list of compliance parameters whenever detection monitoring indicates a significant trend of change in ground water quality. Some BRWM ground water monitoring is intended to help locate new water supplies to replace those polluted by leaking underground storage tanks.

MGS sand and gravel maps will be useful in defining aquifer boundaries. Since the boundaries are in GIS, they can be combined with the DHS water supply data and the contaminant site and land use data available in DEP databases.

As far as characterizing the physical and chemical attributes of the stratified drift aquifers, the MGS is at the "average characteristics" stage. While site specific data do exist for some aquifers (primarily in the vicinity of ground water resource evaluation projects and contamination sites), complete physical pictures of an aquifer system do not exist. The USGS is working with the Town of Windham on just such a project, involving seismic work and drilling as well as geologic mapping. Similarly, MGS has some ambient water quality data but has not fully characterized any one aquifer system. Hard data on the exact natural chemical processes controlling ground water chemical evolution that occur along a flow path in a sand and gravel aquifer are also lacking.

In early 1998, several incidents of MTBE contamination arising from gasoline spills focused the attention of the public and policy makers on the potential threat to ground water posed by MTBE. The Governor directed state health (DHS) and environmental (DEP, MGS) agencies to study the occurrence and concentrations of MTBE in Maine's drinking water supplies. The report is due in October of 1998, and findings from this study will be included in the year 2000 305b report.

Overview of Ground Water Contamination Sources

Almost all ground water contamination in Maine originates from nonpoint source pollution rather than point source pollution. Table 4-2.1 lists the contaminant sources that are the greatest threats to ground water quality.

The following discussion focuses primarily on nonpoint contamination sources that appear to be responsible for most ground water contamination in the State: agriculture, hazardous substance sites, spill sites, landfills, leaking underground and above-ground storage tanks, road-salt storage and application, septic systems, shallow well injection, saltwater intrusion, and waste lagoons. In addition to these major sources, diverse land uses such as sludge, septage and residual land applications, metallic mines, borrow pits and quarries, golf courses, dry cleaners, automobile service stations, cemeteries, and burned buildings are also potential threats to ground water.

Table 4-2.1. Major Sources of Ground Water Contamination

Contaminant Source	Ten Highest Priority Sources (X)	Factors Considered in Selecting a Contaminant Source	Contaminants
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications	x	BCDE	EA
Irrigation practices			
Pesticide applications	x	AFGBE	ABD
Storage and Treatment Activities			
Land application			
Material stockpiles			
Storage tanks (above ground)	x	ACDE	DEC
Storage tanks (underground)	x	ADEC	DEC
Surface impoundments			
Waste piles			
Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills	x	ACDE	EGHC
Septic systems	x	ABDC	EJCKL
Shallow injection wells	x	DC	
Other			
Hazardous waste generators			
Hazardous waste sites	x	ABCDEF	CDHAB M-non-halogenated solvents
Industrial facilities			
Material transfer operations			
Mining and mine drainage			
Pipelines and sewer lines			
Salt storage and road salting	x	ABCDFE	GH
Salt water intrusion			
Spills	x	ACEFD	ABCD
Transportation of materials			
Urban runoff			
Other sources			

Petroleum Product Spills and Leaking Storage Tanks

Underground Tanks

Contact: Bruce Hunter, DEP BRWM, (207) 287-7672.

Non conforming leaking underground storage tanks (LUST's) are viewed as the biggest threat to ground water quality in Maine. The most common petroleum product stored in underground storage tanks is fuel oil, followed by gasoline. Currently, 350 to 400 petroleum LUST sites or spill sites have been prioritized for remediation, according to the hazards they pose to water supply wells and the size of the potentially affected population using groundwater for a drinking water source. Two hundred and seventy wells are contaminated by petroleum products at these sites. Since 1980, LUST facilities have contaminated over 550 private drinking water supply wells. From 1988 to 1993, Maine's LUST remediation program has replaced 286 contaminated wells serving 1,154 people. An estimated 183 additional public and private water supply wells, serving 6,920 Mainers, have been saved by DEP-funded remediation.

Above Ground Tanks

Contact: David McCaskill, DEP BRWM, (207) 287-7056.

Home heating oil storage tanks, which are often above-ground storage tanks (AST's), are a significant contributor to ground water contamination due the leakage of stored petroleum products. The State Fire Marshal's office lists 294 AST's permitted since 1994. The number of tanks attached to heating systems, which would include homeowner tanks, is not tabulated by any state agency, but a rough estimate would number more than 300,000 tanks. AST's represent an ongoing and increasing threat to ground water quality. In the four-year period of 1988 to 1992, over 784 spills were recorded. DEP staff respond to approximately 200 home heating oil spills a year; staff responded to 30 incidents in January of 1996 alone. AST related spills include tank overfills, ruptures, tip-overs and other mishaps. The Pollution Prevention Program and the Maine Oil Dealers Association have cooperated to educate vendors and owners on how to protect their tanks and operate them safely.

Although fuel oil and gasoline are not classified as hazardous substances, many of their constituent compounds, such as benzene, are carcinogens at very low concentrations. The data in Table 4-2.2 come from the sites on the LUST priority list:

Table 4-2.2. LUST Priority Sites - Contamination Summary

Number of Contaminated Wells*	Number of Contaminated Public Water Supplies	Number of Threatened Wells*	Number of Threatened Public Water Supplies
270	11	342	43

* Does not include public water supplies.

To control the LUST threat, in 1985 the Maine Legislature passed a law to regulate underground petroleum storage tanks. This law required that all tanks be registered with DEP by May 1, 1986, regardless of size, use, or contents. The law also established procedures for abandonment of tanks and prohibits the operation, maintenance, or storage of petroleum in any storage facility or tank that is not constructed of fiberglass, cathodically protected steel, or other non-corrosive material after:

A. October 1, 1989, if that facility or tank is more than 15 years old and is located in a sensitive geological area;

B. October 1, 1991, if that facility or tank is more than 25 years old, or if that facility or tank is more than 15 years old and is located in a sensitive geological area;

C. October 1, 1994, if that facility or tank is more than 20 years old, or if that facility or tank is more than 15 years old and is located in a sensitive geological area; and,

D. October 1, 1998, for all remaining unprotected facilities or tanks.

NOTE: A "sensitive geological area" means: 1) a significant groundwater aquifer; 2) a primary sand and gravel recharge area; 3) locations within 1,000 feet of a public drinking water supply; or, 4) locations within 300 feet of a private drinking water supply. Sensitive geological areas around surface water bodies include all areas within 1,000 feet of the intake of a public water system, except on rivers and streams where the term means areas within 1,000 feet of the intake and upstream on either shore. All areas within 300 feet of the intake point of a private water supply in a lake, pond, or other surface water body are sensitive geological areas, except on rivers and streams where the term means areas within 300 feet of the intake and upstream on either shore.

If the age of the underground tank(s) cannot be determined, it is presumed to be 20 years old as of October 1, 1989.

To date, approximately 39,850 tanks have been registered and an estimated 4,000 tanks remain unregistered. Since 1986, approximately 27,750 inactive or old tanks have been removed. Figure 4-2.1 shows the number of drinking water supply wells contaminated by LUST since 1986. Figure 4-2.2 shows the change in the type of tank making up the underground storage tank population in Maine. Figure 4-2.2 indicates a decrease in non-conforming UST's and an increase in protected replacement UST's, a trend, which will help enhance ground water protection. For every $1 spent on preventative measures required by DEP regulations (Chapter 691), an estimated $3 of clean up and third-party damage claim costs are avoided.

A new database has been created for the LUST program. The database became operational in 1995, and data on current ground water contamination caused by LUST's are now accessible by computer to DEP staff.

Figure 4-2.1. Number of Private Drinking Water Supply Wells Contaminated by Leaking Underground Petroleum Storage Facilities: 1986-1993.

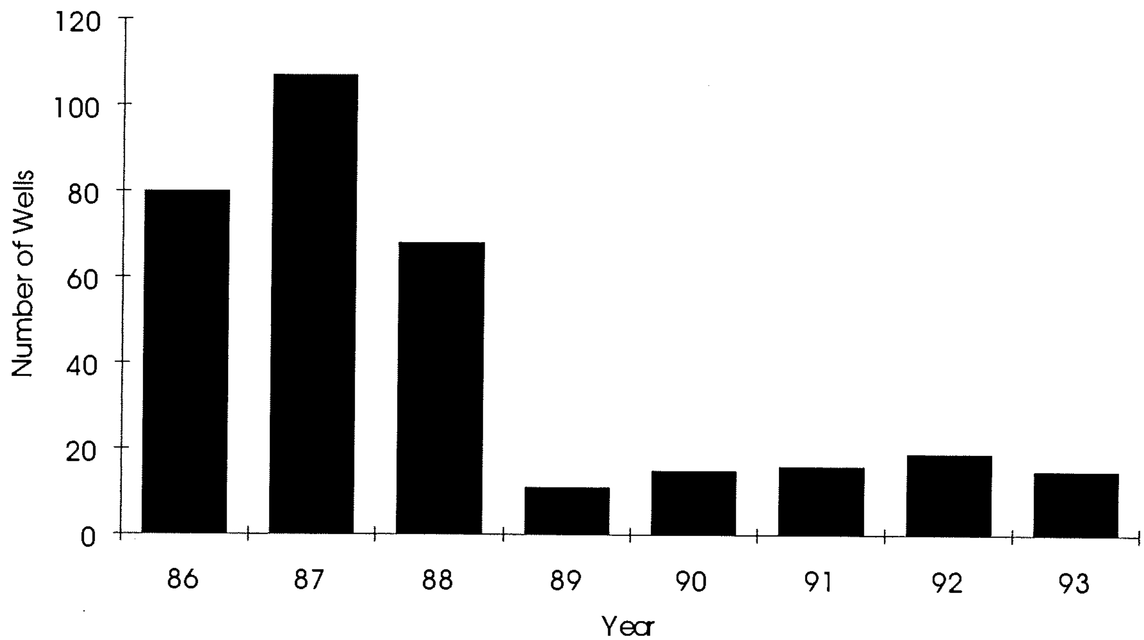
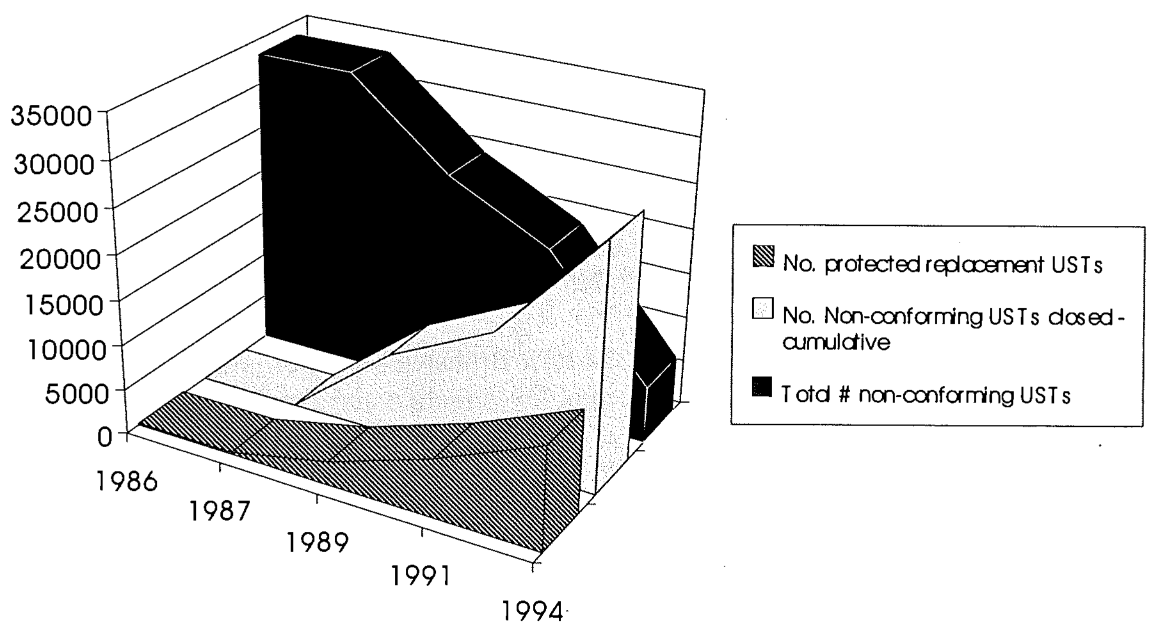


Figure 4-2.2. Changes in the Make-Up of the Maine UST Population.



Spills
Contact: Lyle Hall, DEP BRWM, (207) 287-7499.

The DEP BRWM responded to approximately 4,800 oil spills between January of 1993 and December of 1995 (1995 data are 85% complete). Over 80% of these responses involved discharges of petroleum products to soil and ground water. Between 1993 and 1995, discharges of petroleum products contaminated over 180 wells; sources of these discharges range from overturned tanker trailers to tank overfills (Table 4-2.3).

Table 4-2.3. Sources of Spills 1993 through 1995

Source	Percent of Total Spills
Industrial Sources	27%
Residential Sources	26%
Transportation	18%
Oil Terminals	16%
Other Sources	13%

Federal Facilities

Fuel spills or leaks occurred on 54 occasions at six different federal facilities during 1994 and 1995. Most spills in this time period were a gallon or less and probably didn't cause significant surface or ground water contamination. Two of the larger spills were 500 gallons at Portsmouth Naval Shipyard in Kittery and 2,500 gallons at the Loring Air Force Base (Loring AFB) in Limestone. These spill sites have not been studied to determine whether they have caused ground water contamination. Both of the major fuel pipelines in the State of Maine that were operated by the U.S. Government were decommissioned in 1994. One extended from Searsport to Limestone, serving Loring AFB; the second ran from Harpswell to Brunswick and served Brunswick Naval Air Station (Brunswick NAS). In the past, numerous leaks have occurred along these pipelines.

A Case Study: Brunswick Naval Air Station Ground Water Contamination.
Contact: Mark Hyland, DEP BRWM, (207) 287-7673.

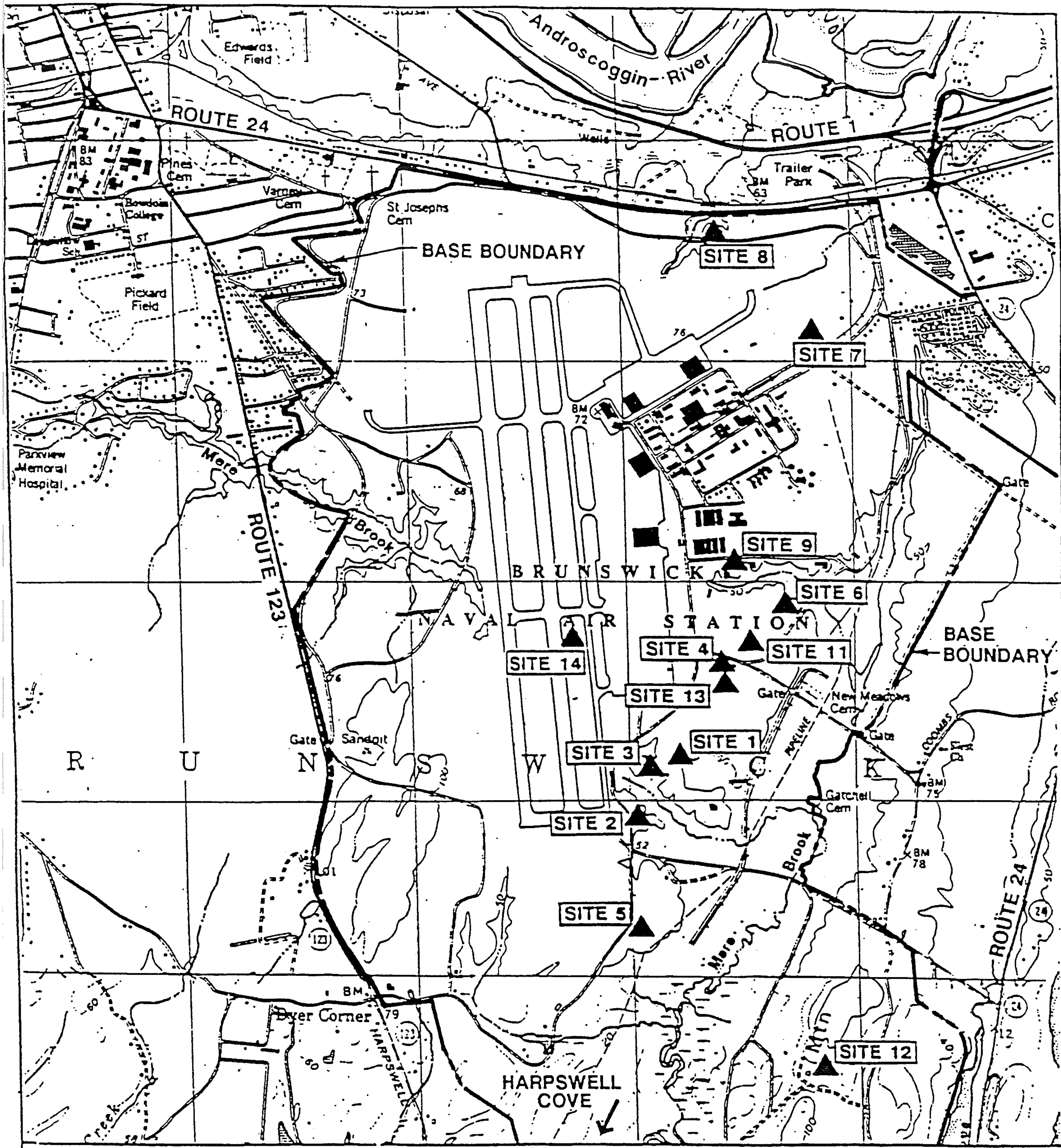
Remediation of ground water contamination in the East Brunswick aquifer is ongoing. Thirteen sites (Figure 4-2.3) are currently part of the Remedial Investigation and Feasibility Study:

Site 1: Orion Street Landfill - North
Site 2: Orion Street Landfill - South
Site 3: Hazardous Waste Burial Area
Site 4: Acid/Caustic Pit
Site 5: Orion Street Asbestos Disposal Site
Site 6: Sandy Road Rubble and Asbestos Disposal Site
Site 7: Old Acid/Caustic Pit

Site 8: Perimeter Road Disposal Site
Site 9: Neptune Drive Disposal Site
Site 11: Fire Training Area
Site 12: Explosive Ordinance Dump Training Area
Site 13: Defense Reutilization and Marketing Office (DRMO)
Site 14: Old Dump Number 3

The U.S. Navy has constructed a water treatment plant at the base which treats contaminated ground water from Sites 1 and 3 and the Eastern Plume area. Site 1 and 3 were used by the Navy for approximately 30 years for the disposal of paint wastes, solvents, household waste, pesticides, petroleum products, airplane parts, and other wastes. The landfills are leaching contaminants into an adjacent stream and ground water in the area is contaminated with volatile organic compounds. Remediation of the landfills involves pumping contaminated ground water out of the waste and piping it to the ground water treatment plant. A slurry wall has been completed around the waste and keyed into a clay layer underlying the landfilled material. An engineered cap has been placed over Sites 1 and 3 to prevent infiltration of water into the waste. In December 1994, the Navy drilled two ground water extraction wells into the landfill and five wells into the Eastern plume of contaminated ground water that is moving toward Harpswell Cove. The wells in the Eastern Plume, located near the former base landfills, have been connected to the treatment plant pipeline and pumping of the contaminated ground water commenced in May 1995.

The Fire Training Area (FTA), Site 11, has been used for fire-fighting training since the 1950's. Fire-fighting exercises at the FTA introduced various liquids into the soils at the site, including waste oils, fuels, solvents, and other liquids. The FTA has contributed to the ground water contamination in the Eastern Plume. Reportedly, the only measure taken before 1987 to control infiltration of the liquids into the soils was to saturate the ground surface with water to float the product prior to a burn. In 1987, the FTA was upgraded with the installation of a 40 feet x 40 feet concrete liner and berms. Additionally, a collection system, including piping and a 6,000 gallon fiberglass underground storage tank, was installed north of the training area to contain unburned liquids. Information obtained in 1993 by NAS Brunswick personnel suggested that drums containing unknown liquids might have been buried at the FTA between 1970 and 1980. Field activities conducted at the FTA site included magnetometer and ground penetrating radar surveys, followed by test pitting of 14 anomalous target areas identified during the geophysical surveys. These investigations located buried drums and miscellaneous containers at five of the fourteen test pit locations; drums containing solvents and petroleum compounds were found in various stages of deterioration. Metal debris, drums, and miscellaneous containers were excavated and consolidated into 18 drums and seven 1-cubic-yard containers in December of 1994. These wastes and 11 tons of contaminated soil were removed from the FTA site in June of 1995; contaminated soils were placed in the landfills at Sites 1 and 3 and capped. Samples collected from soils remaining at the test pit sites indicate the presence of low concentrations of organic compounds and inorganic analytes. A significant volume of metal debris also remains at the site; the average depth of the contaminated soils and metal debris is approximately five feet. The underground storage tank, associated piping and other elements of the collection system, including approximately 4,500 gallons of oily water contained in the tank, were also removed and disposed of offsite. Contaminated groundwater from the FTA is pumped and treated at the base water treatment plant.



SOURCE: U.S.G.S. QUADRANGLES, BRUNSWICK, AND ORRS ISLAND, ME. 1984, 1978. 7.5 MINUTE SERIES.

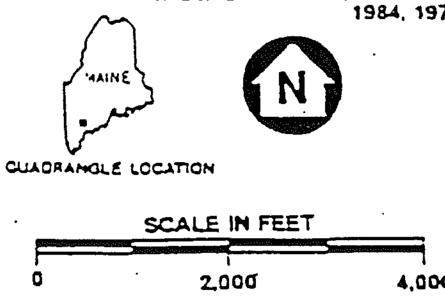


Figure 4-2.3.
Brunswick Naval Air Station
Ground Water Threats
Site Location Map.

6336-05

Agriculture
Contact: Craig Leonard, Maine Department of Agriculture, (207) 287-3117.

In 1992, the total estimated cropland and pasture land in Maine was slightly greater than 660,000 acres, a decline of approximately 40,000 acres since 1987. The agricultural community uses chemicals for pest control and weed eradication; in addition, many farmers apply chemical fertilizers and manure. These are major potential sources of ground water contamination. Farmers apply over 58,000 tons of chemical fertilizers and 2.1 million tons of manure to agricultural land in Maine each year. In 1992 the Department of Agriculture estimates that chemical fertilizer was spread on over 250,000 acres. The major areas of chemical application include potato fields in Aroostook County, blueberry barrens in Hancock and Washington County, and apple orchards and forage cropland in Central Maine. Pesticides and nitrates are the main agricultural ground water contaminants.

Pesticides.
Contact: Robert I Batteese, Jr., Maine Board of Pesticide Control, (207) 287-2731.

Although at high concentrations pesticides are known to have acute health effects, because they are generally present in low concentrations in ground water, most of the concern has been focused on their chronic health effects such as cancer and birth defects. In Maine, increased concern about the health effects of agricultural pesticides in ground water began in 1980 when the pesticide aldicarb (Temik) was found in private wells near potato fields. Forty-seven percent of the 304 wells sampled showed detectable amounts of the pesticide and its toxic derivatives. Subsequently, a study by researchers at the University of Maine at Orono detected traces of the pesticide azinphos methyl (Guthion) in ground water from blueberry regions in Washington and Hancock counties. A summary of pesticide studies follows:

1985: The Natural Resource Information and Mapping Center/ Geology (MGS) and the Maine Department of Agriculture, Food and Rural Resources (DAFRR) began a three-year evaluation of the effects of agricultural pesticides on ground water quality. The researchers collected 229 samples from 95 wells in potato, orchard, blueberry, and market garden/forage cropland areas and tested them for pesticides and nitrate. Fourteen percent of these samples tested positive (mostly at trace levels) for various pesticides. Seven different pesticides were detected in 19 out of 68 wells sampled in potato regions. Trace concentrations of hexazinone were detected in 2 of 21 samples in blueberry areas. The study results suggest that bedrock wells overlain by till in potato regions have the highest incidence of contamination by agricultural pesticides.

1989: MGS, DAFRR, and USEPA tested 51 private wells near potato fields in Aroostook County to assess ground water contamination vulnerability from agricultural chemicals. Water from twenty-two of these wells (42%) showed traces of pesticide.

1990: The University of Maine and the Board of Pesticides Control (BPC) conducted a study to evaluate the effectiveness of immunoassay testing for monitoring pesticides in ground water samples. The study sampled 58 wells on each of three separate occasions; analytical data showed that:

- 31% had detectable concentrations of atrazine at least once during three sample events. Most of these wells had less than 0.60 μg/l atrazine; only two wells demonstrated concentrations of atrazine higher than the MCL of 3.0 μg/l.

- 12% had detectable concentrations of alachlor at least once during three sample events. Concentrations in each of these wells exceeded the maximum contaminant goal level (MCGL) of 0 μg/l in one or more of each sampling event.

- 5% had detectable concentrations of carbofuran in one of the three sample events. None of these were near the MCL of 40 μg/l.

1992: The BPC and the University of Maine conducted the Maine Triazine Survey. The purpose of the study was two-fold. The first purpose was to verify the reliability and accuracy of immunoassay tests for the triazine pesticides. Second, data gathered during the project would provide insight into the quality of Maine's ground water and aid in the development of Maine's Ground Water Management Plan.

One hundred and fifty-two samples were collected and analyzed for the triazine herbicides. Approximately half of the samples were collected from sites near tilled corn fields. The remaining samples were collected from three non-tilled triazine use areas: orchards, Christmas tree plantations, and railroad rights-of-way. None of the sample results exceeded the health advisories for any of the pesticides tested. The highest atrazine sample results were 1.2 parts per billion (ppb), only 40% of the 3 ppb health advisory level.

Of the 152 samples subjected to immunoassay tests:

- 21% tested positive for the triazine immunoassay (which reacts to both atrazine and simazine). High-performance liquid chromatography (HPLC) analysis found 33 (22%) of samples showed a pesticide concentration above the 0.04 ppb HPLC detection limit. In summary:

- 20% of all sampled wells had confirmed atrazine detections. Of these 31 sites with confirmed detections, 25 were near forage corn, 3 were near railroad rights of way and 3 were near Christmas tree plantations.

- 3% of all sampled wells had confirmed simazine detections and only 1 sample (<1%) had a confirmed cyanazine detection.

1994: The large number of hexazinone detections in the 1994 BPC study was one piece of a growing body of information about its potential to contaminate ground water, One-hundred thirty-nine sites were sampled in blueberry growing areas for the herbicide. Detectable residues were found at 96 (69%) of the sites. In 1993, the highest level of hexazinone was detected, 29 ppb. The sample was taken from a two inch test well located in a blueberry field. The average concentration in all studies remains below 4 ppb, which is less than 2% of the USEPA lifetime health advisory for hexazinone. Because of these findings and public concern about the herbicide, the BPC is developing a state management plan for hexazinone. A committee was created in 1995 to draft the document which is based on the Maine Generic State Management Plan for Pesticides in Ground Water (June 1994) and EPA pesticide management plan program guidance. The Board will conduct review of the draft and rule making in 1996.

The BPC began an ambitious pesticides-in-ground water monitoring program. The goal was to assess the impact of highly leachable pesticides on Maine ground water across a variety of agricultural and non-agricultural use sites. Corn, potato, blueberry, Christmas tree, rights-of-way, oat, market garden, and orchard sites were included. Wells chosen for sampling were private domestic wells currently used for drinking water within 1/4 mile of an active pesticide use site and down gradient of or even with the use site.

Of the 129 sites sampled, 31 sites yielded detectable pesticide residues in the drinking water. Alachlor, atrazine, diazinon, dinoseb, ethoprop, hexazinone, metalaxyl and metolachlor were detected at quantifiable levels. Dinoseb, canceled by the EPA in the mid-1980's, was the only pesticide found which currently has no registered users. Only diazinon was detected at levels above established drinking water guidelines.

The BPC concluded that pesticide contamination of ground water appears to be prevalent in areas near active use sites, although at levels which do not currently present a health threat to the citizens of Maine when compared to the health-based standards established by the USEPA and the Maine Bureau of Health. Several areas of concern arose from this study:

- Three pesticides, metolachlor, metalaxyl, and ethoprop, were detected at quantifiable levels for the first time in Maine.

- The prevalence of hexazinone, albeit at levels well below established drinking water advisories, is a cause for concern. While health concerns may not be an issue, it is clear that this pesticide has a widespread impact on ground water.

- Triazine does not appear to be a great concern in Maine, unlike other areas of the country. Although atrazine was detected, neither the 1992 study nor this one detected atrazine above established drinking water advisories.

- Pesticide use and disposal of obsolete pesticides by homeowners may present a much larger risk to ground water than previously believed. Both diazinon and dinoseb were detected at only two sites. The contamination was directly linked to improper homeowner use and storage at both sites.

Nitrate. The documented adverse health effects of nitrate (potential methemoglobinemia in infants and complicity in producing carcinogenic nitrosamines), and its mobility in ground water, may make it the most significant agricultural contaminant in Maine ground water. Nitrate in agricultural areas results primarily from application of chemical fertilizers and manure to cropland. Most of the chemical fertilizer is used on potato cropland. Manure is spread primarily on corn and hay fields. In 1992, 755,000 tons of usable manure was produced on Maine farms. A breakdown of the percentage of manure produced by different domestic animals follows in Table 4-2.4:

Table 4-2.4. Domestic Animal Manure Production

Category of Domestic Animal	% of Manure Produced
Dairy cattle	41
Poultry	32
Beef cattle	17
Horses, hogs and pigs, sheep and lambs	10

Twenty-one of 100 wells tested for nitrate in the MGS/DAFRR three-year study cited above had nitrate concentrations exceeding the 10 mg/L drinking water standard. The percentage of wells in each crop type exceeding the drinking water standard was greatest in market garden/forage crop regions (40%) and potato regions (23%). Wells in orchard and blueberry areas did not exceed the standard. Mean nitrate concentrations were highest in market garden/forage crop regions (8.6 mg/L) followed by potato regions (6.7 mg/L), orchards (1.1 mg/L), and blueberry areas (0.1 mg/L). Results of the MGS, DAFRR, and USEPA study conducted in 1989 in the potato growing regions of Aroostook County showed a similar trend. Nineteen percent of the 211 wells (40 wells) exceeded the 10 mg/L primary drinking water standard for nitrate-N. It is important to note that the nitrate contribution from non-agricultural sources, such as septic systems, has not been evaluated at any of the sites.

The impact of typical manure storage and spreading practices on ground water quality is not well known but merits greater investigation. Documentation of nitrate ground water contamination from manure storage and spreading currently is limited to DEP and DAFRR case files; these probably represent "worst case scenarios". Some "worst case" examples include a poultry farm in Turner where manure disposal caused extensive ground water contamination (nitrate-N above 600 mg/L locally) in both the overburden and bedrock aquifers and in surface waters (see the section on ground water - surface water interactions); and domestic wells in Clinton and Charleston where leachate from nearby uncovered manure piles is alleged to have contaminated domestic wells with nitrate-N concentrations exceeding 100 mg/L.

In 1990, the Maine Legislature gave DAFRR primary responsibility for investigating complaints related to manure storage and spreading. Between 1993 and 1995, DAFRR investigated 146 complaints. Of 44 complaints related to drinking water well contamination, 16 concerned elevated nitrate in wells and 28 complaints concerned elevated bacteria. Forty-eight complaints related to manure impacts to surface water bodies were investigated during this same period.

The extent of nitrate ground water contamination from manure is unknown but may be significant. The Maine Soil and Water Conservation Districts 1988 Manure Management Project found that the plow layer in approximately one-half of the 249 corn fields sampled had more than twice the level of soil nitrate needed to produce a normal 25 ton/acre crop yield. Although not all of the excess nitrate will leach into ground water (some will be bound by soil organic matter), the data show that a very high potential for ground water quality degradation exists beneath these fields. The Maine Cooperative Extension Service originally published manure utilization guidelines in July 1972 (Miscellaneous Report 142). Revised non-regulatory guidelines were developed in 1990. The key elements include testing soil and plant nitrate levels prior to fertilizer application, and fertilizing according to realistic crop uptake rates.

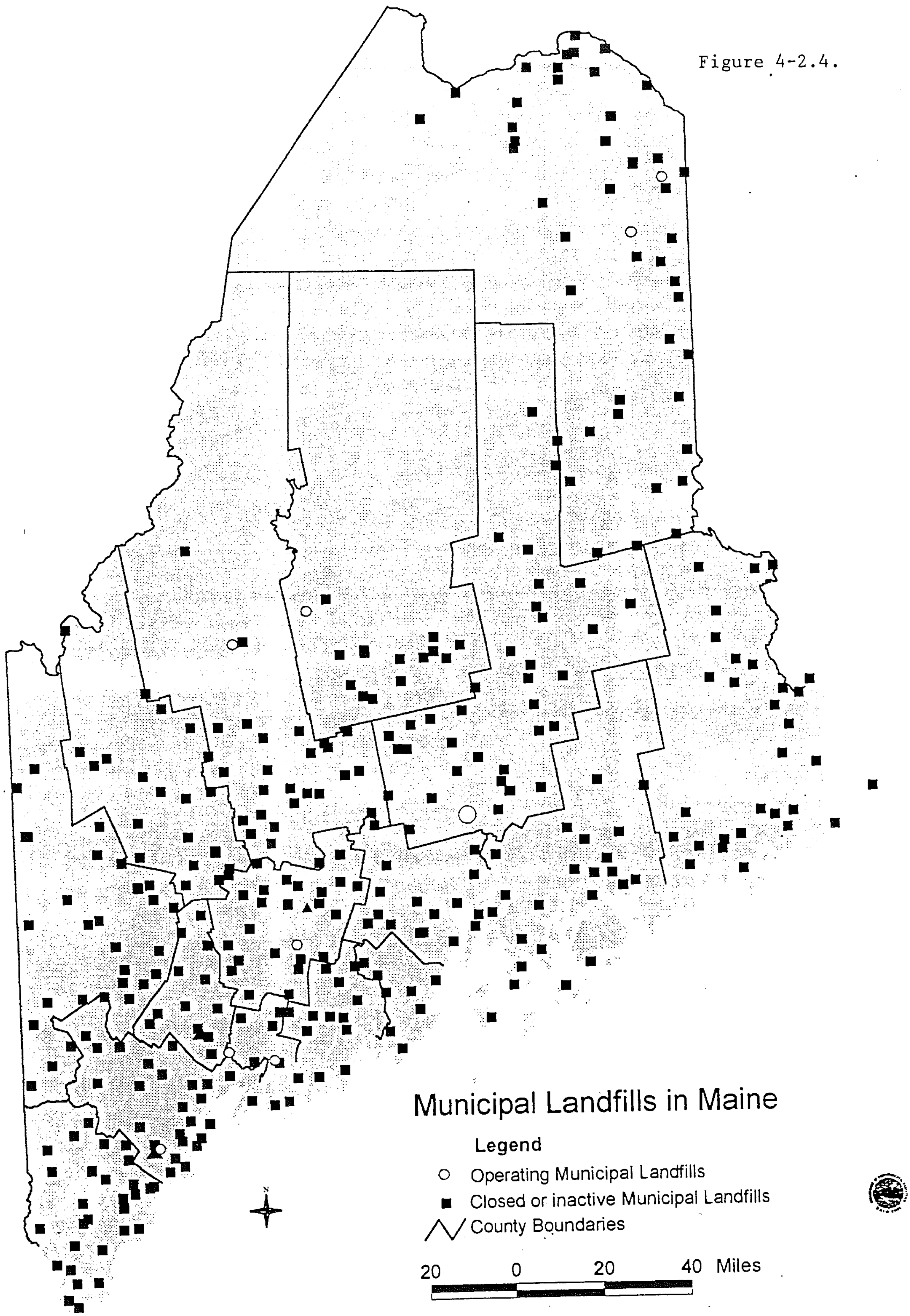
DAFRR statistics for 1992 indicate that farm land available for manure spreading includes approximately 214,000 acres of hay, 24,300 acres of oats, 28,300 acres of silage corn, and 12,000 acres of vegetables and nursery crops. According to the agronomic spreading rates recommended in the 1980 Manure Management Project report, available hay and corn cropland can accept all of the manure generated annually in this state. However, because manure production is concentrated regionally, sufficient land for spreading may not be available in the areas of greatest manure production. Even when spreading areas are available locally, it is usually economically unfeasible for a farmer to haul manure more than two miles from where it is stored.

Landfills

Contacts: Paula Clark, DEP BRWM, (207) 287-7718 and Ted Wolf, DEP BRWM (207) 287-8552

Approximately 1.6 million tons of solid waste were deposited in Maine's landfills in 1991 (Figure 4-2.4). Residential homeowners, municipalities, and commercial operations generate this waste. The Maine DEP is directed by statute to regulate two major categories of municipal solid waste landfills, which include: (1) active landfills, and (2) inactive municipal landfills that were not closed prior to 1976. This second category contains landfills that may now be closed and capped, or are awaiting closure and remediation, and which pose the most serious threat to ground water quality. Leachate released from the landfills that have not been finally closed may contain a variety of toxic organic and inorganic contaminants that will degrade ground water if the leachate migrates beyond the landfill.

Figure 4-2.4.


Municipal Landfills in Maine
Legend
Operating Municipal Landfills
Closed or inactive Municipal Landfills
County Boundaries
20 0 20 40 Miles
Source: Ground Water Resource Database 10/21/96

Active landfills. Active landfills are required to be licensed by the Department of Environmental Protection. Currently 57 landfills are licensed to operate in Maine. Eight of these are licensed to accept municipal solid waste (MSW) only; 22 are licensed to accept special wastes (non-hazardous waste generated by sources other than domestic and typical commercial establishments); and 27 are approved to accept only construction and demolition debris. The landfills licensed to accept MSW and/or special wastes are secure landfills with leachate collection systems and treatment, significantly reducing the risk to ground water quality.

There are two landfills that are currently operating illegally; one is a small island landfill accepting municipal solid waste, and the other is a small-town landfill accepting construction and demolition debris. The Department is pursuing enforcement action to force closure of these landfills as quickly as possible.

Inactive landfills. A total of 391 municipal landfills have been identified in the state. As of December 1995, 206 of these landfills have been closed and capped. Seventeen landfills are partially closed and 168 remain to be closed. These include 45 currently active sites and 123 inactive sites, which are no longer receiving solid waste. In all:

- 184 landfill sites are on sand and gravel aquifers and ground water contamination has been documented at 46 of these sites;

- Sixty other sites have contaminated surface water and/or ground water and are considered to be substandard; 37 of these sites have serious ground water contamination;

- Hazardous substances in ground water are confirmed or suspected at 41 municipal landfills. Public or private water supplies are potentially threatened at 13 of these sites. Public water supplies appear to be threatened by hazardous contaminants at three sites (Bucksport, Pittsfield, and Standish); contaminants at ten sites appear to threaten private water supplies;

- 135 sites have no reported or documented problems with surface water or ground water;

- 17 of these inactive sites appear to be accepting demolition debris; and,

- There are at least 65 sites where open burning occurred.

Maine's landfill closure and remediation program was established in 1987, with goals of closing and remediating solid waste landfills that are inadequately designed and constructed, or inappropriately sited. DEP has conducted evaluations of municipal landfills and developed closure procedures. As a result of new legislation in 1994, municipalities are allowed to determine for themselves (with proper documentation) whether their landfill meets the eligibility requirements for a "reduced procedure" closure. The reduced procedure is a further evolution of the Interim Cover and Grading (ICAG) procedure implemented by the Department in 1993.

Towns that determined that they were eligible for the reduced procedure, were able to proceed immediately with the implementation of their closure without obtaining an advance permit from the DEP. These changes were important in enabling many smaller Maine municipalities to reduce costs and expedite the closures of their landfills in 1995.

This legislation also made changes in the provision of State cost-sharing levels for closure/remediation work. In most cases the State pays 75% of eligible expenses. Municipalities were required to form an agreement with the State by July 1, 1994 in order to preserve this funding arrangement. Some municipalities that did file the necessary agreement were allowed to delay their final closure until 1996 if they showed progress towards final closure by implementing evaluation, design, or initial grading construction work. These municipalities are still eligible for the 75% state cost-share support. Municipalities who do not close their facilities by the end of 1996 will have this funding support reduced unless a license, closure order, or other written agreement is obtained.

A total of 153 landfill closing projects were completed under state guidance, using local and state funds, during the 1993-95 reporting cycle. A total of 241 municipalities have received state cost-share funding for past landfill closures or ongoing landfill closure planning activities. Maine voters have approved seven bond issues to fund assessment, closure, and remediation of landfills. Fifty-nine million dollars have been made available for closure as of January 1996. Estimates for additional funds needed to evaluate, design, and complete capping, but not including remediation and evaluation, approach $40 million.

Sludge, Septage, and Residual Land Applications
Contact: David Wright, DEP BRWM, (207) 287-7676

Land application or composting of solid waste, such as food waste, wood ash, sewage sludge, paper mill sludge, or fish waste is regulated by the DEP in Department Rules, Chapter 567, Rules for Land Application of Sludge and Residuals. Septage is regulated by Department Rules Chapter 420, "Septage Management Rules". These rules establish a framework to characterize residuals to determine potential agricultural benefit and harm if the residual is applied to the State's agricultural or forest lands. The rule also establishes siting criteria and management practices to protect public health and the environment at utilization sites.

There are about 200 active sewage sludge land application sites and 100 septage sites in Maine. There are no documented cases of significant contamination of soil, surface water, or ground water arising from the land application of municipal wastewater sludge or septage in Maine at land application sites.

Road Salt
Contacts: Tammy Gould, DEP BLWQ, (207) 287-7814 or Christine Olson, Maine Department of Transportation, (207) 287-3323.

During the winter, more than 100,000 tons of salt are spread on Maine roads for deicing purposes. The salt is stored in over 700 registered sand-salt storage piles, most of which are uncovered. Leaching of sodium and chloride from uncovered sand-salt storage and spreading has caused substantial ground water degradation in Maine. DEP field investigations have documented over 130 drinking water wells in the State that have become unpotable (chloride in excess of 250 mg/L) as a result of contamination from sand-salt storage. Between 1994 and 1995, seven incidents of water wells contaminated by sand salt storage were recorded by the DOT. Elevated sodium concentrations may pose a health risk for people on sodium-restricted diets, e.g., people with hypertension. For the majority of the population, water will taste salty if the chloride concentration exceeds the State 250 mg/L secondary (aesthetic) standard.

Nearly every uncovered sand-salt storage pile is assumed to contaminate the ground water down gradient from the source. The impacts range from the Maine Department of Transportation (MDOT) site in Dixfield, where leachate from a sand-salt pile flows a few hundred feet before discharging to the Androscoggin River (where it quickly becomes diluted), to the Town of York's former sand-salt pile and leaky salt storage building that combined to contaminate nine wells and threaten at least 20 other down gradient wells.

An investigation conducted in the Province of New Brunswick, Canada, indicated that as much as 57% of the mass of salt stored may leach annually from uncovered sand-salt storage piles. A British study estimated that approximately 10% of the salt in a typical uncovered sand-salt pile may be lost in one year.

In 1985, the Maine Legislature directed the DEP to prioritize all known sand-salt storage areas according to the extent of their ground water contamination problems. Documentation of ground water contamination was based primarily on private well testing. The prioritization was completed in 1986, however funds did not exist for DEP to continue a monitoring program for sand salt storage piles in the state. DEP assumes the existing uncovered piles have an impact on ground water quality, but investigations are currently carried out on a case-by-case basis in response to complaints. DOT does monitor ground water at its sand - salt storage sites to track ground water contamination.

In 1986, the Legislature passed two laws to protect ground water by dealing with sand-salt storage facilities. One statute established a state cost-share program for construction of municipal sand-salt storage facilities. The other statute established a compliance schedule for public and private sand-salt storage operations to construct sand-salt storage facilities. This bill required that all sand-salt be stored under building cover by January 1, 1996. Recent legislation has extended this date to January 1, 2003, because of state budget shortfalls and the lack of state cost-share funds. Through the end of 1994, MDOT has funded the construction of 29 sand/salt storage buildings throughout the state using these cost-share funds. Individual towns have also constructed storage facilities using their own funds, without State reimbursement. In 1998, a multi-agency task force investigated revitalizing the sand-salt storage facility program by (1) modifying the 1986 priority-setting system to include impacts to surface water and current and future ground water use considerations and (2) injecting new monies to complete construction of sites considered most threatened under a new priority system. Legislation to implement these items will be introduced in January 1999.

MDOT files indicate that since 1969 at least 45 wells have been made unpotable by sand-salt spreading on roadways. Recent investigations of sand/salt applications in Massachusetts and urbanized areas of Canada have raised concerns that a large percentage of salt can be retained in shallow ground water. The potential result is an increase in chloride and sodium concentrations above the drinking water standards that can persist for many years. The likelihood of this occurring in Maine depends on the volume of applications and conditions within specific ground watersheds. To date, comprehensive studies of sand/salt spreading impacts in specific ground watersheds have not been undertaken in Maine.

Hazardous Substance Sites

Contacts: Hank Aho, (207) 287-4850 or Gordon Fuller (site investigation and remediation), (207) 287-4853, DEP BRWM

There are numerous sites in Maine where hazardous substances have allegedly been discharged to the environment. As of January 1994, BRWM Division of Site Investigation and Remediation had 71 active uncontrolled hazardous substance sites under investigation; six of these are in the Operations and Maintenance (O&M) stage. Seven additional locations require further investigation to determine whether they should be listed as uncontrolled sites. The definition of an "uncontrolled hazardous substance site" or "uncontrolled site" is an area or location, whether or not licensed, at which hazardous substances are or were handled or otherwise came to be located. The term includes all contiguous land under the same ownership or control and includes without limitation all structures, appurtenances, improvements, equipment, machinery, containers, tanks and conveyances on the site.

Since 1983, 419 active and inactive uncontrolled sites have been or are currently being investigated. Naming a site as inactive means the state has determined no action is currently needed, action is pending, or action has been completed. Eleven sites are listed on the National Priority List of Superfund Sites, including the Brunswick NAS, McKin disposal site, O'Connor Salvage, Pinette Salvage Yard, Saco Tannery Waste Pits, the Union Chemical site, Winthrop Landfill, Loring AFB, Portsmouth Naval Shipyard West Site, Hows Corner in Plymouth, and the Saco Municipal Landfill. At least 97 drinking water wells have been contaminated above the MCL's or MEG's at 16 uncontrolled sites and numerous other wells are at risk. The database listing wells contaminated at uncontrolled sites has not been updated since 1991, so it likely underestimates the number of wells impacted.

Many of these sites are very small. However, because of the extreme health hazard they present, these sites receive a disproportionately large amount of the funds available for ground water protection, mostly for monitoring and remediation. Common hazardous substances found in the ground water at these sites include organic solvents, polychlorinated biphenyls (PCBs), pesticides, and metals. Most of these chemicals are carcinogenic, mutagenic, and/or teratogenic.

Resource Conservation and Recovery Act Sites
Contact: Peter Blanchard, DEP BRWM, (207) 287-7880

The BRWM has 750 active generators of hazardous waste and 500 inactive generators in their tracking system. These facilities store or treat more than 100 kilograms per month of hazardous waste. Maine DEP currently lists approximately 60 sites with non-interim Resource Conservation & Recovery Act (RCRA) licenses and 60 sites with interim licenses. Over 40 sites with interim licenses will be investigated for possible groundwater contamination. Approximately 27 wells, both public and private, have been affected by ground water contamination. Forty-six sites licensed under RCRA have contaminated groundwater by discharges of hazardous substances; approximately 27 public and private water supply wells have been affected by this contamination. Nine of these twenty-seven facilities have ongoing, active remediation. .

Five domestic water supply wells became contaminated by solvents from lagoons and discharges to the septic system leachfield at the GTE facility in Standish. An additional 5 to 7 wells at this site were considered to be at risk from contamination, and existing public water supply lines had to be extended to seven homes. Pump-and-treat remediation is in progress at the leachfield and lagoon/ impoundment areas. Very little contaminant is being recovered at the leachfield, and the water pumped to the remediation system meets drinking water standards for hazardous constituents. The water recovered at the impoundment area contains significant hazardous waste contamination. Plume control appears to be quite good. Remediation at the lagoon area will probably be a long term effort.

Solvents from the Maine Electronics Plant in Lisbon (Figure 4-2.7) have impacted the municipal water supply that serves over 8,000 customers. A pump-and-treat system has been installed to control migration of the contaminants in the Lisbon aquifer. Contaminant levels at the Lisbon town well have begun to fall. Several manufacturing facilities at the Sanford Industrial Park are suspected as the source of solvents contaminating the town well field, which serves over 6,500 customers.

Septic Systems
Contact: Department of Human Services, Division of Health Engineering, (207) 287-5338

U.S. census data from 1990 indicate that there are in excess of 301,000 septic systems in Maine. The DHS Division of Health Engineering currently regulates septic system design and permitting. Of all the sources known to contribute to ground water contamination, septic systems directly discharge the largest volume of wastewater into the subsurface environment. The major contaminants of concern found in septic system effluent are nitrate, bacteria, and viruses. As discussed previously, high concentrations of nitrate may cause methemoglobinemia ("blue-baby syndrome") in infants. Correlations have also been shown between the incidence of stomach cancer and the concentration of nitrate in drinking water. The potential for disease transmission by the microbes discharged by septic systems is a public health concern.

Nitrate. Major factors affecting the potential of septic systems to contaminate drinking water are (1) the density of the systems per unit area, (2) hydrogeological conditions and, (3) water well construction and location. Areas with high septic system density may experience substantial ground water quality degradation partly because of the inability of the systems to adequately treat nitrates. Representative septic system effluent nitrate concentrations vary considerably according to the household lifestyle, diet, and water consumption. Studies have shown that the septic effluent reaching ground water contains approximately 40-80 mg/L nitrate-N. In Maine, estimates of the nitrate concentration from septic systems range from 30-40 mg/L. Ground water quality monitoring conducted jointly by DEP and MGS in 1990 at four Maine septic system leachfields recorded total nitrogen concentrations (as nitrate-N, nitrite-N, and/or ammonia-N) ranging between 27 mg/L and 93 mg/L.

Examination of test data for nitrate-N from private wells in Maine can help identify the threat of conventional septic systems to ground water quality. The earliest ground water quality study performed in Maine to address water quality problems was done in 1973 and involved 523 private wells in York County. The study found nitrate-N concentrations exceeding the 10 mg/L standard in 2% of the wells tested. Approximately 33% of the wells sampled had nitrate-N concentrations in the 1.0 - 9.6 mg/L range. More recent studies have been conducted to document the impact of nitrate on private wells. Data from these studies are summarized in Table 4-2.5.

The Health and Environmental Testing Laboratory (HETL) database contains the results of water tests done on private wells. These tests are requested by homeowners or state or local officials on behalf of homeowners. This database provides the largest sample of private well nitrate concentrations in the state and includes sites impacted by a variety of nitrate sources including septic systems and agricultural activities. Assuming that the HETL database for nitrate-N represents Maine ground water quality, approximately 1% of private wells in Maine are unpotable because they exceed the 10 mg/L drinking water standard for nitrate-N and approximately 95% have concentrations below 5 mg/L, well below the standard.

The 1991 Hancock/Lincoln-Knox County (HLK) study focused on the impact of septic systems, but also examined the influence of agriculture on nitrate concentrations. The HLK study represents rural sites with both modern septic systems (post-1974) and older (pre-1974) septic system designs. The study found that 1.5% of the wells sampled exceeded the 10 mg/L nitrate-N primary drinking water standard. Statistical analysis was performed to identify principal factors affecting nitrate-N concentrations in wells. Results suggest that the highest nitrate-N concentrations would occur in dug wells or driven well points in surficial deposits or bedrock with short casing that are located near agricultural areas or a short distance from septic systems.

The DEP-MGS study focused on residential subdivisions with modern septic systems and associated well siting criteria. Site selection minimized the potential influence of agricultural practices on the ground water. This study, designed to represent modern residential development, demonstrated that ground water impacts with respect to nitrate-N may be expected to make less than 1% of private wells unpotable. Approximately 94% of the test wells were shown to have concentrations below 5 mg/L.

The HETL data and the data from the HLK study show similar percentages of wells with nitrate concentrations over the MCL (>1%). The DEP-MGS study shows a smaller percentage of wells exceeding the MCL (<.5%). The reason for the disparity may be the contribution of agricultural activities to increased nitrate concentrations, a factor in the HETL and HLK studies; the DEP-MGS study was designed to minimize or exclude agricultural impacts on ground water quality and focus on septic system impacts. Also, the differences may not be significant, depending on the variance and number of samples. Alternately, people who know or suspect they have problems with nitrate may tend to test more often, increasing the percentage slightly. Various other considerations might affect comparisons among the studies.

Table 4-2.5. Nitrate-N Frequency Distributions.

Nitrate-N (mg/L)	HETL Database[1] %	HLK Study[2] %	DEP-MGS Study[3] %
0.00 to 2.50	-	85.5	83.8
2.51 to 5.00	-	9.2	10.4
5.01 to 7.50	4.2*	2.5	4.1
7.51 to 10.00	*	1.3	1.4
Greater than 10.0	1.2	1.5	0.4
# Analyses	3,972	381	511

[1]HETL database for private well analyses between 1/1/94 and 12/31/95.
[2]Cooperative project between the Maine DEP and the Hancock and Lincoln-Knox County Soil and Water Conservation Districts. Project focused on private well testing for nitrate-N in unsewered regions of four towns.
[3]Cooperative project between the Maine DEP and MGS. Project designed to evaluate ground water/well water quality impact of septic systems in 20 residential subdivisions with respect to nitrate-N.
*This percentage is for wells testing >5.00 mg/L but less than 10 mg/L.

Bacteria. Private well testing for presence of bacteria identifies a greater contamination potential from bacteria than from nitrate. In public and private drinking water supplies, coliform bacteria are used as the indicator of microbial contamination. The Primary Drinking Water Standard for total coliform bacteria is 0 colonies per 100 ml.

HETL data for wells tested between 1960 and 1990 showed approximately 31% of the wells tested for total coliform exceeded the drinking water standard. Data for the period January 1994 and December 1995 shows that 34% of the 4057 well samples analyzed for total coliform tested positive. During the same time period, the HETL database indicates 37% of the 451 wells tested for fecal coliform tested positive. Twenty-six percent of the wells tested for total coliform bacteria in Hancock County as part of the Hancock/Lincoln-Knox County SWCD study had coliform bacteria. However, only 26% of these wells (7% of the wells tested in Hancock County) also tested positive for fecal coliform bacteria.

Fecal coliform bacteria originate inside the intestinal tract of mammals. The fecal coliform test is a better indicator of septic system contamination than total coliform because the total coliform test results may be affected by input from non-mammalian sources such as decaying vegetation. Surface water infiltration around poorly sealed well casings, especially dug well casings, may contribute to the disparity between detection of total coliform and fecal coliform. Examination of the HETL database for the period between 1960 and 1990 indicates that 52% of dug wells and 24% of drilled wells tested positive for total coliform bacteria; this lends support to the belief that dug wells are more susceptible to total coliform bacteria than drilled wells.

Shallow Well Injection

Contact: Tammy Gould, DEP BLWQ, Division of Water Resource Regulation, (207) 287-7814

Discharge of pollutants underground by shallow well injection has been illegal in Maine since 1983 when the State adopted the Federal Underground Injection Control (UIC) regulations. Shallow injection wells are classified as Class IV or Class V "wells" under the UIC designation. No other classes of UIC wells are documented in Maine. Class V wells are usually gravity feed, low-technology systems which include cesspools, septic systems, pits, ponds, and lagoons. Industrial and commercial wastes discharged via Class V wells include petroleum products, cleaning solvents and degreasers, industrial and agricultural chemicals, storm water runoff, and a variety of other wastes.

Because of their high ground water contamination potential, the DEP has focused most of the UIC Program efforts on inventorying and eliminating automobile service station and manufacturing facility floor drains. Since 1988, the DEP has received over 3,391 responses to survey requests mailed to potential Class V facilities. Survey responses show 415 facilities with Class V wells discharging to soil or septic systems. Most of these facilities have been required to seal their floor drains or install oil/water separator systems that are connected to holding tanks. This effluent must be disposed of at a licensed disposal facility. No ground water quality monitoring has been performed at any of the facilities to assess ground water degradation.

Disposal of hazardous substances through floor drains has led to ground water contamination of at least two sites that are currently classified as uncontrolled hazardous waste sites.

In 1992, dry cleaning businesses were surveyed for their waste handling practices and the presence of injection wells. Photoprocessors were surveyed in 1993. Car and truck washes were surveyed in 1994. No new business categories were surveyed on a statewide basis in 1995. Facilities in the Androscoggin River Basin with the potential for having injection wells were targeted for inspection. Inspections were conducted at 160 facilities within a half-mile radius of public water supply wellheads. A total of 34 injection wells were discovered during these inspections. Other businesses handling hazardous materials will be targeted for future inspection. These include: funeral homes, auto body shops, rust-proofers, boatyards, farms, and various laboratories.

Stormwater Infiltration

Contact: John Hopeck, DEP BLWQ, (207) 287-3901

Infiltration of stormwater runoff has been practiced in Maine for many years, although primarily as a means of stormwater quality control, principally phosphorous control from residential developments in lake watersheds. Use of infiltration practices for control of stormwater quantity is, in contrast, a relatively recent development for large commercial/industrial developments, although infiltration is encouraged in sand and gravel mines by performance standards which allow less complex permitting procedures in pits which remain naturally internally drained throughout their development and reclamation.

The current generation of stormwater management systems using infiltration for quantity control provides minimal treatment prior to discharge of stormwater to the infiltration structure; most simply include oil - water separators at the bottom of each catch basin, with pipes from the separators directly to the infiltration facility. Only one site employs a wetpond for treatment prior to release to the infiltration area, while another site, which was to have constructed a grassed swale for treatment, used that area for additional parking space. Maine DEP's Stormwater Best Management Practices manual specifies that additional pre-treatment, such as passage of runoff through a wetpond, a grassed filter strip, grassed swale, or equivalent treatment BMP, is required prior to discharge to an infiltration structure. These BMP's also require ground water quality monitoring in most situations, particularly if runoff is from a commercial/industrial area or other facility with a large connected impervious area.

A Case Study: Stormwater Infiltration

Maine DEP is currently attempting to identify all sites of deliberate infiltration of stormwater from commercial, industrial, or residential developments, in order to evaluate the performance of these structures and the potential for ground water contamination. In mid-1995 we were aware of only four DEP-permitted sites with engineered infiltration structures and required ground water monitoring; more projects have been identified since then, including several which were permitted only at the local level.

Of the four sites known at that time, one was under construction, and one had never submitted monitoring data; preliminary analysis of the data from the other two sites was presented at NEIWPCC's conference on ground water recharge for stormwater management, and is summarized here. Both sites show evidence of degradation of ground water quality, although there has been no consistent violation of drinking water standards. Neither site provides pre-treatment other than oil - water separators in the catch basins, and both infiltrate stormwater in excavated basins. The site which has not provided data discharges stormwater first to a wetpond above the infiltration area, and then to a series of level spreaders above an undisturbed forested area; this should minimize the pollutant load in the stormwater and the potential for ground water contamination, so that lack of data from this site is particularly unfortunate.

One site provided a nested pair of wells, with one well screened at 12.7 to 14.7 feet below ground surface, and the second screened between 52.7 and 54.7 feet below ground surface. The shallow and deep wells showed statistically significant differences in pH, specific conductance, nitrate, chloride, and sodium prior to operation of the infiltration system. Other parameters are detected infrequently, or have variances, which do not allow resolution of shallow and deep ground water. Samples subsequent to operation of the system, allowing for some travel time to the wells, show no significant difference between shallow and deep ground water for these parameters. Both wells show increased specific conductance and sodium, and decreased nitrate and pH. Chloride increases significantly in the deep well, and decreases in the shallow well. At the time of a site inspection, water up to a depth of approximately two feet was ponded in the basin. This failure is probably related to the disposal of the excavated material adjacent to catch basin leading to the infiltration structure, and to the failure to install the grass swale above the basin shown on the site plans.

The second site has several wells upgradient and down gradient of the infiltration basins. Analysis of the data is complicated by the location of this particular site in an urbanized area with on-site wastewater disposal; the previous site located its basin in a relatively undisturbed forested area. Two infiltration basins were constructed at this site, one (the upper basin) adjacent to the parking area, and the second (lower basin) in a previously undeveloped area. Overflow from the upper basin is directed to the lower basin, which, in turn, has an overflow directed to a wooded area. Evidence at the site indicated that overflow from the lower basin occurs fairly often, perhaps indicating infiltration rates lower than anticipated.

All wells at this site seem affected by the development to some extent. BTEX compounds and MTBE are detected, although rarely and at very low concentrations, in several of the wells. There is no evidence of a pattern, or association with the infiltration facility, in the wells showing positive detects, and this may reflect only a very low "background" level of organic contaminants in urbanized areas underlain by sand and gravel deposits. A weak positive trend in total organic carbon concentrations is found in all wells except one near a major pre-existing roadway, at which no trend is evident.

All wells showed increasing concentrations of sodium, with trends significant at greater than 95% down gradient of both infiltration areas; no clear trend was evident for chloride, however. All wells show decreasing concentrations of dissolved oxygen, with the strongest trend (significant at > 95%) down gradient of the lower basin; significance of the trend in the developed area ranges from 87% near the other infiltration basin to 73% at a down gradient well near the pre-existing road. Nitrate concentrations increase at all wells except the lower basin; the trend is significant at greater than 95% both upgradient and down gradient of the upper basin. All wells except that upgradient of the upper basin show weak increasing trends for total dissolved solids, and all wells show weak negative trends for total phosphorous. The data show no consistent trend for copper, lead, manganese, zinc, iron, pH, or specific conductance. In general, the wells show that ground water throughout the development is becoming more like ground water in the vicinity of the major pre-development road; it is not clear whether or not this would have occurred if infiltration had not been used for stormwater management.

Assessment of data at the second site led to a reduction in the parameters but not the sampling frequency; wells at this site are now sampled for BTEX, MTBE, zinc, nitrate, TDS, dissolved oxygen, pH, specific conductance, and temperature. Levels of these parameters have remained approximately the same, reflecting a low-to-moderate level of water quality degradation. Sampling parameters and monitoring frequency remain the same at the first site, which also appears to show a relatively constant, low-to-moderate level of impairment. Attempts to use terrain conductivity down gradient of these infiltration basins have been frustrated by overhead electric wires and buried pipelines and debris; it appears that this method is not likely to provide reliable data at these sites. Strand lines, staining of rocks, growth of obligate wetland species in the basins, and evidence of flow through bypass structures suggest that the basins may be clogging, which would reduce the pollutant load to groundwater. The stable groundwater quality does not, therefore, present unambiguous evidence that such structures present minimal risk to groundwater in all cases.

Maine's Stormwater Management law allows the Department to establish stormwater quality standards for all pollutants in runoff from any development including 20,000 square feet or more of impervious area or five acres or more of disturbed area when infiltration is proposed. If infiltration is not proposed, the quality standards for developments with three or fewer acres of impervious area may address only phosphorous, nitrate, and suspended solids. The intention of the lower threshold for infiltration was, in part, to require more stringent standards, where necessary, for stormwater infiltration from small facilities such as service stations; infiltration from a station constructed prior to the effective date of the law may have contributed to MTBE contamination of a public supply wellfield, as discussed elsewhere in this report. The monitoring programs conducted for these earlier sites has allowed the Department to establish a minimum set of monitoring parameters, essentially those in place for the second development described above, for infiltration from new commercial or industrial facilities which do not handle unusual contaminants. In most cases, groundwater monitoring would not be required at residential developments. In Maine, residential developments generally are subdivisions with lots of one-or-more acres; runoff from these developments can be expected to be relatively low in pollutants; monitoring might, however, be required at a large condominium or apartment complex.

Surface Impoundments

Storage, treatment, and disposal of liquid and semi-liquid materials in surface impoundments have long been suspected as major sources of ground water contamination. Currently, the DEP has authority under different statutes (e.g., the UIC Program, Waste Discharge Law, Site Location of Development Law) to regulate a variety of activities and materials related to surface impoundments. In 1979, the DEP conducted a study to characterize and inventory surface impoundments in the State. The Surface Impoundment Assessment was funded by EPA. Although the inventory probably was incomplete, the study identified at least 173 impoundment sites with a total of 453 individual pits, ponds, and lagoons (both active and abandoned). Materials stored at these sites included municipal sewage, industrial wastewater (including hazardous wastes), and animal wastes.

Some of the important facts revealed in the 1979 DEP study include the following:

1. surface water and ground water have been contaminated by surface impoundments at many sites in Maine;

2. approximately 75% of the assessed surface impoundments did not have impermeable liners;

3. approximately 45% of the surface impoundments are located on highly permeable soils (sandy, gravelly deposits);

4. approximately 50% of the assessed abandoned impoundments were not closed properly to prevent future waste migration;

5. approximately 18% of the impoundment site operators may generate potentially hazardous wastes, which could enter the surface impoundments;

6. site monitoring wells were present at only 14 of the impoundment sites assessed and ground water contamination was detected at 6 of these sites; and,

7. most surface impoundments in Maine pose a high potential for ground water and surface water contamination.

Since the 1979 study was completed, no follow-up work has been performed to complete the initial surface impoundment inventory, to update the inventory with new sites, or to assess the degree of ground water contamination at the various sites. Improperly operated and abandoned sites probably continue to degrade ground water quality today, but some may not be a threat. A systematic evaluation of all open and abandoned surface impoundments would facilitate a more comprehensive assessment of their ground water impacts. Presently, new facilities proposing to utilize surface impoundments must demonstrate through proper siting and design that there will be no unreasonable adverse effects on ground water quality. These facilities must also conduct ground water quality monitoring, as illustrated in the following section.

Municipal Facilities
Contact: William Brown, DEP BLWQ, (207) 287-7804

Since 1990 the BLWQ, Division of Engineering and Technical Assistance has authorized the construction of 13 wastewater treatment facilities that use lagoons to treat or store treated wastewater before discharging to surface water or prior to land application (spray irrigation).

The authorization to fund these treatment facilities with State grant funds comes from Section 411 MRSA Title 38. In these lagoons, biological treatment of domestic wastewater occurs. Oxygen, which is necessary for the treatment, is introduced naturally in facultative lagoons or artificially introduced by blowers in aerated lagoons.

To minimize leakage, lagoons at 10 of the 13 facilities were constructed using a hypalon or high-density polyethylene synthetic liner. Lagoons at the remaining three facilities were constructed of compacted native soil materials. All 13 facilities installed monitoring wells to monitor any leakage that may result in contamination of the ground or surface water. If contaminants are noted in the monitoring wells, or if excessive leakage is confirmed by other testing (e.g. lagoon underdrain discharge), the lagoon is taken off-line as soon as possible and repaired. Potential contaminants typically required to be monitored include nitrate-nitrogen, ammonia-nitrogen, TKN, TOC, COD, hardness, pH, chloride, alkalinity and fecal coliform. Metals typically monitored include arsenic, cadmium, zinc, lead, mercury, selenium, silver and nickel. The DEP has realized that required ground water monitoring parameters have not always been established consistently at wastewater treatment facilities. Accordingly, an effort is underway to determine the most appropriate and cost-effective parameters for these facilities, and to require these parameters to be monitored at all facilities, where appropriate.

Salt-water Intrusion

Contact: Marc Loiselle, Natural Resource Information and Mapping Center/Geology (MGS)
(207) 287-2801

In coastal areas, excessive ground water withdrawals and well placements too close to the shoreline may lead to saltwater intrusion. This is particularly significant considering that Maine has approximately 3500 miles of coastline and development pressures are great along most of it. Saltwater intrusion is particularly common on coastal peninsulas and off-shore islands that rely primarily on private drilled bedrock wells for drinking water. For example, a 1982 hydrogeologic study conducted in the peninsular town of Harpswell found approximately 70 wells that were being affected by saltwater intrusion. As development pressure along the Maine coast continues, the incidence of saltwater intrusion is expected to increase.

Metallic Mining

Contact: Mark Stebbins, DEP BLWQ, (207) 287-7810

Maine does not have any operating metallic mines at this time. In August of 1991, metallic mining rules were adopted by the State of Maine to be administered by the DEP. The purpose of these rules is to protect land and water quality while allowing for metallic mineral exploration and property development. Currently, no new permit applications are pending. One permit was issued in November 1992 to BHP Utah for advanced exploration.

Historical metallic mining sites such as the Callahan Mine site in Brooksville are known to degrade surface water quality by acid rock drainage from tailings ponds. Impacts to ground water at the Callahan site have not been observed.

Gravel Pits
Contact: Mark Stebbins, DEP BLWQ, (207) 287-7810

Four-hundred nineteen gravel pits 5 acres or greater have been licensed by the State. The number of unlicensed (illegal) pits and gravel pits falling below licensing thresholds is unknown. Recent changes to performance standards include a variance provision for excavation into ground water. Previously, a separation distance of at least two feet was required between the base of the excavation and the seasonal high water table.

Impacts to ground water from gravel pit operations include contamination by spillage or spraying of petroleum products in or near the pits, and dewatering of local surficial aquifers. Improper use, storage, or handling of petroleum products is known to have caused ground water contamination in three gravel pits. The State does not have any record of the number of wells or surface water resources such as wetlands adjacent to gravel pits that have been dewatered due to mining activities. Another threat to ground water indirectly related to gravel pits is dumping into pits that do not adequately restrict unauthorized access. Unreclaimed sand and gravel pits are too often sites of illegal dumping. At the present time, 16 abandoned gravel pits are listed as uncontrolled hazardous waste sites. Ground water in the area of these pits contains a variety of pollutants such as solvents and PCBs.

Radioactive Waste Storage and Disposal Sites
Contact: Dale Randall, Radiation Control Program, Department of Human Services, Division of Health Engineering, (207) 287-5338

Maine has two high-level radioactive waste generators, Maine Yankee in Wiscasset and Portsmouth Naval Shipyard in Kittery. Portsmouth Naval Shipyard currently ships spent nuclear fuel to interim storage at the Idaho National Engineering Laboratory. Maine Yankee continues to store its high level waste on-site.

Maine generators have two potential disposal options for low-level radioactive waste. On July 1, 1995, access to the low-level radioactive waste disposal site at Barnwell, SC was reopened to Maine generators, following the South Carolina legislature's vote to leave the Southeast Compact. Once departed from the Southeast Compact, South Carolina reopened access to Barnwell to all states and Compact regions, except North Carolina. The other low-level radioactive waste disposal option is Envirocare of Utah, which specializes in bulk shipments of low specific activity waste. Most of Maine's low-level radioactive waste generators continue to store waste on-site. However, Maine Yankee nuclear power plant in Wiscasset (Maine's largest generator by volume and radioactivity) has disposed of most of its low-level radioactive waste inventory at Barnwell.

In 1993, Maine voters approved an agreement with Texas to accept and dispose of Maine's waste. The bill that would grant congressional approval of this Compact is currently awaiting floor debate in the U.S. House of Representatives. Approval of the Compact would allow Maine to begin sending low-level radioactive waste to Texas as soon as the proposed disposal facility is built.

Maine has one confirmed low-level radioactive waste site in Greenbush. Other sites may exist, but they have not been located. Ground water monitoring wells have been installed at the Greenbush site and on adjacent property. As of November 1995, no contamination had been detected in the monitoring wells. The former Loring Air Force Base once had a low-level radioactive waste site containing small quantities of weakly radioactive material associated with the maintenance of first-generation nuclear weapons. The material was distributed in a small number of discrete trenches in a compacted earth matrix. The trenches were excavated in late 1994, and all material in them was shipped to Envirocare and disposed of as radioactive waste. Underground storage tanks near the trenches were also removed, and were later determined to be uncontaminated. During early 1995, the empty trenches were confirmed clean of radioactive contamination and backfilled.

Summary of Ground Water Quality

For 1998, DEP has selected two stratified drift aquifers and one bedrock aquifer to put into the EPA format for assessing ground water quality. The three aquifers were chosen based on hydrogeologic setting; sand and gravel aquifers are often high yield and are often found in developed areas, and are therefore vulnerable to contamination; bedrock aquifers, though not hydrologically connected, underlie the whole state and are mostly used as private water supplies. DEP has also added information on raw water quality from a DHS database to indicate "ambient" water quality. The locations of the wells used to indicate ambient water quality in Figure 4-2.8 and Table 4-2.6B coincide with the area of Maine covered by the U.S.G.S. NAWQA study.

The ambient ground water quality monitoring network consists of 754 public water supplies. Each of the selected public water supplies is provided by only one source of water: a drilled well in bedrock; a dug well in glacial till; a drilled well, well point, or dug well in glacial outwash sand and gravel or recent sandy alluvium. Some of the wells are large community water supplies; some are non-transient, non-community water supplies. Analytical results for periodic, routine sampling of raw water were provided by HETL. Not all the well samples were analyzed for the all the same chemical constituents every time they were obtained: frequency depends on the type of water supply and the population served. Nevertheless, we believe that the selection represents ambient ground water quality in the three major geologic settings that provide ground water in Maine.

Since Maine is early in the process of prioritizing ground water on use and vulnerability criteria, it is premature to choose specific aquifers based on these criteria. Because of our ongoing efforts at ground water threat database management linked with ground water use and vulnerability assessment, we expect to be able to accomplish this type of prioritization during the next round of reporting. Therefore, the examples, which follow, are an attempt to utilize the format requested by EPA and help the Ground Water Program determine where we can improve our data management to provide better coverage in the future.

Figures 4-2.5 through 4-2.7 and Tables 4-2.6 and 4-2.6B summarize aquifer data and threats to ground water in selected aquifers. Table 4-2.7 lists the status of actions being taken to address ground water contaminant problems in these aquifers. This attempt has uncovered three areas that pose a difficulty in reporting information as requested by EPA:

1. The data are stored differently (hard copy vs. electronic) and are collected from numerous programs having different sampling reporting periods.

2. Aquifer description and setting: private well information from the HETL database does not always clearly identify the source for a well as bedrock or stratified drift.

3. The ground water database site information, i.e. type of site, location, owner information, remediation status, etc. are available, but ground water quality monitoring information is not yet accessible for many categories.

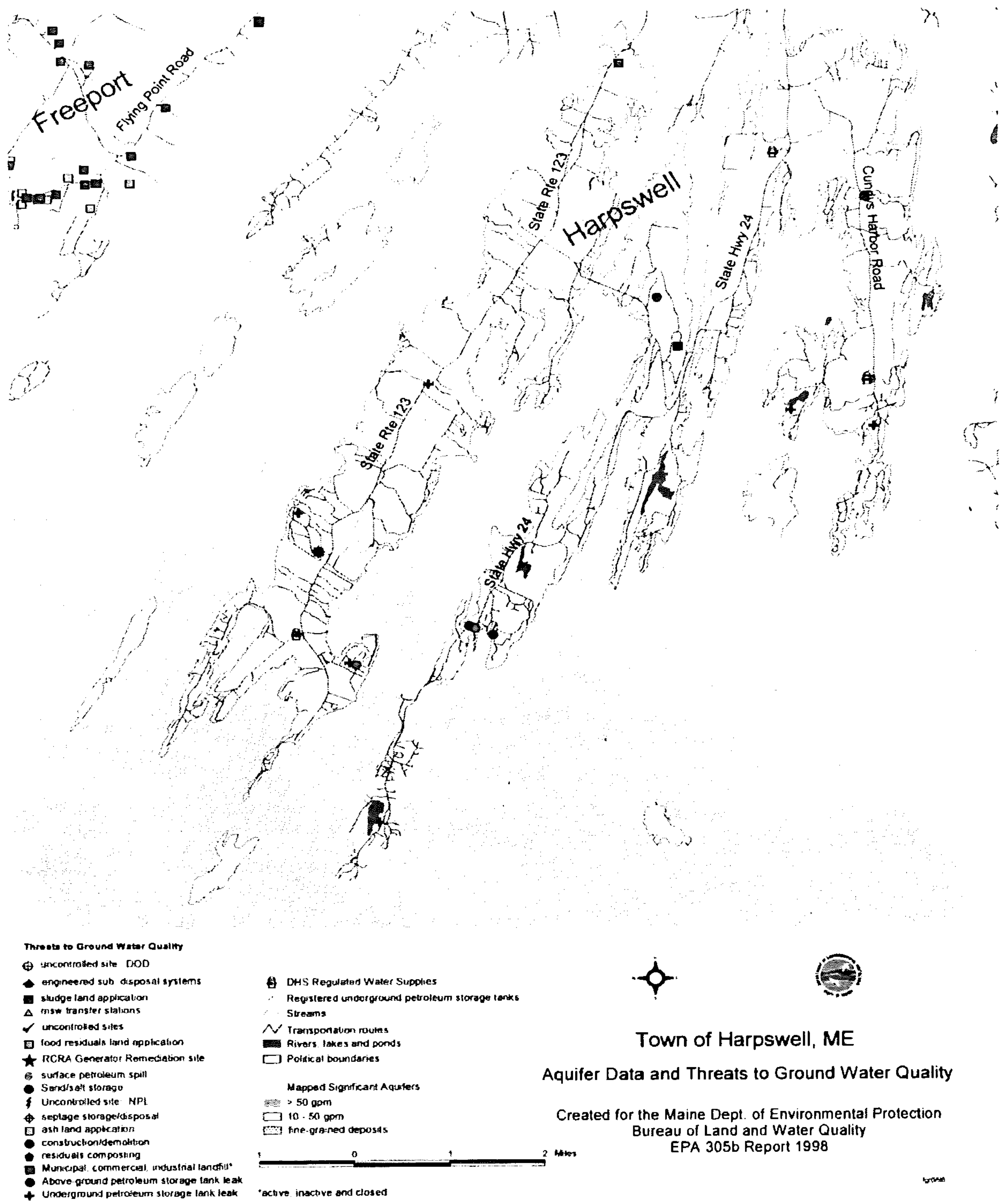


Figure 4-2.6. Town of Harpswell - Aquifer Data and Threats to Ground Water

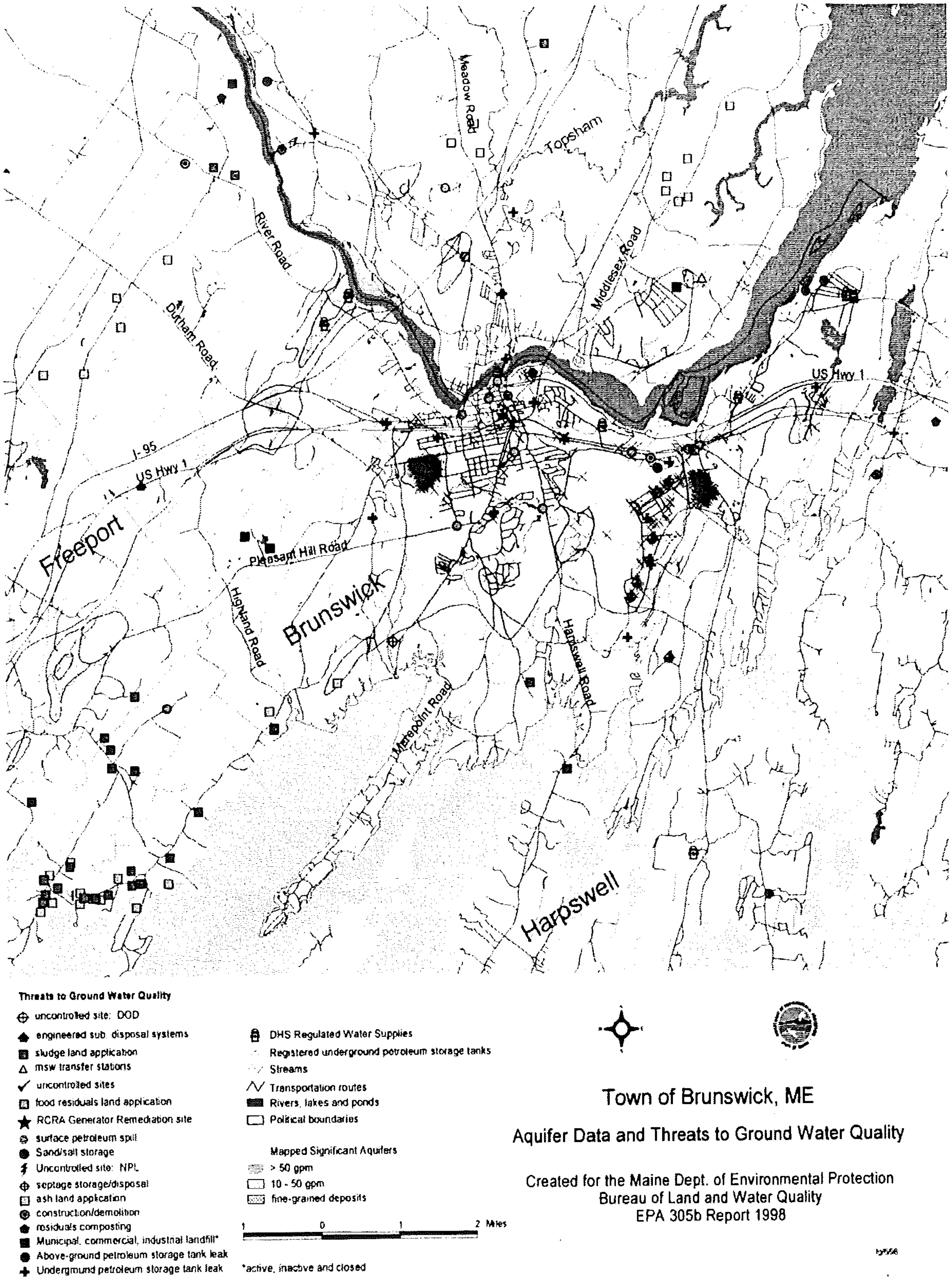


Figure 4-2.6. Town of Brunswick - Aquifer Data and Threats to Ground Water

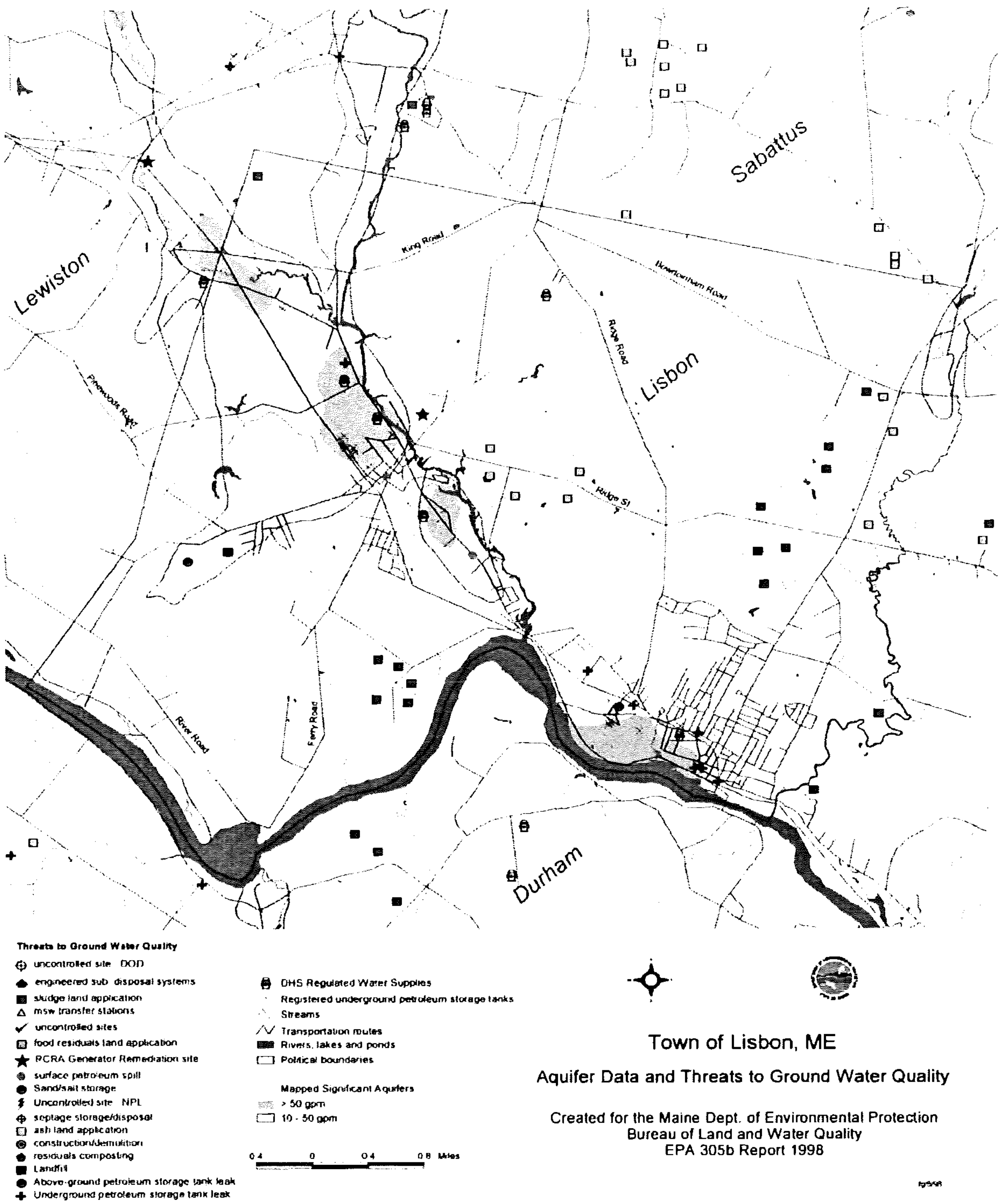


Figure 4-2.7. Town of Lisbon - Aquifer Data and Threats to Ground Water

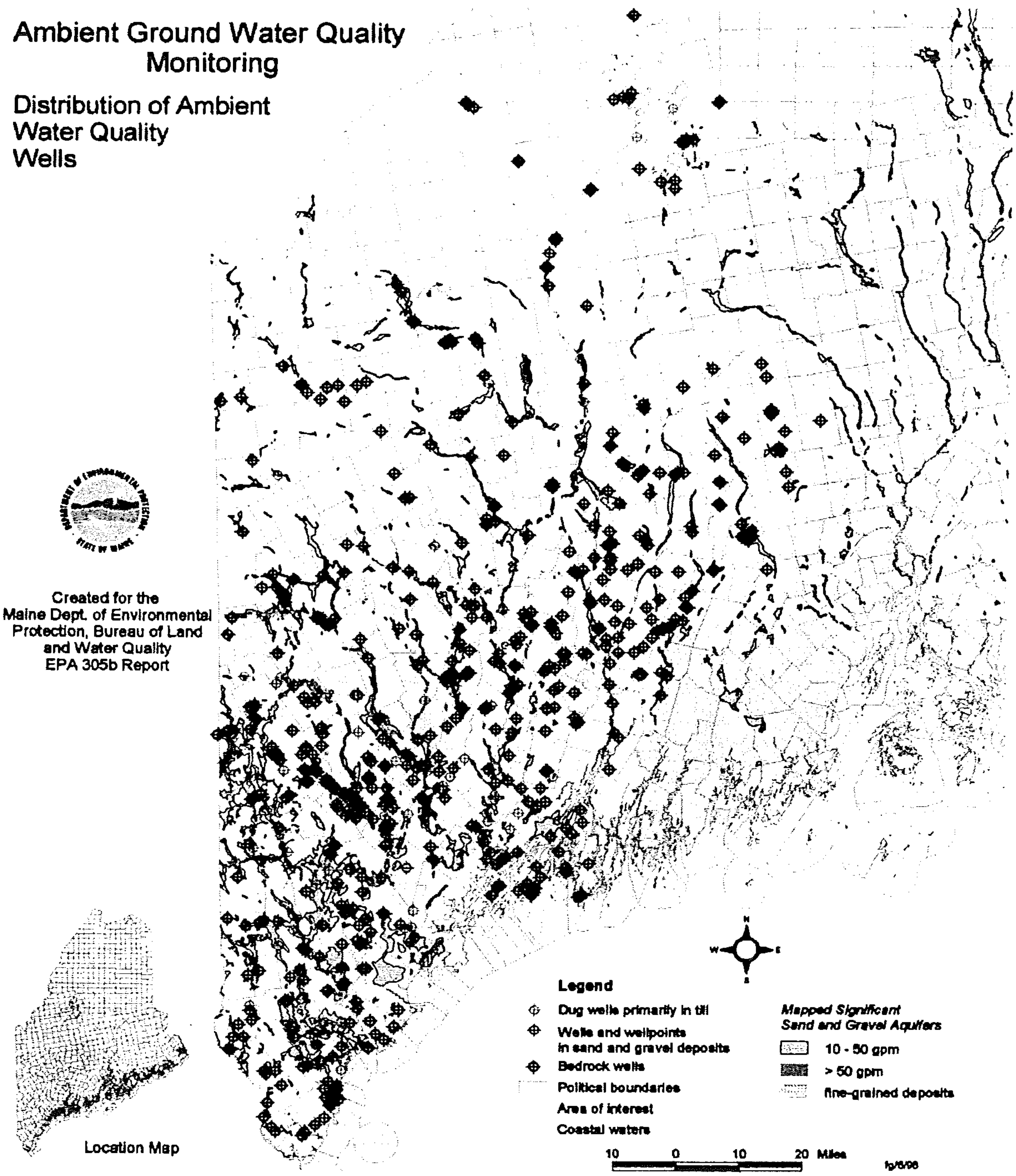


Figure 4-2.8 Ambient Ground Water Quality Monitoring-Distribution of Ambient Water Quality Wells listed in Table 4-2.6B

Table 4-2.6B Aquifer Monitoring Data

Ambient Ground Water Quality Monitoring Well Data

Aquifer Description: Till **Data Reporting Period:** Jan. 1996-Dec. 1997, not continuous

Counties: York, Cumberland, Franklin, Somerset, Piscataquis, Penobscot, Oxford, Sagadahoc, Lincoln, Waldo

Monitoring data type [1]	Total number of wells used in assessment	Parameter groups	No detections of parameters above MDLs or background levels	No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to ≤5 mg/l	Parameters are detected at concentrations exceeding the MDL, but are less than or equal to MCLs and/or nitrate ranges from >5 to ≤10 mg/l	Parameters are detected at concentrations exceeding MCL's
Ambient (raw) water quality data from public water supply wells	77	VOC	2	0	0	0
		SOC	0	0	0	0
		NO3	30	14	2	1
		Other	30	0	0	0

Ambient Ground Water Quality Monitoring Well Data

Aquifer Description: Bedrock **Data Reporting Period:** Jan. 1996-Dec. 1997, not continuous

Counties: York, Cumberland, Franklin, Somerset, Piscataquis, Penobscot, Oxford, Sagadahoc, Lincoln, Waldo

Monitoring data type [1]	Total number of wells used in assessment	Parameter groups	No detections of parameters above MDLs or background levels	No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to ≤5 mg/l	Parameters are detected at concentrations exceeding the MDL, but are less than or equal to MCLs and/or nitrate ranges from >5 to ≤10 mg/l	Parameters are detected at concentrations exceeding MCL's
Ambient (raw) water quality data from public water supply wells	621	VOC	30	0	0	1
		SOC	2	0	0	0
		NO3	335	59	8	1
		Other	321	0	3	3

Major uses of aquifers or hydrologic units: X Public water supply ___ Irrigation ___ Commercial ___ Mining ___ Baseflow
___ Private water supply ___ Thermoelectric ___ Livestock ___ Industrial ___ Maintenance

Uses affected by water quality problems: ___ Public water supply ___ Irrigation ___ Commercial ___ Mining ___ Baseflow
___ Private water supply ___ Thermoelectric ___ Livestock ___ Industrial ___ Maintenance

Table 4-2.6B Aquifer Monitoring Data (Continued)

Ambient Ground Water Quality Monitoring Well Data

Aquifer Description: Stratified Drift **Data Reporting Period:** Jan. 1996-Dec. 1997, not continuous

Counties: York, Cumberland, Franklin, Somerset, Piscataquis, Penobscot, Oxford, Sagadahoc, Lincoln, Waldo

Monitoring data type [1]	Total number of wells used in assessment	Parameter groups	No detections of parameters above MDLs or background levels	No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to ≤5 mg/l	Parameters are detected at concentrations exceeding the MDL, but are less than or equal to MCLs and/or nitrate ranges from >5 to ≤10 mg/l	Parameters are detected at concentrations exceeding MCL's
Ambient (raw) water quality data from public water supply wells	56	VOC	3	0	0	0
		SOC	0	0	0	0
		NO3	15	13	1	1
		Other	15	0	0	0

Major uses of aquifer or hydrologic unit: X Public water supply___ Irrigation___ Commercial___ Mining___ Baseflow___ Private water supply ___ Thermoelectric
__ Livestock ___ Industrial___ Maintenance

Uses affected by water quality problems:___ Public water supply___ Irrigation___ Commercial___ Mining___ Baseflow___ Private water supply ___ Thermoelectric
___ Livestock ___ Industrial___ Maintenance

Table 4-2.6. Aquifer Monitoring Data.

Aquifer Description: East Brunswick Aquifer **County:** Cumberland
Aquifer Setting: Stratified fine sand, 15-100 feet thick (some private wells in bedrock) **Data Reporting Period:** Jan. 1994-Dec. 1997, not continuous

Monitoring data type [1]	Parameter groups	Total number of wells used in assessment	No detections of parameters above MDLs or background levels	No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l	Parameters are detected at concentrations exceeding the MDL, but are less than or equal to MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding MCLs
Finished water quality data from public water supply wells	VOC	33	22	0	11	0
	SOC	50	50	0	0	0
	NO3	28	14	13	1	0
	Other	0	0	0	0	0
Raw water quality data from private or unregulated wells (Maine Health and Environmental Testing Laboratory)	VOC	0	0	0	0	0
	SOC	0	0	0	0	0
	NO3	110	0	108	1	1
	Other	0	0	0	0	0
Other sources (BNAS monitoring wells)	VOC	71	19	0	25	27
	SOC	0	0	0	0	0
	NO3	0	0	0	0	0
	Other	0	0	0	0	0

Major uses of aquifer or hydrologic unit: X Public water supply; ___ Private water supply; ___ Irrigation; ___ Thermoelectric; ___ Commercial; ___ Livestock; ___ Mining; ___ Industrial; ___ Baseflow; ___ Maintenance

Uses affected by water quality problems: ___ Public water supply; ___ Private water supply; ___ Irrigation; ___ Thermoelectric; ___ Commercial; ___ Livestock; ___ Mining; ___ Industrial; ___ Baseflow; ___ Maintenance

1. Department of Human Services does not collect raw water quality data from public water supply wells.

Table 4-2.6 (continued). Aquifer Monitoring Data.

Aquifer Description: Harpswell bedrock aquifer
Aquifer Setting: bedrock, primarily metasedimentary with some igneous

County: Cumberland
Data Reporting Period: 1985-1997

Monitoring data type[1]	Parameter groups	Total number of wells used in assessment	No detections of parameters above MDLs or background levels	No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l	Parameters are detected at concentrations exceeding the MDL, but are less than or equal to MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding MCLs
Finished water quality data from public water supply wells	VOC	5	4	0	1	0
	SOC	8	8	0	0	0
	NO3	33	9	24	0	0
	Other	0	0	0	0	0
Raw water quality data from private or unregulated wells (Maine Health and Environmental Testing Laboratory)	VOC	12	10	0	2	0
	SOC	0	0	0	0	0
	NO3	75	0	74	1	0
	Other	0	0	0	0	0
Raw water quality data from public water supply wells "ambient" network	VOC	5	5	0	0	0
	SOC	3	3	0	0	0
	NO3	47	0	47	0	0
	Other	0	0	0	0	0

Major uses of aquifer or hydrologic unit: ___ Public water supply, X Private water supply, ___ Irrigation, ___ Thermoelectric, X Commercial, ___ Livestock, ___ Mining, ___ Industrial, ___ Baseflow, ___ Maintenance

Uses affected by water quality problems: ___ Public water supply, X Private water supply, ___ Irrigation, ___ Thermoelectric, ___ Commercial, ___ Livestock, ___ Mining, ___ Industrial, ___ Baseflow, ___ Maintenance

1. Department of Human Services does not collect raw water quality data from public water supply wells.

Table 4-2.6 (continued). Aquifer Monitoring Data.

Aquifer Description: Lisbon sand and gravel aquifer
Aquifer Setting: stratified drift (some private wells in bedrock)

County: Androscoggin
Data Reporting Period: 1985-1995

Monitoring data type[1]	Parameter groups	Total number of wells used in assessment	No detections of parameters above MDLs or background levels	No detections of parameters above MDLs or background levels and nitrate concentrations range from background levels to less than or equal to 5 mg/l	Parameters are detected at concentrations exceeding the MDL, but are less than or equal to MCLs and/or nitrate ranges from greater than 5 to less than or equal to 10 mg/l	Parameters are detected at concentrations exceeding MCLs
Finished water quality data from public water supply wells	VOC	144	29	0	115	0
	SOC	22	22	0	0	0
	NO3	9	1	8	0	0
	Other	0	0	0	0	0
Raw water quality data from private or unregulated wells (Maine Health and Environmental Testing Laboratory)	VOC	0	0	0	0	0
	SOC	1	1	0	0	0
	NO3	15	0	13	2	0
	Other	0	0	0	0	0
Other sources	VOC	0	0	0	0	0
	SOC	0	0	0	0	0
	NO3	0	0	0	0	0
	Other	0	0	0	0	0

Major uses of aquifer or hydrologic unit: X Public water supply ___ Private water supply ___ Irrigation ___ Thermoelectric X Commercial ___ Livestock ___ Mining ___ Industrial ___ Baseflow ___ Maintenance

Uses affected by water quality problems: X Public water supply ___ Private water supply ___ Irrigation ___ Thermoelectric ___ Commercial ___ Livestock ___ Mining ___ Industrial ___ Baseflow ___ Maintenance

1. Department of Human Services does not collect raw water quality data from public water supply wells.

Table 4-2.7. Ground Water Contamination Summary.

Aquifer Description: East Brunswick Aquifer **County: Cumberland**
Aquifer Setting: stratified drift **Data Reporting Period: 1985-March 1998**

Source Type	Present in reporting area	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contamination	Contaminants	Number of site investigations	Number of sites that have been stabilized or have had the source removed	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed
NPL	Yes	1	1							
CERCLIS (non-NPL)	Yes	3	3	2	PAH's, 111 TCE	2				
DOD/DOE	Yes	17	17	2	MTBE, TPH, fuel oil, gasoline	10				11
UST/LUST	Yes	469	15	10	fuel oil, gasoline	2			4	2
RCRA Corrective Action	No									
Underground Injection	Yes	9				1		9 cemented floor drains		
State Sites	Yes	1	1	1	lead, PCBs					
Nonpoint Sources										
Surface Spills	Yes	36	36	1	BTEX, MTBE		23		1	27
Above-ground tanks	Yes	2	2		fuel oil, TPH					
Municipal landfills	Yes	3			As, Pb, Cr, Hg, Se, VOC, SVOC		2			
De-icing	Yes	3	1		Chloride, Na		1		I	
Biomass ash utilization	Yes	9	n/a		Na					
Residuals						53				
TOTALS		553	78	16		68	26	9	6	40

NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act
UST - Underground Storage Tanks, Registered

Table 4-2.7 (continued). Ground Water Contamination Summary.

Aquifer Description: Harpswell bedrock aquifer **County: Cumberland**
Aquifer Setting: bedrock, primarily metasedimentary with some igneous **Data Reporting Period: 1985-March 1998**

Source Type	Present in reporting area	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contamination	Contaminants	Number of site investigations	Number of sites that have been stabilized or have had the source removed	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed
NPL	No									
CERCLIS (non-NPL)	No									
DOD/DOE	Yes	2	1	1	hydrocarbons	9	2	1 pending	1	0
UST/LUST	Yes	10	7	4			1		2	1
RCRA Corrective Action	No									
Underground Injection	No									
State Sites	No									
Nonpoint Sources										
Surface Spills	Yes	3	3	2			2		1	1
Above-ground tanks	Yes	1	1	1					1	
Municipal landfills	Yes	1								
De-icing	Yes	2	2	1						
Biomass ash utilization										
Residuals						7				
TOTALS		19	14	9		16	5	1	5	2

NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System

DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks

RCRA - Resource Conservation and Recovery Act
UST - Underground Storage Tanks, Registered

Table 4-2.7 (continued). Ground Water Contamination Summary.

Aquifer Description: Lisbon sand and gravel aquifer **County: Androscoggin**

Aquifer Setting: stratified sand and gravel **Data Reporting Period: 1985-March 1998**

Source Type	Present in reporting area	Number of sites in area	Number of sites that are listed and/or have confirmed releases	Number with confirmed ground water contamination	Contaminants	Number of site investigations	Number of sites that have been stabilized or have had the source removed	Number of sites with corrective action plans	Number of sites with active remediation	Number of sites with cleanup completed
NPL	No									
CERCLIS (non-NPL)	Yes	2								
DOD/DOE	No									
UST/LUST	Yes	53	8	2			2			
RCRA Corrective Action	Yes	1	1	1	VOCs, arsenic			1	1	
Underground Injection	Yes	1						1 connected to POTW		
State Sites	Yes	2	2	2	fuel oils, PCBs					
Nonpoint Sources										
Surface Spills	Yes	16	2	2			1			1
Above-ground tanks										
Municipal landfills	Yes	1	1	1			1			
De-icing										
Biomass ash utilization										
Residuals	yes	4								
TOTALS		84	14	8			4	2	1	1

NPL - National Priority List
CERCLIS (non-NPL) - Comprehensive Environmental Response, Compensation, and Liability Information System
DOE - Department of Energy
DOD - Department of Defense
LUST - Leaking Underground Storage Tanks
RCRA - Resource Conservation and Recovery Act
UST - Underground Storage Tanks, Registered

Resources for Aquifer Delineation and Ground Water Prioritization

Contact: Marc Loiselle, Natural Resource Information and Mapping Center/Geology (MGS)
(207) 287-2801

For the future, we see a major challenge in defining all aquifers in the State. At this point, the goal will be to define the aquifer boundaries of stratified drift aquifers as either ground water divides or major surface water bodies (i.e. real hydrogeologic boundaries). For the bedrock flow system we envision using surface drainage divides as opposed to a town or similar unit. While it is not clear that bedrock ground water flow will be controlled by surface drainage divides, it will be a closer approximation than a political boundary and will be a more realistic scenario with respect to collecting data from a variety of local sources. Also for the bedrock system we can identify the principal basins of interest. With current data coverage we should be able to identify reasonable sized drainage basins.

To support this effort, we will use the sand and gravel aquifer maps and the significant aquifer maps that have been published and digitized by the Natural Resource Information and Mapping Center/Geology (formerly the Maine Geological Survey). We do not have an ongoing ambient monitoring program for ground water with an established network of wells. The MGS is developing plans for an ambient water quality survey; this would be an extension of the Bedrock Ground Water Resources basic data program. This bedrock well database consists of information on bedrock wells supplied by water well drillers in Maine. Many of these wells have been located through field visits to town offices and reference to property tax records and tax maps. The basic data on well yield, well depth, and estimated overburden thickness, including some information on fracture depth and yield, have been published as a series of Maine Geological Survey Open-File maps.

This database can serve as the starting point for an ambient bedrock ground water quality database. To study ambient ground water quality, a subset of wells in a variety of hydrogeologic settings and geologic units would be selected for sampling and analysis of major cations and anions, trace elements, pH, Eh, dissolved oxygen, and an organic contaminant screen. The data would be examined for correlations between ambient water quality and hydrogeologic setting and or geologic unit. The information would be published as part of the MGS bedrock ground water resources basic data map series, and be accessible through an electronic Ground Water Resource Database. This database will eventually contain all state information on groundwater usage, availability, ambient quality, monitoring data and threats to quality.

The advantage of using the existing bedrock well database is the ability to first screen the database for wells with as much information on yield, depth, etc., as possible. At this point the GIS can be used to select a subset of wells in varied hydrogeologic settings and geologic units with the knowledge that it will be possible to obtain current ownership information with minimum effort. This process would significantly reduce the amount of field work needed to identify wells for sampling and analysis.

The information reporting system requested by EPA does not work well for characterizing overall ground water quality in the state. Therefore in this report, DEP has relied on the previous narrative section entitled "Overview of Ground Water Contamination Sources" to indicate ground water quality problems and the sections on ground water protection programs to indicate progress in protecting ground water quality and to identify areas that still need improvement.

Ground Water - Surface Water Interaction
Contact: John Hopeck, DEP BLWQ, (207) 287-3901.

No single program addresses the water quality concerns that arise from ground water- surface water interactions. Evaluating priority ground water areas or approximations of surface watersheds, as described above, enable risks to surface water from contamination or over-exploitation of ground water to be evaluated. However, contamination, or potential contamination, of surface water through baseflow of contaminated ground water is being evaluated at several locations. This section presents information on three closely monitored sites.

1. Mixed Organic Waste and Wastewater Disposal, Turner, Maine

Excessive land spreading of chicken manure, hen carcass disposal, septage disposal, and various other pollution sources related to egg production at a single large facility have resulted in the contamination of large areas of a sand and gravel aquifer. Concentrations of nitrate in ground water exceed the drinking water standard at many monitoring points, and nitrate concentrations over 1000 mg/l have been recorded (Table 4-2.8). Licensing of the facility and related enforcement actions have limited new nitrogen sources to on-site wastewater disposal from egg-washing plants and fertilizer for hay crops, but the widespread sources predating the 1990 licensing cannot be removed in any practical way, and so are continuing to release nitrogen to ground water. Speciation of nitrogen in ground water at the site is complex, possibly reflecting the variety of different sources, ages and concentrations of the sources, and various other factors. Concentrations of organic nitrogen in at least some sources were sufficiently high that nitrification of some wastes was incomplete, and ammonia concentrations exceed those of nitrate in many wells.

Ongoing monitoring at this site indicates that ground water quality has shown marginal improvement over the past two years in many areas, although many areas continue to show highly elevated nitrate concentrations and some show increasing nitrate levels. Water supply wells drawing from the surficial aquifer on this site show significantly greater nitrate concentrations than wells in bedrock. Application of nutrients for hay crops has ceased, and impacts on surface water remain approximately the same as described previously, suggesting that the major component of this pollution may come from ongoing subsurface wastewater disposal of egg washwater. These subsurface systems are prone to failure due to the formation of a thick organic mat on top of the soil as a result of very high BOD and suspended solids in the wastewater, despite use of two septic tanks in series and filters in the wastewater stream. Consequently, the Department is working with the site owner to design a land application and lagoon wastewater storage system, in order to eliminate subsurface disposal of almost all wastewater at this site. Submission of designs for review is anticipated in spring of 1999.

Table 4-2.8. Ground Water-Surface Water Interactions -Contamination of Surface Water by Ground Water

Aquifer Description: Sand and gravel/glaciofluvial delta
Aquifer Setting: Underlain by discontinuous till over bedrock
Name of Surface Water Body: Lively Brook
County: Androscoggin
Data Reporting Period: 1989-1996

Contaminant	Concentration in Surface Water (mg/l) 1		Concentration in Ground Water (mg/l) 2	
	Average	Range	Average	Range
NH3	1.78	ND-4.22	4.45	ND-25.4
NO3	4.52	0.55-12.9	38.02	1.95-100
Organic N	2.29	ND-9.3	3.08	ND-28.4

1. Composite of several stations along worst polluted reach.
2. Highly variable around site, with no wells immediately upgradient of surface water points. Data from closest well to degraded reach.

The majority of the shallow ground water at the site discharges to streams on the east and west sides of the property; monitoring points have been established on these streams in order to evaluate the effects of past practices and current wastewater disposal on surface water quality. Nitrogen species in surface water upgradient of the property are principally nitrate and organic nitrogen; nitrite and ammonia are frequently below detection limits and never present in a concentration greater than five-to-ten percent of either nitrate or organic nitrogen. Surface waters within the property and along the property boundary, however, show evidence of sources of reduced nitrogen. In particular, a smaller stream on the eastern side of the property shown concentrations of ammonia which average approximately 2.0 mg/l; these concentrations are frequently 40 to 50 percent of the nitrate concentration, and often exceed the organic nitrogen concentration.

The data described above are from grab samples of surface water; there is no regular monitoring of baseflow water quality. A single round of sampling of shallow ground water adjacent to the stream was conducted at relatively large intervals along the affected reach. Discrete areas of elevated conductivity were identified along the reach, with the highest conductivity found in the areas seen to have the greatest ammonia concentration in the surface water grab samples. Numerous potential sources exist in the affected area, and the high conductivity areas have not yet been associated with specific sources. Figure 4-2.9A shows the location of the Turner study site. Figure 4-2.9B shows the location of Turner with respect to other towns in the State of Maine.

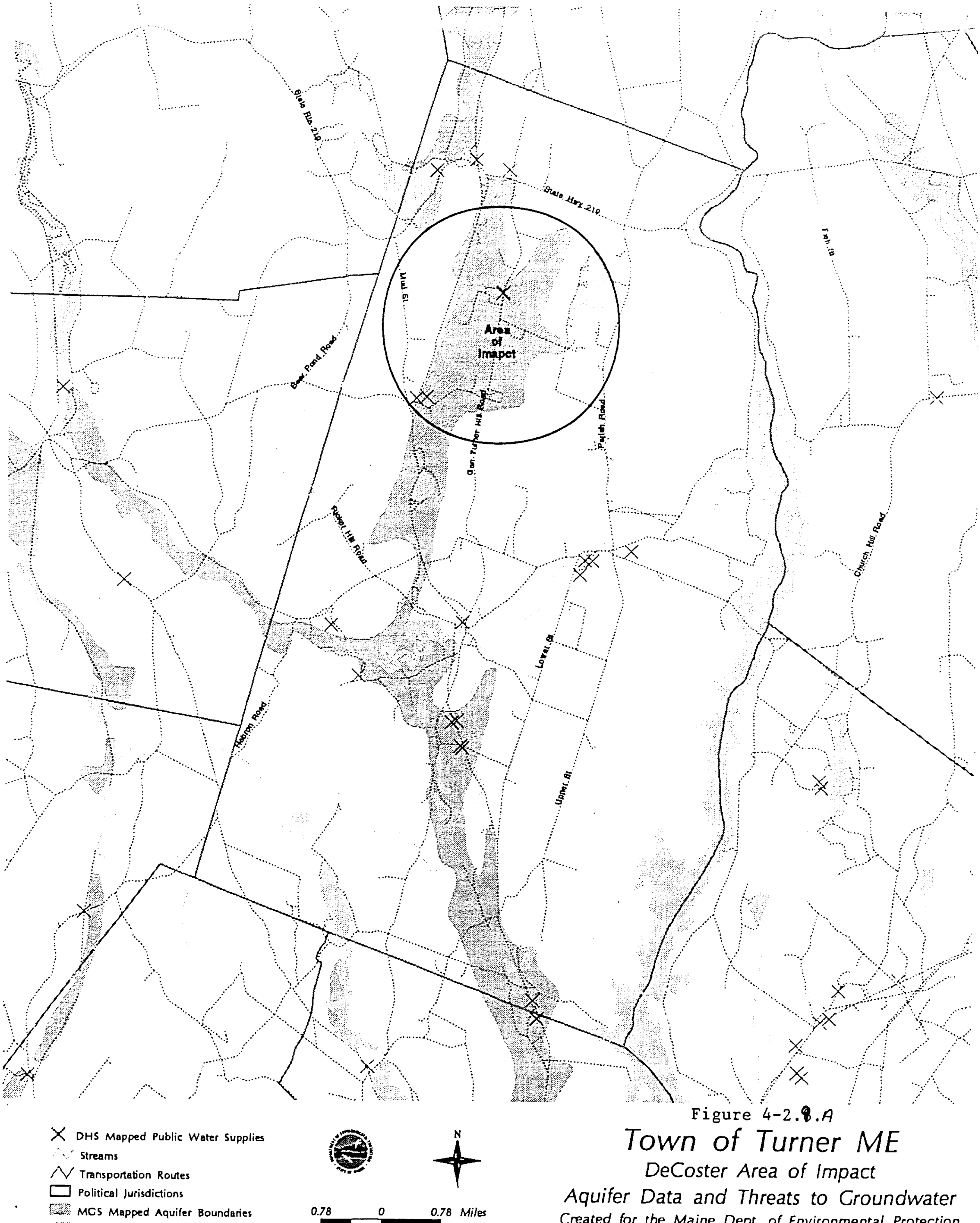


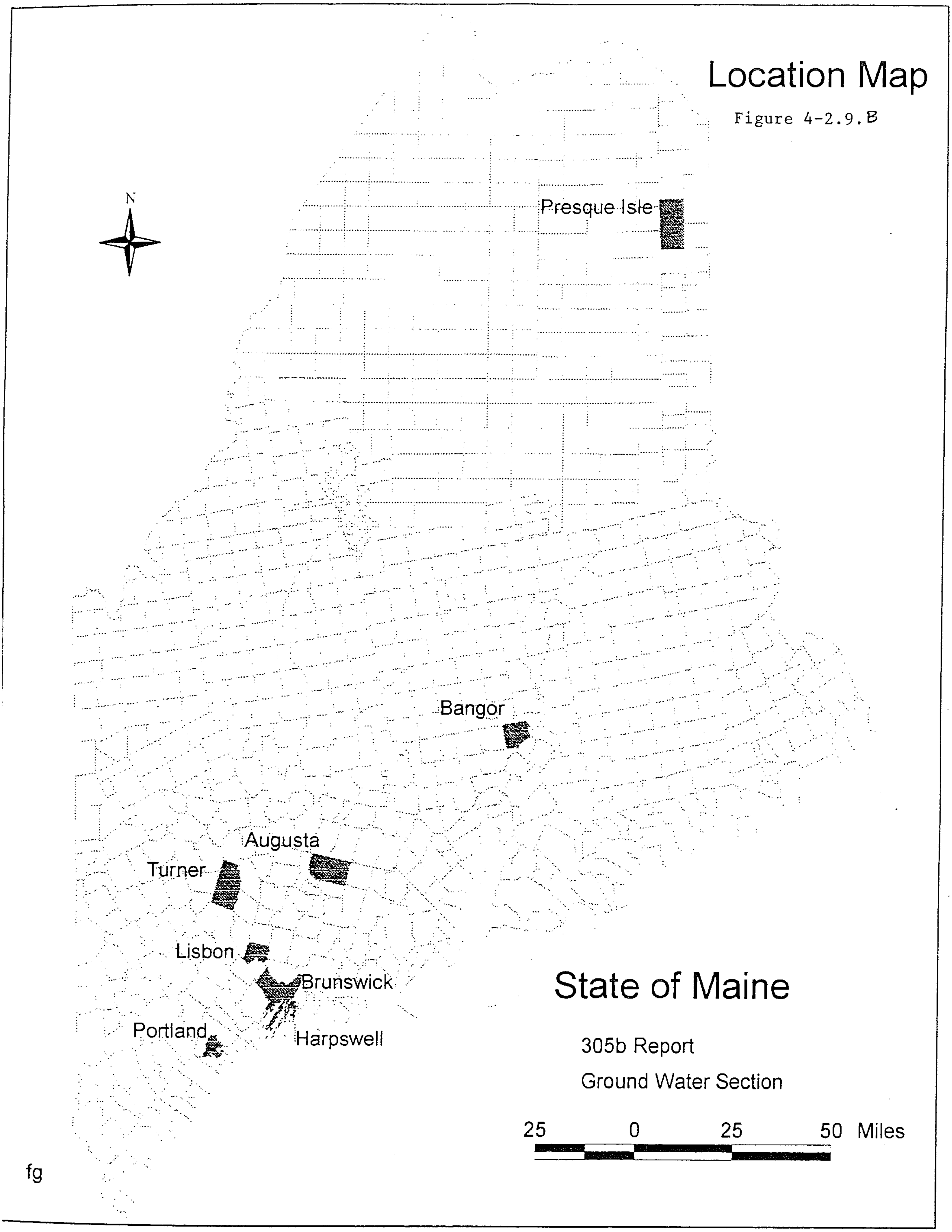
Figure 4-2.9.A

Town of Turner ME

DeCoster Area of Impact

Aquifer Data and Threats to Groundwater

Created for the Maine Dept. of Environmental Protection
Bureau of Land & Water Quality
EPA 305b Report 1996


Location Map
Figure 4-2.9.B
N
Presque Isle
Bangor
Augusta
Turner
Lisbon
Brunswick
Portland
Harpswell
State of Maine
305b Report
Ground Water Section
25 0 25 50 Miles
fg

2. Sanitary Wastewater Disposal

A recent development with numerous residential units has proposed an experimental wastewater treatment system which, although to be developed in phases, will ultimately dispose of at least 60,000 gallons per day into a lot with large areas of wetlands and only two surface water outlets. At full build-out, this flow may amount to several percent of the pre-development flow currently leaving the wetland watershed. Soils at the site are ablation till over bedrock, and the water table is relatively shallow at most points on the lot. It is anticipated that effluent from the components of the disposal system will flow downwards and then laterally to the wetlands, with a travel path of less than 100 feet in some cases. Although work has been done in Maine and other states on the use of constructed wetlands for wastewater treatment, and natural wetlands for secondary or tertiary treatment, MDEP does not know of other locations at which natural wetlands will be providing treatment for baseflow comprising large volumes of septic effluent.

A monitoring program has been established at this site to evaluate the long-term impacts of system operation on water quality in the wetland system. Surface water at the outlets from the parcel will be sampled quarterly for temperature, pH, specific conductance, nitrate, nitrite, total nitrogen, and ammonia. Monitoring wells down gradient of the first component of the system and located between the system and the wetland will be monitored for the same parameters and at the same frequency. Construction of the first phase of the system and installation of the monitoring wells was completed in the spring and summer of 1996; the first component of the system was activated on June 2, 1996.

Usage of this system increases gradually as older disposal systems are taken off-line and their flows added to the new field. The most recent data (October 1998) indicate that mounding is minimal. Flows to the system prior to March 1998, however, averaged 2000 gallons or less per day. Flow was increased to approximately 11,000 gallons per day on March 26, 1998, decreased to approximately 1000 gallons per day from June through August, and resumed at a rate of 12,000 gallons per day in September. No statistically significant changes have been detected in groundwater or surface water as yet.

3. Cumulative Impacts of Development on Ground Water Quality and Quantity

Maine DEP is working with two high schools in southern Maine to establish a monitoring network to collect data on surface water and ground water quality and quantity from a watershed undergoing significant changes in land use. This project is funded through a Section 319 Nonpoint Source Pollution Control grant to MDEP. Planned road construction will open a small (approximately 2.5 km^2), largely undeveloped watershed to commercial and industrial uses. Field mapping and review of the engineering and environmental studies prepared for the road construction project show the surficial deposits in the watershed to be principally glaciomarine sand and gravel overlying marine rock flour clay; these discontinuously overlie igneous, metaigneous, and metasedimentary bedrock.

Mt. Ararat High School in Topsham, which is partially within the affected watershed, and Brunswick High School in Brunswick, are working with MDEP, with the cooperation of local landowners and the Maine Department of Transportation, to develop a program where students will participate in the installation of monitoring wells and other sampling points, and collect and analyze water samples and stream flow, stream cross-section, and baseflow data. MDEP staff will provide technical support and training in sampling techniques, and supplement classroom instruction in geology and hydrology.

The short-term goals are to instruct students in practical applications of ground water and surface water hydrology, elementary geochemistry, basic statistics, and writing skills. Continuation of this project over several years is intended to allow students and teachers the opportunity to see and demonstrate changes in the watershed which may be related to land-use patterns, and develop an understanding of geologic and anthropogenic changes in natural systems. Thus far, seven monitoring wells have been installed at various points in the watershed, and surface water stations have been flagged along the length of the stream draining the watershed.

Work to date is still preliminary, but demonstrates that the greatest pollutant concentrations in the current low-development state are found in the headwaters of the stream where there are significant contributions from culverts flowing out from an urbanized strip along a major roadway and from high school athletic fields. Geologic mapping of the site shows that the streambed in much of the headwater area is underlain by marine silt and shallow alluvial soil over bedrock. Flow data indicate that the baseflow contribution in the upper reaches of the stream is small. Significant improvements in stream water quality are associated with baseflow contribution from a thick section of medium-to-coarse-grained marine sands that forms the streambed in the lower quarter-mile of the watershed. No degradation of groundwater quality has been observed in this unit to date. Attempts to model the baseflow contribution using MODFLOW are ongoing, as a preliminary step to modeling of the watershed.

Public Health and Environmental Concerns

Contaminants found in ground water have numerous adverse human health and environmental impacts. Public health concerns arise because some of the contaminants are individually linked to numerous toxic effects ranging from allergic reactions and respiratory impairment to liver and kidney damage, and damage to the central nervous system. Additional public health concerns also arise because information is not available about the health impacts of many contaminants found in ground water. Because of uncertainties about the relationship between exposure to contaminants and impacts on human health, public health efforts are based on identifying the probabilities of impacts (i.e. risk assessment). Conducting a risk assessment for combinations of contaminants that are commonly found in ground water is difficult because there are no generally accepted protocols for testing the effects of contaminant interactions. The primary route of exposure to contaminants is through ingestion of drinking water, although exposure is also possible through contact with skin and inhalation of vapors from ground water sources (bathing, food preparation, industrial processes, etc.)

Because ground water generally provides base flow to streams and rivers, environmental impacts include toxic effects on benthic invertebrates, fish, wildlife and aquatic vegetation. This also presents a public health concern if the surface waterbody is a source of food and recreation. In some areas of the State there is probably a link between low-level, long-term ground water quality degradation and the water quality of streams and brooks during low-flow conditions. (See the previous section on ground water - surface water interaction.)

Radon

Contact: Bob Stillwell, Department of Human Services, Division of Health Engineering
(207) 287-5743

Not all ground water public health concerns are related to pollutants caused by human activities. The presence of naturally occurring radioactive radon gas in ground water drawn from granite bedrock aquifers and overlying soils has recently raised concerns regarding ground water that had previously been regarded as safe. The average concentration of radon in private residential water supplies is 5,000 picocuries/liter. Based on studies of miners, medical researchers have shown that high radon levels in air are associated with increased incidence of lung cancer. The question remaining is whether radon levels found in some Maine homes and in drinking water can have a similar health effect. Future research in Maine should increase understanding of the nature and extent of this water quality problem.

Arsenic

Contacts: Marc Loiselle, Maine Geological Survey (MGS), (207) 287-2801, and David Braley, Department of Human Services, Division of Health Engineering, (207) 287-5338.

Wells showing high levels of arsenic have been found in a number of areas in Maine. In the fall of 1993, occurrences of arsenic concentrations in well water above the 50 ppb MCL in York and Cumberland Counties came to public attention. In this area, approximately 13% of nearly 1,200 well water samples tested greater than the MCL. HETL records show that of 356 private wells tested statewide between January 1, 1994 and December 31, 1995, 12.4% had levels of arsenic greater than .05 mg/L. Additionally, MDEP records indicate that 27 public water supplies are contaminated with arsenic.

A source or sources for the arsenic is unknown. However, preliminary work by the MGS, MDEP and the DHS indicate that the problem is of statewide significance and that the arsenic concentration of ground water is most likely the result of both natural processes and human activity. It is possible that agricultural and industrial activities have contributed to some cases of contamination, although arsenic is known to occur naturally in soils and bedrock in Maine, and may also be a source. To determine the extent of the problem and discover the sources of the contamination, the MGS, the DHS Drinking Water Program, and the Maine DEP will continue to study the problem by testing more wells and conducting additional geologic mapping. Affected towns in southern Maine are also researching historical land uses to find possible anthropogenic sources.

Wellhead Protection Program

Contact: David Braley, Department of Human Services, Division of Health Engineering
(207) 287-3194, email: david.braley@state.me.us

The DHS, Division of Health Engineering, administers the Maine Wellhead Protection Program. Public water suppliers voluntarily participate in this program. The goals of the program are to educate the public and water suppliers on the need for protecting ground water supplying their drinking water, and to assist water suppliers in preparing a wellhead protection plan (WHPP). The complexity of a wellhead protection plan depends on the type of system, the type of well used, volume of water supplied, the number of people served, duration of service, and the known threats to the water system.

Waivers granted for testing of Phase II and Phase IV contaminants are available only to systems with approved wellhead protection programs. All community systems had to have an approved WHPP by December 31, 1995 to be eligible for waivers in 1996 and beyond. The remaining systems are being phased in. To date, more than 725 WHP plans have been received. Future benefits available to systems will also be tied to wellhead protection whenever appropriate. These benefits may include reduced monitoring and application of new programs, such as groundwater under the influence of surface water and the groundwater disinfection rule.

Ground Water Indicators

Contact: David Braley, Department of Human Services, Division of Health Engineering (207) 287-5338

Table 4-3.0 shows the number of exceedances of MCLs for public water supplies using ground water and gives a relative indication of the condition of the ground water resource used as a drinking water supply. Data as of December 1995.

Table 4-3.0. Summary of Public Water Supplies with MCL and Wellhead Protection Programs.

Ground Water-Based or Partial Ground Water-Supplied Community Public Water Supplies with MCL Exceedences for Selected Contaminants:

Contaminant group	Number of MCL Exceedences	Number of Samples
Metals, VOC's, Pesticides	49	3105
Nitrate	0	366

Ground Water-Based or Partial Ground Water-Supplied Community Public Water Supplies with MCL Exceedences:

	Number of MCL Exceedences	Total Number
Number of PWS's	365	364
Population Served	unknown	216,955

Ground Water-Based or Partial Ground Water-Supplied Community Public Water Supplies that have Local Wellhead Protection Programs (WHPP's) in Place:

	Total Number of Public Water Supplies (PWSs)	Population Served
Community PWSs	364	216,955
Non-Community PWS's	1724 (approximate)	variable
PWS's with Local WHPP's in Place (Community and Non-Community)	408	215,229

Ground Water Quality Trends

Maine's complex hydrogeologic setting makes representative ground water quality sampling difficult. The hilly topography, complex geology, and general shallow water table have created numerous localized ground water flow basins, "ground watersheds", which are similar to and often coincide with surface watersheds. As a result, water quality data obtained from monitoring wells indicate only the water quality at a specific location and depth in an aquifer. The data reflect the ground water quality in the immediate vicinity of the monitoring well, but they are not indicators of ground water quality elsewhere, either inside or outside a particular "ground watershed". Current information about State ground water contamination problems may not describe the actual situation as much as it reflects the reason for the investigation and the manner in which it is conducted, i.e., the contaminants tested for, where the monitoring occurred, and how it was performed.

New occurrences of ground water contamination are documented in Maine each year. Although discovery of existing contamination is expected to continue, future reports of contamination are expected to decline substantially as State ground water protection initiatives continue to be implemented. These programs stress contamination prevention rather than remediation. Key aspects of these programs include:

1. Stricter underground storage tank installation and monitoring standards, removal of old and substandard tanks, and registration of all active and abandoned tanks should continue to reduce discharges from underground storage tanks.

2. In light of the increasing number of AST-related ground water threats, better tank standards and a statewide spill protection program need to be developed to protect ground water; also, more outreach is needed to make the public aware of weather and overhead dangers as threats to home heating oil ASTs.

3. Continued development and implementation of a strategy to protect ground water from agricultural chemicals will diminish the impact of pesticides and fertilizers on ground water quality. In 1995, the BPC received concurrence from EPA New England Region on the *Maine Generic State Management Plan for Pesticides in Ground Water* and is currently using it as a platform for development of a pesticide-specific management plan for hexazinone.

4. Development of new manure application guidelines that reflect agronomic nutrient utilization rates will decrease the adverse impact of the poultry and dairy farms on ground water quality.

5. Investigation and final closure of the older, polluting landfills will reduce one of the most prominent sources of contamination in the State. In 1995 the State Legislature abolished the Maine Waste Management Agency (MWMA), certain MWMA responsibilities were transferred to the State Planning Office and to the DEP. It is not

anticipated that these actions will have significant impact on landfill policy in the state. Further emphasis on recycling would reduce the waste stream and decrease landfill capacity needs, however with the abolition of the Maine Waste Management Agency, it is not clear how recycling will be promoted in the future.

6. Storing sand-salt mixtures for road maintenance in water-tight storage buildings will prevent highly concentrated salty leachate from contaminating ground water. However, this solution is still nearly a decade from full implementation. Elevated concentrations of sodium and chloride will persist in the ground water adjacent to roadsides unless an economical substitute for sodium chloride can be found.

7. The emphasis of the UIC Program on inventory and elimination or control of shallow injection wells will undoubtedly aid ground water protection efforts. Although the extent of contamination from shallow well injection in Maine is unknown, studies in other states indicate the potential ground water quality impacts resulting from routine and accidental discharges of toxic and hazardous substances is serious.

8. The Maine Nonpoint Source Pollution Program will have the most impact toward reducing ground water contamination. The program develops best management practices (BMP's) for activities contributing to nonpoint source pollution. Despite the paucity of data to quantify the extent of ground water contamination from many of those sources, the deleterious ground water quality impacts from many of the activities are well documented. Development of BMP's for those activities can proceed concurrently with ground water monitoring. Developing public awareness of BMP's is one of the most important aspects of the Nonpoint Source Pollution Program.

9. The Maine Geological Survey (MGS), is developing plans for an ambient water quality survey of bedrock wells as an extension of the Bedrock Ground Water Resources basic data program. This program is based on well driller information submitted from new well installations from around the state. This would add to our rather limited knowledge of ambient ground water quality.

10. Recent changes to Site Location of Development Act strengthen erosion and sedimentation control and stormwater management, and place emphasis on defining and protecting sensitive watersheds. These changes may help protect drinking water quality in developed areas of the State.

Chapter 3 - Overview of State Ground Water Protection Programs

Background

The protection of Maine ground water is an issue of concern at the local, regional, state and federal levels. Serious ground water pollution problems that have occurred throughout the State and elsewhere have heightened the need for protecting ground water supplies. A few municipalities and regional planning agencies have conducted ground water quality assessment studies, but programs for effective assessment of the quality of ground water resources are needed in many areas of the State. Maine's ground water protection program (Table 4-3.1) emphasizes three areas of effort:

1. State interagency coordination of ground water programs through the development and implementation of a Comprehensive State Ground Water Protection Program;

2. Assessment of ground water protection problems, including development of a ground water resource database;

3. Statutory changes and building upon implemented state ground water protection programs to increase ground water protection and risk reduction.

Surface Water Assessment Program (SWAP)
Contact: Paul Hunt, DHS DWP, (207) 287-2070

The Maine Drinking Water Program (DWP) wants to ensure that when a water supply is at risk of contamination, the people are made aware so that the appropriate steps can be taken to minimize or eliminate the risk. That is the purpose of the Source Water Assessment Program. By implementing SWAP, the DWP will evaluate each of the 2600 public water supply sources, assess for each the likelihood of contamination by existing or future activities, and make the results of these studies widely available to the public.

The Maine Drinking Water Program (at the Department of Human Services) has assembled a SWAP Citizens and Technical Advisory Committee consisting of approximately 40 members. The committee has met four times since May 1998, and has guided the development of a draft SWAP document. The Drinking Water Program has also had eight public comment meetings around the state to present and receive comment on the proposed SWAP methodology. A second draft document is in preparation and will be presented at the final advisory committee meeting on January 6, 1999. The DWP will submit the Maine SWAP for approval by the February, 1999, deadline.

Because the SWAP will utilize many existing sources of information, data collection has been underway for several years and will be a DWP area of focus for several more years. Implementation is expected to be completed and results publicized by 2003.

Table 4-3.1. Summary of State Ground Water Protection Programs

Programs or Activities	Check (X)	Implementation Status	Responsible State Agency
Active SARA Title III Program		authority not delegated	
Ambient ground water monitoring system	x	in development	MGS
Aquifer vulnerability assessment	x	continuing efforts	DHS
Aquifer mapping	x	stratified drift in progress	MGS
Aquifer characterization	x	stratified drift in progress	MGS
Comprehensive data management system	x	under development	DEP, DHS, MGS
EPA-endorsed Core Comprehensive State Ground Water Protection Program (CSGWPP)	x	under development	DEP
Ground water discharge permits	x	continuing efforts	DEP
Ground water Best Management Practices	x	continuing efforts	DHS
Ground water legislation	x	continuing efforts	DHS
Ground water classification	x	fully established	DEP
Ground water quality standards	x	continuing efforts	DHS
Interagency coordination for ground water protection initiatives	x	continuing efforts	DEP, DHS, MGS, DOT, DOA
Nonpoint source controls	x	under development	DEP
Pesticide State Management Plan	x	generic plan completed; PSMP under development	BPC
Pollution Prevention Program	x	fully established	DEP
Resource Conservation and Recovery Act (RCRA) Primacy	x	fully established	DEP
State Superfund	x	fully established	DEP
State RCRA Program incorporating more stringent requirements than RCRA Primacy	N/A		
State septic system regulations	x	fully established	DHS
Underground storage tank installation requirements	x	fully established	DEP
Underground Storage Tank Remediation Fund	x	fully established	DEP
Underground Storage Tank Permit Program	x	fully established	DEP
Underground Injection Control Program	x	fully established	DEP
Vulnerability assessment for drinking water/wellhead protection	x	continuing efforts	DHS
Well abandonment regulations	N/A		
Wellhead Protection Program (EPA-approved)	x	fully established	DHS
Well installation regulations	x	under development	DHS, MGS

Comprehensive State Ground Water Protection Program (CSGWPP)
Contact: John Hopeck, DEP BLWQ, (207) 287-3901

Maine is developing a core CSGWPP program through preparation of a summary and assessment of existing programs and by developing legislative and non-statutory initiatives to improve measures of ground water quality and vulnerability, better coordinate ground water-related programs on the state level, and more effectively deliver services to the public and other agencies. The draft of Maine's CSGWPP was submitted to EPA for review in February of 1997. Ongoing activities, including those described in this report, have necessitated reorganization and rewriting of sections of the document, particularly those dealing with enabling legislation and ongoing programs. Completion of the document and EPA approval are expected in 1999.

Ground Water Prioritization and Vulnerability Assessment
Contact: John Hopeck, DEP BLWQ, (207) 287-3901

Although CSGWPP stresses prevention of contamination whenever possible as the first priority in ground water protection, it also recognizes that all human activity has impact on ground water, and that the degree of protection afforded should be based on the relative vulnerability of the resource and, where necessary, the ground water's use and value. The lack of a comprehensive, GIS-linked, database has been identified as one of the major obstacles to Maine's efforts to developing an effective CSGWPP. Linkage of known contamination sites, sites presenting risks to groundwater quality, populations served by public and private water supply wells, and the quality of surface waters, among other factors, through the GIS, will allow the state to focus resources where the potential for adverse impacts on the environment and human health and welfare is the greatest, and help in designing and improving regulatory and non-regulatory programs by better defining the risks and preventive measures needed in particular circumstances.

Some methods used to assess regional groundwater vulnerability and risk, such as the USEPA DRASTIC method, require many types of data, the relative significance of which is subject to disagreement, and are intended to be used in identifying locations for facilities such as landfills and public water supply wells, and land use and zoning activities. The intention of Maine's chosen methodology is to assess regional intrinsic risk to groundwater in the bedrock flow system using relatively fewer factors, with the intention of setting regional priorities for activities by government agencies and local organizations. The methodology divides bedrock groundwater risk assessment into the three distinct layers: intrinsic vulnerability; pollution sources, and potential receptors.

1. Intrinsic Vulnerability: Intrinsic vulnerability includes those physical characteristics of an aquifer, which make it susceptible to contamination introduced at or near the land surface. Intrinsic groundwater vulnerability is determined as a function of overburden thickness and surficial geology at specific points; the vulnerability at intervening locations is determined by interpolation of these data, and a grid is prepared with a vulnerability factor assigned to each cell.

Soils maps are available at a very coarse level on GIS. For some areas, these can be supplemented by maps of surficial geology and overburden thickness, and data from the MGS well database, but there is not statewide coverage for these layers.

2. Pollution Sources: Maine's ground water quality is threatened or impaired by a variety of point and non-point pollutant sources, as detailed in this report. While many of these sources are located on the existing GIS system, many are not, and the coverage of large areas of the state remains poor. Linkage among the existing GIS database, land use patterns, water quality data, surface water quality, and resource and habitat values is, at best, preliminary. MDEP has received funding through a grant under Section 319 to improve the existing ground water resource database of point sources of potential ground water contamination by completing data QA/QC and entry of locational data onto the GIS system.

Pollution sources include point-data locations of USTs, landfills, sand - salt piles, and similar facilities; major transportation corridors, and population density (treated as a surrogate for much non-point source pollution). Risk of pollution is evaluated at each grid cell as a function of the vulnerability, the population density, and the values assigned to other sources of risk, if present in the cell. Aggregate risk to users of the aquifer is the normalized risk of pollution presented by the cells within each watershed.

3. Potential Receptors: Major problems with assessment of pollution risk thus far include difficulty in assessing possible agricultural impacts from the data available. In assessment of other sources of risk, it is at least possible to place an initial relative-risk factor for that general threat category (sand - salt storage, for example); this factor can subsequently be modified on a site-specific basis as information on site management practices becomes available. A similar procedure, based on crop types and management practices, could be applied to agricultural land if it could be identified satisfactorily. The available data do not, however, allow even unambiguous identification of which lands are in cultivation; satellite data interpretation has thus far proven unreliable. As is the case with non-point source pollution, it may be possible to identify an acceptable surrogate for agricultural acreage, but no satisfactory surrogate value has been found thus far. Data on acreage in production, for example, are not sorted by watershed, and weighting the available data as, for example, a function of cleared area and area of a watershed within a county is unsatisfactory.

Although it is possible to identify public water supply wells within watersheds, no satisfactory way has been found to determine what percentage of the population of a watershed is served by private wells and what percentage is served by public water. Only one municipal supply has CAD data showing their entire distribution system; others have digital data showing new portions of the system, but none showing the older portions, which generally include the principal lines from water supply sources. Since the risk to a water supply is a function of both the threats within the watershed and the population served, it is necessary to know both the threats in the vicinity of the source and the population both in and outside of the source watershed in order to assess risk, and this is not possible without knowledge of the distribution system. For similar reasons, certain areas identified as very high risk solely on the basis of threats may in fact present very little risk to public health if the watershed is largely or entirely served by public water from a source outside the watershed.

Ground Water Resource Database
Contact: Florence Grosvenor, DEP BLWQ, (207) 287-7745

A ground water quality database, which links site characteristics and ground water quality information to a spatial database, has been in development within the DEP for the last nine years. The work includes identification and location of various activities, which may affect ground water quality, known contamination sites, and populations served by public and private water supply wells. This effort is part of a statewide GIS-linked ground water database project, which when fully developed, can be used to: (1) achieve understanding of the spatial interrelationships between natural resources and population as they relate to potential or known pollution sources; (2) assess the flow and transport interrelationships between surface and ground water quality, in order to evaluate ground water impacts on surface water bodies, and ground water dependent habitat; (3) assist in prioritizing protection of sensitive ground water and surface water bodies, wetlands, and other environmental resources; and, (4) plan development to provide for the protection of public health and safety.

The Ground Water Resource Database (the Database) will be used to develop a Comprehensive Ground Water Protection Program, and to provide a base of potential threats to ground water quality information for the Drinking Water Program's Source Water Assessment Plan. The Database is also being used to satisfy requests for water quality data; reviewing applications for safety and practicability submitted under the state's environmental laws.

During the 1996-1998 reporting period, we have continued the construction and development of the Database. All three phases of project activity have been underway during the latest reporting period:

Phase I includes:

- listing and defining activities which may release contaminants at levels that could contribute significantly to the concentration of contaminants in ground and surface waters, particularly in drinking water source water areas;
- identifying and listing sites within each activity category; acquiring basic site, ownership and spatial data information, and
- entry of this information into the Database.

Spatial data files are then created, for use in mapping relationships between various activities, natural resources, and ground and surface water use.

The Phase II activities include data gathering and entry of site-specific information:

- including geology,
- well design and construction information, and

- sampling and analytical data.

The detailed site, well and analytical information, which includes 5400 monitoring locations, has now been added to 600 sites.

Procedures for Phase III of the project, database maintenance and upkeep, have not yet been finalized. Quality assurance activities are focusing on data and location accuracy, consistency in expressing data, and the ability to link related data. DEP-GIS and OGIS will manage spatial data quality.

Many of the above project activities will be conducted jointly with the Department of Human Services' Drinking Water Program, in order to focus attention on gathering information that best meets the needs of the most people, especially in developing Source Water Assessment and Protection programs.

We originally estimated that about 3000 sites would be included in the ground water database. As of the 1996 305b reporting period, about general site and location data for 4000 sites had been compiled and entered. During the January 1996-March 1998 reporting period, the number of sites for which general site and location data had been compiled and entered exceeded 6600. Additionally, 4500 registered underground petroleum storage tank locations were QA'd and entered into the tanks database as potential contamination sites. Underground tanks included those at gas stations, and those used for storage of home heating oil and other petroleum products. We have identified at least 5000 more sites from the original group of 27 site types, and at least 10,000 additional sites that should be researched and entered, including the large, medium and small quantity RCRA generators, 3500 additional underground petroleum tank storage sites; laundries and dry cleaners; car and truck washes; photo labs, and the like. We anticipate that additional contamination site types will be added as we work with staff from the Drinking Water Program.

The individual site types (as of December 1998) include:

Ash Utilization Sites
Automobile Graveyards
CERCLA Sites
Compost Facilities
Construction/Demolition Debris Disposal Sites
Engineered Subsurface Wastewater Disposal Systems (>2000 gallons per day)
Industrial Parks
Commercial Landfills
Municipal Landfills
Special Waste Landfills
LAST Sites
LUST Sites
Mining and Beneficiation Activities
Non-Point Sources (highways, golf courses, etc.)
RCRA Sites
Residuals Utilization Sites

Sand/Salt Storage Sites
Sanitary and Industrial Wastewater Treatment Facilities
Septage Storage and Disposal Sites
Sludge Utilization Sites
Surface Impoundments
Surface Spills
Tank Farms
Transfer Stations
Uncontrolled Sites
Underground Injection Wells
Woodyards, Lumberyards, Biomass Fuel Piles

Continuous progress is being made in completion of spatial data for underground tanks, surface spills, hazardous waste landfills, municipal landfills, and other waste management activities; lists of sites in each waste management site type have been completed. Spatial data entry for all public water supply wells has been completed by the Department of Human Services.

Proposed Statutory Changes
Contact: John Hopeck, DEP BLWQ, (207) 287-3901

Several measures were undertaken by MDEP in the spring and summer of 1995 to improve coordination of ground water regulation among state agencies, water utilities, and other interested parties. The most significant of these involved proposals to replace or significantly amend the Site Location of Development Act, a state environmental impact law dealing with large commercial and industrial facilities, non-metallic mineral extraction, large residential subdivisions, and similar developments. Analysis of the "Site Law" in comparison to other existing regulatory programs revealed that it addressed four issues with regard to ground water quality and quantity, which were not addressed in other DEP regulatory programs:

1. Subsurface sanitary wastewater disposal (except publicly owned treatment plants;
2. Ground water withdrawal;
3. Non-point source pollution, and;
4. Ground water protection plans.

A work group including representatives of state agencies, water suppliers, and municipal and commercial/industrial interests, was formed to discuss how these issues could be addressed in the absence of the Site Law, and how the State's approach to these areas could be improved.

1. Sanitary Wastewater Disposal:
The Department of Environmental Protection and Department of Human Services have clarified their respective authorities over subsurface wastewater disposal. Under existing state law, subsurface disposal systems, which are designed and installed in conformance with the state plumbing code, do not require a waste discharge license from DEP. According to a June 1998

Memorandum of Agreement between the two agencies, the jurisdiction of the plumbing code is limited to wastewater defined as any domestic wastewater, or other wastewater from commercial, industrial, or residential sources that is generally similar to domestic wastewater. Subsurface disposal of any other type of wastewater is now understood to require a wastewater discharge license from DEP if the water contains pollutants of a type and concentration of concern to DEP. Subsurface disposal of non-contact cooling water would therefore generally not require a permit from DEP; subsurface disposal of water from a car wash would likely not be eligible for review under the plumbing code, and would probably require a discharge license from DEP.

Under this same Memorandum of Agreement, DEP will provide review of engineered disposal systems to DHS; this review is directed towards assessment of the geology of the disposal area and vicinity, the primary, secondary, and cumulative effects of the proposed wastewater disposal on the quality of groundwater and the impact of any degradation of groundwater quality on the natural environment and the water quality of any surface water, and the public and private uses of groundwater in the area of the system. Prior to this MOA, the Department of Environmental Protection reviewed only a very small number of these large systems, which happened to be associated with developments large enough to require review under the Site Location of Development Law. One of the major purposes of the MOA is to provide the Department with a complete picture of the setting and design of these large systems, in order to evaluate the need for any changes to the plumbing code to address potential impacts of these systems.

2. Groundwater Withdrawal:
A Groundwater Quantity Workgroup was convened in the fall of 1997, in order to study the requirements of a program to minimize the potential for unreasonable adverse impact of groundwater extraction on the availability of groundwater to support existing uses, such as water supplies and baseflow to streams. This group included representatives of the Department of Environmental Protection, Department of Human Services' Drinking Water Program, public water suppliers, and business and industry groups.

The Workgroup found that there is credible evidence demonstrating that groundwater overdraft has resulted in significant impacts on the environment and on public health and safety in other states, as a result of reduction in flow to, or induced flow from, surface water bodies, and reduced availability of groundwater for existing wells. Largely anecdotal evidence indicates that local effects of overdraft have impacted some areas in Maine, and that some aquifers may be unable to support current or reasonably anticipated future demands. However, the present state of knowledge regarding the magnitude and occurrence of groundwater overdraft in Maine is so limited that the workgroup could not determine whether or not a new regulatory program was justified at this time, and, if it were justified, what the applicable thresholds and submission requirements of such a program would be.

Given that there is evidence of adverse impact due to groundwater overdraft in this state, the likelihood of increased usage of groundwater in developing areas of the state, the potential for accelerated development resulting from improved transportation and energy infrastructures, and the significant public and private investment represented by water supply systems and the residential and commercial facilities dependent on those supplies, the workgroup found that there is a need to determine the magnitude and extent of existing or potential problems with groundwater availability. The final report of the group has been delayed due to work on a more general rule dealing with flow in streams, which will provide general requirements limiting direct and indirect withdrawals from surface waters, although not specifically addressing impacts on other water supplies. The final report will include a recommendation for additional work required to evaluate the magnitude of any problems due to groundwater overdraft, and to develop an outline and reasonable thresholds for a regulatory program, should the Legislature determine that such a program is needed.

3. Non-point Source Pollution:

Some general categories of development present the potential for significant non-point source pollution of ground water. These include residential developments, developments that infiltrate stormwater, and various developments which use pesticides, fertilizers, or other materials with the potential to contaminate groundwater, such as golf courses, truck stops, highways, and biomass plants. Although most nonpoint source problems can be dealt with through a combination of BMPs and monitoring, some can be dealt with specifically. Much of the groundwater NPS pollution from residential development is from on-site wastewater, and this can be addressed through improvements in the plumbing code and in municipal understanding of groundwater issues. Fertilizer and pesticide use issues may be approached through requiring development and implementation of an Integrated Pest Management Plan, with monitoring of groundwater quality or, if conditions are suitable, benthic macroinvertebrate populations to determine the impacts of contaminated baseflow. The Department's licensing and technical review staff will continue to analyze the various options available to developments as part of the licensing process and technical assistance to municipalities.

Concern with non-point source pollution of groundwater in Maine has increased recently, in part due to concerns related to MTBE contamination of private and public water supply wells. Work on the Governor's plan for safe drinking water, discussed elsewhere in this report, may address many of the issues identified by the work group. One option under consideration is a Legislative Resolve directing the formation of a Wellhead Protection Task Force to consider the improvement of wellhead and water supply protection for public and private wells. This task force would include members of the legislature, relevant state agencies, and public members representing water utilities, municipalities, the petroleum industry, business owners, and the real estate industry, and would draft a report, including any proposed legislation, during late 1999. This report will suggest measures to improve the protection of community and non-transient, non-community water supply wells and intakes, and private water supply wells from threats including septic system installations, petroleum storage, and storage and handling of hazardous materials, pesticides, and other materials.

4. Ground Water Protection Plans:

A committee of certain state agencies, affected industries, and municipal and public interests to discuss and study the requirements of a uniform system for the registration, storage and handling of petroleum products, hazardous materials, and other substances with the potential to contaminate ground water was formed in 1996.

Certain developments regulated under the Site Law, particularly commercial and industrial developments, handle or use in the course of their operation a variety of materials with the potential to contaminate ground water. These developments have been required to demonstrate that they had measures in place to minimize the risk to the environment posed by these substances. In the course of researching the potential impact of changes to the Site Law, the work group found that the storage, use, and handling of petroleum products, hazardous materials, and certain other substances with the potential to contaminate ground water, was addressed through the Site Law and the Waste Discharge Law, as well as through regulations of the DEP BRWM, the State Fire Marshal's Office, the Board of Pesticides Control, and the Maine Emergency Management Agency (MEMA), and also various federal agencies, including the USEPA and the U.S. Coast Guard. There is no consistent state oversight for storage of these materials, and neither federal nor MEMA standards specifically address ground water protection; federal standards alone do not provide uniform guidance for design of ground water protection plans (spill prevention, control, and countermeasures).

Consideration of the available options and the diversity of stakeholders required for development of a truly comprehensive uniform registration system indicated that, although such a system could have definite advantages, it was impractical to develop through the mechanism originally considered. Initiatives of the Bureau of Remediation and Waste Management dealing with home heating-oil storage and other pollutants, together with the possible outcomes of the Governor's plan discussed above, may sufficiently address the concerns identified by the groundwater workgroup.

APPENDICES

STATE OF MAINE

1998 WATER QUALITY ASSESSMENT

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APPENDIX I

STATE OF MAINE 1998 WATER QUALITY ASSESSMENT

THE MAINE WATERBODY SYSTEM

Appendix I. Chapter 1. Introduction

The collection and analysis of water quality data is essential to the effective management of both Federal and State water pollution control programs. This information is necessary to determine workloads and plan expenditures; establish priorities and focus efforts on areas where water quality problems actually exist; evaluate the effectiveness of pollution control programs; and report to the public on progress toward achieving environmental goals.

The basic requirements for developing and reporting water quality information are set forth in Sections 305(b) and 106(a)(1) of the Clean Water Act (CWA). The reporting process involves preparation of a biennial status report called the 305(b) Report, by each State, Territory, and Interstate Commission which is then sent to the U.S. Environmental Protection Agency (EPA). EPA analyzes the individual reports, compiles a national assessment and transmits both the national and state reports to Congress.

The USEPA has developed a water quality information management system. This system, known as the Section 305(b) Waterbody System (WBS) manages information concerning the water quality status of specific waterbodies. WBS summarizes the assessments that have been done to characterize water quality conditions, the causes (pollutants and sources) of poor water quality, and program activities related to improving water quality. WBS is intended to fill the information gap between the analytical data generated from monitoring activities and the program implementation data managed in various systems such as the Permits and Compliance System and the Grants Information Construction System.

Table 1 presents the numbering system which was used to divide the State into major basins and geographic areas. These six major basins were assigned number three-digit waterbody code number, with the first digit corresponding to the third digit of the sub-region identifier of the United States Geological Survey (USGS) Hydrologic Unit Code. Although WBS guidance from USEPA does not explicitly require it, all waterbodies established by a state must be sub-units of the basins and sub-basins already defined by USGS.

This complicates the process of defining the geographical limits of waterbodies because the USGS system combines some major river basins, portions of minor coastal basins, estuarine waters and marine waters which must be grouped differently for State reporting purposes. This limitation of the USGS hydrologic unit code has been overcome by adding regrouping instructions, where required, as a note to the waterbody descriptions. It should be noted that basin codes 4 and 6, as presented in Table 1 are sub-units of the boundaries defined by USGS for those basins. This partitioning was necessary because basins 4 and 6 extend into the State of New Hampshire.

Table 1. Major Basin Codes for Use With Maine's Waterbody System

Code#	Basin or Geographic Area
1	Saint John River Basin, those waters lying in Maine,
2	Penobscot River Basin,
3	Kennebec River Basin,
4	Androscoggin River Basin, those waters lying in Maine,
5	Minor basins entering tidewater east of Small Point, those waters lying in Maine,
6	Minor basins entering tidewater west of Small Point, those waters lying in Maine,

Within each of the major basins listed as 1 through 6 in Table 1, two to five sub-basins (21 in all) have been delineated by the USGS. A description of the sub-basins used for development of the WBS in Maine is presented in Table 2.

Also presented in Table 2 are the number of sub-sub-basins established for WBS within each sub-basin. These 159 sub-sub-basins are one of two cataloging units used in Maine's Waterbody System. These sub-sub-basins were established according to the following protocols:

(1) Waterbodies were made as large as possible consistent with there being similarities of land use and ambient water quality within a waterbody.

(2) For waterbodies which are in major river basins, waterbodies in each sub-basin were numbered from the basin's headwaters to its mouth.

(3) For waterbodies which are Minor Coastal Basins or groups of these basins, waterbodies were numbered from east to west.

Because the EPA Waterbody System cannot group lacustrine and riverine waters in the same waterbody the suffixes L and R have been added to the code numbers identifying sub-sub-basins, resulting in the establishment of 318 waterbodies.

The second cataloging unit type consists of river main stems or segments thereof. Segments of most major river main stems were established as separate waterbodies to reflect existing differences in ambient water quality and point source discharge patterns. These 53 main stem segments (reaches) are presented in Table 3. Forty-one of these segments are riverine in nature and one is lacustrine. Eleven of the river segments include both lacustrine and riverine waters, requiring the establishment of 22 waterbodies for these eleven segments. Thus, 64 waterbodies are used to track water quality conditions in these 53 river segments.

Three river main stem segments which would be grouped with riverine waters by USGS hydrologic unit boundaries are actually estuarine/marine in nature. While the USGS hydrologic unit boundaries, however arbitrary, must be adhered to in setting up the WBS, the description of attainment status for these three waterbodies is included in Chapter 5 of this Appendix, with the rest of Maine's estuarine/marine waterbodies. Maine currently has insufficient resources to establish estuarine/marine management units (waterbodies) similar to those established for fresh waters. The major impediment to establishing estuarine/marine waterbodies is that there is no information on the area of State waters or the area of shellfish closures for appropriately sized management units. Consequently, Maine has grouped most estuarine/marine waters outside the three USGS-delineated areas into one waterbody (#900M). This waterbody should be considered as temporary. Hopefully, sufficient resources will become available to allow waterbody #900M to be subdivided into appropriate management units.

Descriptions of the 387 waterbodies (318 drainage area waterbodies, 64 river main stem waterbodies and 5 estuarine/marine waterbodies) are presented in Chapter 4 of this Appendix, along with information about land use and hydrologic characteristics present in the waterbody, water quality classifications assigned in the waterbody, and the status of classification attainment in the waterbody. The designated uses ascribed to Maine's water quality classifications are presented in Table 4. It should be noted that the goals of all these classifications are equal to or higher than the interim goals of the CWA. A map showing the location and boundaries of these waterbodies is available for inspection at the Augusta offices of the Bureau of Land and Water Quality .

Although the initial reason for establishing these waterbodies was to facilitate the setup of WBS they also serve other purposes. The code numbers for sub-sub-basins will be used by the United States Department of Agriculture, Soil Conservation Service for inventories of nonpoint pollution sources. The sub-sub-basin and river reach code numbers are also used as first three digits of a six-digit number identifying all present and prospective surface water monitoring stations located in a waterbody. This six-digit monitoring station number is used as a secondary station code in the STORET system. This additional use of the waterbody code numbers will facilitate powerful WBS-based data retrieval and analysis in the STORET system.

Table 2. Sub-Basin Codes for Use With Maine's Waterbody System

Sub-basin#	Sub-basin description	# of Sub-sub-basins
	SAINT JOHN RIVER BASIN	44
11	St. John River and its minor tributaries entering above the confluence of Limestone Stream, those waters lying in Maine	13
12	Allagash river and its tributaries	1
13	Fish River and its tributaries	8
14	Aroostook River and its tributaries and Limestone Stream and its tributaries, those waters lying in Maine	17
15	Minor tributaries of the St. John River entering below the confluence of the Aroostook River, those waters lying in Maine	5
	PENOBSCOT RIVER BASIN	22
21	West Branch and its tributaries	2
22	East Branch and its tributaries	1
23	Mattawamkeag River and its tributaries	5
24	Piscataquis River and its tributaries	5
25	The Penobscot River and its minor tributaries	9
	KENNEBEC RIVER BASIN	26
31	Kennebec River, main stem, above the confluence of the Dead River and tributaries of the Kennebec River entering above the confluence of the Dead River	4
32	Dead River and its tributaries	4
33	The Kennebec River, main stem, below the confluence of the Dead River and tributaries of the Kennebec River entering below the confluence of the Dead River	18
	ANDROSCOGGIN RIVER BASIN	18
41	Tributaries of the Androscoggin River entering above where the Androscoggin River crosses the Maine - New Hampshire boundary, those waters lying in Maine	5

Table 2. (Cont'd). Sub-Basin Codes for Use With Maine's Waterbody System

Sub-basin#	Sub-basin description	# of Sub-sub-basins
42	Androscoggin River, main stem, and its tributaries entering below where the Androscoggin River crosses the Maine - New Hampshire boundary, those waters lying in Maine	13
	MINOR BASINS ENTERING TIDEWATER EAST OF SMALL POINT	27
51	St. Croix River Basin, those waters lying in Maine	4
52	Minor basins entering the tidewater between the St. Croix River Basin and Marshall Point	15
53	Minor basins entering the tidewater between Marshall Point and Small Point	8
	MINOR BASINS ENTERING TIDEWATER WEST OF SMALL POINT	22
61	Minor basins entering the tidewater between Small Point and the Saco River Basin	10
62	Saco River Basin, those waters in Maine	5
63	Minor basins entering tidewater between the Saco River Basin and the Maine - New Hampshire boundary	7
	TOTAL NUMBER OF SUB-SUB-BASINS	**159**

Table 3. Main Stem Waterbodies (Reaches)

Sub-basin Code #	# of Segments	Main Stem Name
11	5	St. John River
12	1	Allagash River
13	1	Fish River
14	2	Aroostook River
21	3	West Branch of the Penobscot River
22	1	East Branch of the Penobscot River
23	1	Mattawamkeag River
24	1	Piscataquis River
25	6	Penobscot River
31	1	Moose River
31	1	Kennebec River
32	1	Dead River
33	1	Wilson Stream
33	1	Sandy River
33	1	Messalonskee Stream
33	1	East Branch of the Sebasticook River
33	1	West Branch of the Sebasticook River
33	1	Sebasticook River
33	5	Kennebec River
42	2	Little Androscoggin River
42	7	Androscoggin River
51	1	St. Croix River
52	1	Union River
61	2	Presumpscot River
62	2	Saco River
63	1	Mousam River
63	1	Great Works River
63	1	Salmon Falls River
TOTAL NUMBER	53	

Appendix I. Chapter 2. Maine's Water Quality Classification System

Table 4. Designated Uses Ascribed to Maine's Water Quality 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.

Appendix I. Chapter 3. Documentation of Maine's Waterbody System

Determination of the number of stream miles in each waterbody was based on the Reach File Version 2.0 (RF2). Drainage area and reach boundaries were delineated on a RF2 plot of Maine and then reach indexed by the Research Triangle Institute. The resulting computation of stream miles through reach indexing was 11,000 miles. This presented a problem since an earlier, non-computerized study by the Maine Department of Inland Fisheries and Wildlife had determined that there were 31,672 miles of riverine habitat in Maine. This conflict was resolved by multiplying non-reach mileages by a factor of 2.7 to more closely approximate the actual number of stream miles in Maine.

Drainage area determinations, although not a required statistic for loading of WBS, were obtained from the USGS publication "Drainage Areas in Maine." Because some of the waterbodies used in WBS comprise portions or aggregations of USGS drainage area data, drainage areas have not been provided for all waterbodies. When resources allow, the remaining drainage areas will be calculated. Another planned addition to the WBS database is a description of land use characteristics and point source discharges affecting water quality.

Determination of the surface area of lakes and ponds in each lacustrine waterbody was accomplished through use of the Maine DEP lakes database. Much effort was put into determining which lakes were in which waterbody. When the lists of lake numbers were completed, waterbody numbers were entered as a sortable attribute into the lake database and waterbody lacustrine acreages determined. Assessments of attainment were based on the protocols specified in Part III, Chapter 2 of Maine's 1998 Water Quality Assessment.

Appendix I. Chapter 4. Non-Attainment Rivers and Streams

Table 5. Non-Attainment Rivers and Streams in Maine – 1998 Assessment

WBS #	NAME	TOWN	CLASS	ATTAIN	N/A MI	CAUSE	SOURCE	DATA
117R	St John R	Madawaska,Van Buren	C		2	Bact	CSO	1994
140R	N Br Presque Isle Str	Mapleton	B		5	DO	POTW, flow, Ag nps	1996
	Presque Isle Str	Presque Isle	B		1	DO, Tox, Bact	POTW, CSO	1996
	Dudley Bk	Chapman	A	C	2	AqL	Ag nps	1996
142R	Caribou Str	Caribou	B		1.5	AqL, Bact	Urban nps,habitat	1994
143R	Everett Bk	Fort Fairfield	B		4	DO	Ag nps	
145R	Little Madawaska R	Caribou	B		4	Tox	Haz waste	1995
	Greenlaw Str	Caribou	B		6	Tox	Haz waste	1995
146R	Webster Bk	Fort Fairfield	B		2.5	Bact	Untreated waste	
152R	Meduxnekeag R	Houlton	B	C	6	DO	POTW, Ind, Ag nps	1996
205R	W Br Penobscot R	TA R7 WELS	C		0.5	DO	Ind, Habitat	1996
	W Br Penobscot R	Millinocket	C		4	AqL	Hydro	
	Millinocket Str	Millinocket	C		3	Bact	Untreated waste	
216R	W Br Pleasant R	KIW Twp	A	B	1	AqL	Mine waste	1996
	Blood Bk	KIW Twp	A		1	AqL	Mine waste	1996
219R	Piscataquis R	Dover Foxcroft	B		7	DO, Bact	CSO, Ag nps, Hydro	1997
222R	Costigan Str	Milford	B		0.5	DO, Bact	Untreated waste	1995PIN
224R	Burnham Br	Garland	B	C	3	DO	Ag nps	
	Kenduskeag Str	Bangor	C		1.5	Bact	CSO, untreated waste	
	Unnamed Bk	Corinth	B	C	2	DO	Ag nps	
	French Str	Exeter	B		2	AqL	Ag nps	1997
	Unnamed Bk(Pushaw)	Bangor	B		1	AqL	Urban nps	1997
	Unnamed Bk(Ohio)	Bangor	B		1	AqL	Urban nps	1997
	Unnamed Bk(Valley)	Bangor	B		1	AqL	Urban nps	1997
226R	Otter Str	Bradley	B		1	Bact	untreated waste	
	Boynton Bk	Bradley	B		0.5	Bact	untreated waste	
228R	Unnamed Bk	Frankfort	B		1	Bact	untreated waste	
231R	Penobscot R	Lincoln	C		14	Tox, Bact(1mi)	Ind, CSO	1997
232R	Penobscot R	Enfield	B/C		20	Tox	Ind	1997

233R	Penobscot R	Old Town	B		12	Tox	Ind	1997
234R	Penobscot R	Orono,Veazie,	B/C		10	Tox, Bact(5mi)	Ind, CSO	1997
		Bangor						
311R	Dead R	T3R4 BKP	AA/A	B	1	AqL	Hydro	1993
314R	Wesserunsett Str	Athens	B		2	Bact	untreated waste	1991
316R	Barker Str	Farmington	B	C	4	DO	Urban nps	
	Unnamed Bk	New Sharon	C		0.2	DO	Habitat	
	Tannery Bk	Farmington	B		1.5	Bact	untreated waste	
317R	Meadow Bk	Wilton	B		1	Bact, DO	untreated waste	
320R	Carrabassett Str	Canaan	B	C	11	DO	Ag nps	
	Currier Bk	Skowhegan	B		1	Bact	Urban nps	1991
	Whitten Bk	Skowhegan	B		1	Bact	Urban nps	1991
	Mill Str	Norridgewock	B	C	2	AqL	Waste disposal,habitat	1997
322R	Fish Bk	Fairfield	C		7	DO	Ag nps, habitat	1991
323R	Messalonskee Str	Oakland	C		1	Bact	CSO	1992
324R	Thompson Bk	Hartland	B	C	4	DO	Ag nps	
325R	E Br Sebasticook R	Corinna	C		2	Tox, Bact	POTW, nps, CSO,	1997
							Haz waste	
	Brackett Bk	Palmyra	B		2	DO	Ag nps	
	Mulligan Str	St. Albans	B	C	2	DO	Ag nps	
327R	Mill Str	Albion	B		2.5	DO	Ag nps	
329R	Farnham Bk	Pittsfield	B		3	DO	Ag nps	
	Twelvemile Bk	Clinton	B		7	DO	Ag nps	
	Unnamed Bk	Benton	B		2	DO	Ag nps	
330R	W Br Sebasticook R	Hartland	C		13	Tox	POTW	1996
332R	Sebasticook R	Burnham	C		3	DO	Hydro	
333R	Riggs Bk	Augusta	C		0.2	Bact	CSO, Urban nps	
	Whitney Bk	Augusta	B		0.5	Bact	Untreated waste, nps	
	Bond Bk	Augusta	B/C		2	Bact	Urban nps, CSO	
334R	Mud Mills Str	Monmouth	B		5	DO	Ag nps	
	Potters Bk	Litchfield	B	C	2.5	DO	Ag nps	
	Cobbossee(Mill) Str	Winthrop	B		0.5	AqL	Urban nps	1984
335R	Kimball Bk	Pittston	B	C	3	DO	Ag nps	
	Togus Str	Chelsea	B		2	DO	POTW	1997

338R	Kennebec R	Norridgewock	B		4	AqL	Hydro	1997
339R	Kennebec R	Fairfield	B/C		30	Tox, Bact(5mi),	Ind, Hydro, CSO	
						AqL(7 mi)		
340R	Kennebec R	Augusta	C		26	Tox, Bact	Ind, CSO	
410R	Spears Str	Peru	B		1.5	Bact	untreated waste	
412R	Nezinscot R	Buckfield	B		4	Bact	untreated waste	
	House/Lively Bk	Turner	B		2	AqL	Ag nps	1997
413R	Jepson Bk	Lewiston	B	C	1	DO, Bact	CSO, Urban nps, habitat	
	Penley Bk	Auburn	B		0.7	DO	Urban nps	
	Stetson Bk	Lewiston	B		0.5	DO, Bact	Urban nps	
	Logan Bk	Auburn	B		1	Bact, DO	Urban nps	
414R	Penneseewassee Outlet	Norway	B		1	Bact, DO	Urban nps	
415R	Davis Bk	Poland	B	C	1	DO	Ag nps	
	Morgan Bk	Minot	B	C	2.3	DO	Ag nps	
416R	Little Androscoggin R	Paris	C		3	Bact	CSO	1995
417R	Little Androscoggin R	Mechanic Falls	C		1	Bact	CSO	
	Little Androscoggin R	Auburn	C		1	Bact	CSO	
418R	Sabattus R	Sabattus	C		4	DO	Ag nps, POTW	1994
	No Name Bk	Lewiston	C		3	Bact, DO	Nps	
420R	Abagadasset R	Richmond	B		9	DO	Ag nps	
421R	Androscoggin R	Gilead	C		35	Tox	Ind	
422R	Androscoggin R	Rumford	C		23	Tox	Ind	
423R	Androscoggin R	Jay	C		21	Tox, AqL(6mi)	Ind, Hydro	
						Bact (1 mi)	CSO	
424R	Androscoggin R	Turner	C		14	Tox, DO(3mi)	Ind, sediment, hydro	
425R	Androscoggin R	Lewiston	C		23	Tox, Bact(5mi)	Ind, CSO	
426R	Androscoggin R	Brunswick	C		6	Tox	Ind	
427R	Merrymeeting Bay	Bath	C		3	Tox	Ind	
508R	Pottle Bk	Perry	B		0.5	Bact	untreated waste	
	Unnamed Bk	Calais	C		1	Bact	untreated waste	
509R	Chase Mill Str	E Machias	B	C	1	AqL	Ind	1989
511R	Bog Str	Deblois	B		2	AqL	Ind	1989

512R	McCoy Bk	Deblois	B		1	AqL	Ind	1993
	Narraguagus R	Cherryfield	B	C	1	AqL	Ind	1993
520R	Carleton Str	Blue Hill	C		1.4	AqL	Mine waste	1996
521R	Warren Bk	Belfast	B	C	2	DO	Ag nps	
522R	Megunticook R	Camden	B		0.1	Bact	untreated waste	
	Unnamed Bk	Camden	B		0.7	Bact	untreated waste	
	Unnamed Bk	Rockport	B		0.5	Bact	untreated waste	
	Unnamed Bk	Rockland	B		0.5	Bact	untreated waste	
524R	Unnamed Bk	N. Cushing	B		0.5	Bact		1995
527R	Damariscotta R	Newcastle	B		0.2	AqL	Hydro	1995
528R	W Br Sheepscot R	Windsor	AA	C	4	DO, Bact	Ag nps	1995
	Dyer R	Alna	B		1	DO, Bact	unknown	1995
528R	Sheepscot R	Alna	SB		4	Bact	untreated waste	1995
602R	Frost Gully Bk	Freeport	A	C	3	Bact, DO	Urban nps	
	Mare Bk	Brunswick	B	C	2	AqL	Ind (military) nps	
	Concord Gully	Freeport	A		1	AqL	Urban NPS	1995
603R	Royal R	Gray	B		2	Tox	Haz waste	
	Unnamed Bk	N. Yarmouth	C		2	DO	Ag nps	
	Eddy Bk	New Gloucester	B	C	1	AqL	Ind	1992
	Hatchery Bk	Gray	B	C	1	AqL	Ind	1994
607R	Black Bk	Windham	B		5	DO	Ag nps	
	Pleasant R	Windham	B		1	Bact	Untreated waste	1995DEP
	Colley Wright Bk	Windham	B	C	5	DO	Urban/Ag nps	
	Piscataqua R	Falmouth	B	C	3	Bact	unknown	1995
	E Br Piscataqua R	Falmouth	B	C	2	DO	Urban/Ag nps	
	Hobbs Bk	Cumberland	B	C	1.5	DO	Ag nps	
	Inkhorn Bk	Westbrook	B		4	DO	Ag nps	
	Mosher Bk	Gorham	B		2	DO	Ag nps	
	Otter Bk	Windham	B		2	DO	Ag nps	
	Thayer Bk	Gray	B		3	DO	Ag nps	
609R	Presumpscot R	Westbrook	C		7	Bact, AqL	Ind, CSO	1997
						DO(2 mi)		
610R	Capisic Bk	Portland	C		3	AqL,DO, Bact	Urban nps, CSO	1995
	Clark Bk	Westbrook	C		1	DO	Urban nps	
	Long Cr	S. Portland	C		3	DO, Bact	Urban nps, CSO	

	Stroudwater R	Gorham	B	C	4	DO	Urban nps	
	Red Bk	Scarborough	C		4	Tox	NPS	1996
	Barberry Cr	S. Portland	C			DO	NPS	
	Trout Br	S. Portland	C		3	AqL	Urban nps, CSO	1997
							Sediment	
611R	Phillips Bk	Scarborough	C		1.5	DO	Urban nps	
613R	Wards Bk	Fryeburg	C		1.5	DO	Impoundment	
616R	Deep Bk	Saco	C		2.5	DO	Ag nps, urban nps	
618R	Saco R	Fryeburg	AA/A		0.1	Habitat	Hydro	
	Saco R	Saco	B		0.5	Bact	CSO	
	Saco R	Dayton	A		0.2	AqL	Hydro	1991
	Saco R	W Buxton	A		0.2	AqL	Hydro	1991
622R	Kennebunk R	Kennebunk	B	C	3	Bact	Urban nps	1991
624R	Stevens Bk	Ogunquit	B		1	DO	Urban nps	1995
625R	Adams Bk	Berwick	B		1.5	DO	Ag nps	
626R	Smelt Bk	York	B		1	DO	Impoundment	1992
628R	Mousam R	Sanford	B		4	AqL,DO, Bact	CSO, POTW, Hydro	1994
						Tox	Urban nps, Haz waste	
630R	Salmon Falls R	S. Berwick	B		5	DO, Bact, AqL	POTW	1997
				Total	539.8			

Appendix I. Chapter 5. Non-Attainment Estuarine and Marine Waters

Table 6. Non-Attainment Estuarine and Marine Waters in Maine – 1998 Assessment

WBS #	NAME	TOWN	CLASS	ATTAIN	N/A MI	CAUSE	SOURCE	DATA
235M	Penobscot R	Bangor, Hampden	C/SC		10	Bact	CSO	
525M	Medomak R Estuary	Waldoboro	SB		1.5	DO	POTW	1994
603M	Royal R	Yarmouth	SB	SC	2	DO	Sediment	1994
610M	Fore River	S. Portland	SC		4	AqL, Bact	Ind, CSO, Urban nps	
612M	Goosefare Bk	Saco	B/SB	C	2	AqL(4mi)	Urban/Ind nps	1994
						Bact/DO(1mi)	CSO, Sediment	1994
620M	Saco R Estuary	Saco	SC		4	Bact, Tox	CSO, POTW	
628M	Mousam R Estuary	Kennebunk	SB		3	DO	POTW	1995
630M	Sturgeon Cr	Eliot	SB		1	DO	untreated waste	1992
630M	Piscataqua R Estuary	S. Berwick	SB		4	DO	POTW	1994
630M	Piscataquis R Estuary	Kittery	SB		1	Bact	CSO	
				Total	32.5			

Appendix I. Chapter 6. Partially Supporting and Threatened Lake Designations

Table 7. Partially Supporting Lakes in the State of Maine - 1998 Assessment

Partially Supporting Maine Lakes are listed below by Waterbody # (WB #), Lake #, lake name, town and acreage. The 'Designated Uses' column indicates which designated uses are partially supported in the lake: AL = Aquatic Life Support, PC = Primary Contact (swimming), and TS = Trophic Stability. Nonattainment causes, sources, related codes and their respective relative magnitudes), are indicated in the four rightmost columns (Mag: S = slight, M = moderate and H = high). All lakes are considered Partially Supporting the designated use of fish consumption. Note: this list includes all lakes; the one lake not considered "Significant" according to the Section 314 definition is indicated with an *.

WB #	Lake #	Lake Name	Town	Acres	Designated Use(s)	Nonattainment Causes: Cause	Code	Mag	Nonattainment Sources: Source	Code	Mag
123	1682	LONG L	T17 R04 WELS	6000	PC	Nutrients	910	M	Non Irrigated Crops	1100	M
						Organic Enrich/DO	1200	S	Internal Nutrient Cycling	8530	S
						Siltation	1100	S	Shoreline Develop.	4701	S
									Silviculture	2000	S
									Irrigated Crops	1200	M
124	1665	DAIGLE P	NEW CANADA	36	PC	Nutrients	910	M	Non Irrigated Crops	1100	H
						Organic Enrich/DO	1200	S	Confined Animal Feeding	1640	M
						Siltation	1100	S			
124	1666	BLACK L	FORT KENT	51	PC	Nutrients	910	M	Non Irrigated Crops	1100	M
						Organic Enrich/DO	1200	S	Silviculture	2000	S
						Siltation	1100	S			
124	1674	CROSS L	T17 R05 WELS	2515	AL, PC	Nutrients	910	M	Crop Related	1050	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
						Siltation	1100	S	Silviculture	2000	S
132	1654	SQUAPAN L	SQUAPAN TWP	5120	AL	Flow Alteration	1500	H	Hydromodification	7000	H
140	409	ARNOLD BROOK L	PRESQUE ISLE	395	PC	Nutrients	910	M	Crop Related	1050	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
						Siltation	1100	S			
140	1776	ECHO L	PRESQUE ISLE	90	PC	Nutrients	910	M	Crop Related	1050	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
						Siltation	1100	S			
140	9767	HANSON BROOK L	MAPLETON	118	AL, PC	Nutrients	910	M	Crop Related	1050	M
						Siltation	1100	S	Shoreline Develop.	4701	S
143	1808	FISCHER L	FORT FAIRFIELD	10	PC	Nutrients	910	M	Crop Related	1050	M
						Siltation	1100	S	Shoreline Develop.	4701	S

Table 7. Partially Supporting Lakes in the State of Maine - 1998 Assessment (continued)

WB #	Lake #	Lake Name	Town	Acres	Designated Use(s)	Nonattatinment Causes: Cause	Code	Mag	Nonattainment Sources: Source	Code	Mag
143	1820	MONSON P	FORT FAIRFIELD	160	PC	Nutrients	910	M	Crop Related	1050	M
						Siltation	1100	S	Shoreline Develop.	4701	S
145	1802	MADAWASKA L	T16 R04 WELS	1526	PC, TS	Nutrients	910	M	Non Irrigated Crops	1100	S
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	S
						Siltation	1100	S	Silviculture	2000	M
146	9779	TRAFTON L	LIMESTONE	85	AL, PC	Nutrients	910	H	Crop Related	1050	S
									Shoreline Develop.	4701	M
149	9525	CHRISTINA RES.	FORT FAIRFIELD	400	PC	Nutrients	910	H	Industrial Land Treatment	6400	H
						Organic Enrich/DO	1200	M			
152	1736	DREWS(MEDUX.) L	LINNEUS	1057	TS	Organic Enrich/DO	1200	H	Unknown	9000	H
201	2516	CANADA FALLS L	PITTSTON A.G.	2627	AL	Flow Alteration	1500	H	Hydromodification	7000	H
201	2936	RAGGED L	T02 R13 WELS	2712	AL	Flow Alteration	1500	H	Hydromodification	7000	H
201	4012	CAUCOMGOMOC L	T06 R14 WELS	5081	AL	Flow Alteration	1500	H	Hydromodification	7000	H
201	4048	SEBOOMOOK L	SEBOOMOOK TWP	6448	AL	Flow Alteration	1500	H	Hydromodification	7000	H
208	3670	PLEASANT&MUD LKS	T06 R06 WELS	498	PC	Nutrients	910	M	Shoreline Develop.	4701	S
						Organic Enrich/DO	1200	M	Unknown	9000	H
224	4128	GARLAND P	GARLAND	102	PC	Nutrients	910	M	Grazing-Related	1350	M
						Organic Enrich/DO	1200	M	Residential Development	4702	M
									Non Irrigated Crops	1100	S
225	2286	HERMON P	HERMON	461	PC	Nutrients	910	M	Crop Related	1050	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
									Grazing-Related	1350	M
225	2294	HAMMOND P	HAMPDEN	83	PC	Nutrients	910	M	Crop Related	1050	H
						Organic Enrich/DO	1200	S	Grazing-Related	1350	M
						Siltation	1100	S			
226	4274	HOLBROOK P	HOLDEN	280	TS	Nutrients	910	M	Unknown	9000	H
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	S

Table 7. Partially Supporting Lakes in the State of Maine - 1998 Assessment (continued)

WB #	Lake #	Lake Name	Town	Acres	Designated Use(s)	Nonattainment Causes: Cause	Code	Mag	Nonattainment Sources: Source	Code	Mag
303	269	FITZGERALD P	BIG SQUAW TWP	550	PC	Nutrients	910	H	Wastewater	6200	M
									Shoreline Develop.	4701	S
									Silviculture	2000	S
									Sediment Resusp.	8540	H
									Urban Runoff	4300	M
303	404	SPENCER P	E MIDDLESEX C.G	980	PC	Nutrients	910	H	Unknown	9000	H
304	328	NOTCH P (BIG)	L. SQUAW TWP	12	PC	Nutrients	910	M	Silviculture	2000	S
						Organic Enrich/DO	1200	H	Unknown	9000	H
305	4120	BRASSUA L	ROCKWOOD ST.E.	8979	AL	Flow Alteration	1500	H	Hydromodification	7000	H
309	38	FLAGSTAFF L	FLAGSTAFF TWP	20300	AL	Flow Alteration	1500	H	Hydromodification	7000	H
315	2336	TOOTHAKER P	PHILLIPS	30	PC	Flow Alteration	1500	S	Aquaculture	1700	H
						Nutrients	910	M			
						Organic Enrich/DO	1200	S			
321	5274	GREAT P	BELGRADE	8239	TS	Organic Enrich/DO	1200	H	Crop Related	1050	S
									Shoreline Develop.	4701	M
									Silviculture	2000	S
									Grazing-Related	1350	S
321	5280	MESSALONSKEE L	BELGRADE	3510	TS	Nutrients	910	M	Crop Related	1050	S
						Organic Enrich/DO	1200	M	Residential Development	4702	M
									Shoreline Develop.	4701	M
									Silviculture	2000	S
									Grazing-Related	1350	S
321	5296	FAIRBANKS P	MANCHESTER	14	PC	Nutrients	910	M	Shoreline Develop.	4701	H
						Organic Enrich/DO	1200	S			
321	5344	NORTH & LITTLE PDS	ROME	2873	TS	Nutrients	910	M	Crop Related	1050	M
						Organic Enrich/DO	1200	H	Shoreline Develop.	4701	M
									Grazing-Related	1350	M
321	5349	EAST P	SMITHFIELD	1823	PC, TS	Nutrients	910	M	Crop Related	1050	M
						Organic Enrich/DO	1200	M	Natural	8600	M
									Residential Development	4702	M
									Shoreline Develop.	4701	M
									Grazing-Related	1350	M

Table 7. Partially Supporting Lakes in the State of Maine - 1998 Assessment (continued)

WB #	Lake #	Lake Name	Town	Acres	Designated Use(s)	Nonattatinment Causes: Cause	Code	Mag	Nonattainment Sources: Source	Code	Mag
321	5352	SALMON L (ELLIS P)	BELGRADE	666	PC	Nutrients	910	M	Internal Nutrient Cycling	8530	S
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	M
						Siltation	1100	S	Silviculture	2000	S
323	8115	HUTCHINS L (Messalonskee Str. Impound.)	OAKLAND	76	PC	Nutrients	910	M	Minor Municipal Point Source	0220	H
						Organic Enrich/DO	1200	M			
325	2264	SEBASTICOOK L	NEWPORT	4288	PC	Nutrients	910	M	Non Irrigated Crops	1100	M
						Organic Enrich/DO	1200	S	Internal Nutrient Cycling	8530	M
						Siltation	1100	S	Major Municipal Point Source	0210	S
									Shoreline Develop.	4701	S
									Irrigated Crops	1200	S
325	5460	HALFMOON P	ST ALBANS	36	PC	Nutrients	910	M	Agriculture	1000	H
						Organic Enrich/DO	1200	S			
						Siltation	1100	S			
325	5474	GOULD P *	DEXTER	8	PC	Nutrients	910	M	Unknown	9000	H
326	5172	UNITY P	UNITY	2528	AL, PC, TS	Nutrients	910	M	Grazing-Related	1350	M
						Siltation	1100	S	Shoreline Develop.	4701	S
									Crop Related	1050	M
326	5174	SANDY (FREEDOM) P	FREEDOM	430	PC	Nutrients	910	M	Agriculture	1000	H
						Organic Enrich/DO	1200	S			
						Siltation	1100	S			
327	5176	LOVEJOY P	ALBION	324	PC	Nutrients	910	M	Grazing-Related	1350	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
						Siltation	1100	S	Crop Related	1050	M
328	5448	CHINA L	CHINA	3845	AL, PC, TS	Nutrients	910	M	Non Irrigated Crops	1100	S
						Organic Enrich/DO	1200	M	Internal Nutrient Cycling	8530	M
						Siltation	1100	S	Shoreline Develop.	4701	S
						Taste & Odor	2000	S	Silviculture	2000	S
									Grazing-Related	1350	S
329	5458	PATTEE P	WINSLOW	712	PC	Nutrients	910	H	Grazing-Related	1350	S
									Shoreline Develop.	4701	M
									Crop Related	1050	S
333	5408	WEBBER P	VASSALBORO	1201	PC	Nutrients	910	M	Non Irrigated Crops	1100	S
						Organic Enrich/DO	1200	S	Internal Nutrient Cycling	8530	S
						Siltation	1100	M	Shoreline Develop.	4701	M

Table 7. Partially Supporting Lakes in the State of Maine - 1998 Assessment (continued)

WB #	Lake #	Lake Name	Town	Acres	Designated Use(s)	Nonattainment Causes: Cause	Code	Mag	Nonattainment Sources: Source	Code	Mag
333	5416	THREEMILE P	CHINA	1162	PC	Nutrients	910	M	Non Irrigated Crops	1100	S
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	M
						Siltation	1100	S	Silviculture	2000	S
333	5424	THREECORNERED P	AUGUSTA	182	PC	Nutrients	910	M	Shoreline Develop.	4701	M
						Organic Enrich/DO	1200	S	Silviculture	2000	S
334	98	NARROWS P (UPPER)	WINTHROP	279	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	M
									Silviculture	2000	S
334	3832	WILSON P	WAYNE	582	TS	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
334	5236	COBBOSSEECONTEE L	WINTHROP	5543	AL, PC	Nutrients	910	M	Grazing-Related	1350	S
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	M
									Crop Related	1050	S
334	5240	WOODBURY P	LITCHFIELD	436	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
334	5254	PLEASANT (MUD) P	GARDINER	746	PC, TS	Nutrients	910	M	Grazing-Related	1350	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	M
						Siltation	1100	S	Crop Related	1050	M
334	8065	LITTLE COBBOSSEE	WINTHROP	75	PC	Nutrients	910	M	Grazing-Related	1350	S
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	M
						Siltation	1100	S	Crop Related	1050	S
334	9961	ANNABESSACOOK L	MONMOUTH	1420	PC	Nutrients	910	M	Grazing-Related	1350	S
						Organic Enrich/DO	1200	M	Hazardous Waste	6600	S
						Siltation	1100	S	Internal Nutrient Cycling	8530	M
									Shoreline Develop.	4701	S
									Urban Runoff	4300	S
									Crop Related	1050	S
335	9931	TOGUS P	AUGUSTA	660	PC	Nutrients	910	M	Internal Nutrient Cycling	8530	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
									Silviculture	2000	S
401	3290	AZISCOHOS L	LINCOLN PLT	6700	AL	Flow Alteration	1500	H	Hydromodification	7000	H
403	2374	KENNEBAGO L (BIG)	DAVIS TWP	1700	TS	Nutrients	910	M	Unknown	9000	H
						Organic Enrich/DO	1200	M			
404	3308	RICHARDSON LAKES	RICHARDSON-TOWN TWP	7100	AL	Flow Alteration	1500	H	Hydromodification	7000	H

Table 7. Partially Supporting Lakes in the State of Maine - 1998 Assessment (continued)

WB #	Lake #	Lake Name	Town	Acres	Designated Use(s)	Nonattainment Causes: Cause	Code	Mag	Nonattainment Sources: Source	Code	Mag
404	3526	QUIMBY P	RANGELEY	165	PC	Nutrients	910	M	Shoreline Develop.	4701	H
						Siltation	1100	S			
404	3534	HALEY P	DALLAS PLT	170	PC	Nutrients	910	M	Minor Municipal Point Source	0220	M
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
412	3624	BEAR P (BIG)	HARTFORD	432	TS	Nutrients	910	H	Unknown	9000	H
414	3758	TRIPP P	POLAND	768	AL	Nutrients	910	M	Intensive Animal Feeding	1600	M
						Organic Enrich/DO	1200	M	Urban Runoff	4300	M
									Residential Development	4702	M
									Shoreline Develop.	4701	M
415	3750	TAYLOR P	AUBURN	625	AL	Organic Enrich/DO	1200	H	Unknown	9000	H
415	3780	HALLS P	PARIS	51	PC	Nutrients	910	H	Shoreline Develop.	4701	H
418	3796	SABATTUS P	GREENE	1962	PC	Nutrients	910	M	Crop Related	1050	M
						Siltation	1100	S	Shoreline Develop.	4701	S
									Grazing-Related	1350	M
									Intensive Animal Feeding	1600	M
513	4434	TUNK L	T10 SD	2010	TS	Nutrients	910	M	Unknown	9000	H
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	S
517	4350	GRAHAM L	MARIAVILLE	7865	AL, PC	Turbidity	2500	M	Hydromodification	7000	S
						Siltation	1100	M	Natural	8600	M
517	4406	GEORGES P	FRANKLIN	380	AL	Nutrients	910	M	Unknown	9000	H
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	S
522	83	LILLY P	ROCKPORT	29	PC	Nutrients	910	M	Landfill	6300	H
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	S
522	4850	NORTON P	LINCOLNVILLE	133	AL	Organic Enrich/DO	1200	H	Unknown	9000	H
523	4806	HOBBS P	HOPE	264	TS	Nutrients	910	M	Unknown	9000	H
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	S
526	5702	DUCKPUDDLE P	NOBLEBORO	293	PC	Nutrients	910	M	Grazing-Related	1350	H
						Organic Enrich/DO	1200	S	Crop Related	1050	M
						Siltation	1100	S			
526	5710	BISCAY P	DAMARISCOTTA	377	TS	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H

Table 7. Partially Supporting Lakes in the State of Maine - 1998 Assessment (continued)

WB #	Lake #	Lake Name	Town	Acres	Designated Use(s)	Nonattainment Causes: Cause	Code	Mag	Nonattainment Sources: Source	Code	Mag
529	5366	ADAMS P	BOOTHBAY	73	PC	Nutrients	910	M	Natural	8600	S
						Organic Enrich/DO	1200	S	Shoreline Develop.	4701	
529	5372	WEST HARBOR P	BOOTHBAY HARBOR	84	PC	Nutrients	910	M	Shoreline Develop.	4701	H
						Organic Enrich/DO	1200	S			
530	9943	SEWALL P	ARROWSIC	46	PC	Nutrients	910	M	Natural	8600	M
						Organic Enrich/DO	1200	S			
605	3454	HIGHLAND L	BRIDGTON	1401	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
605	5780	LONG L	BRIDGTON	4867	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
605	9685	BAY OF NAPLES	NAPLES	762	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
606	3392	THOMAS P	CASCO	442	AL	Nutrients	910	M	Urban Runoff	4301	M
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	M
606	3692	NUBBLE P	RAYMOND	23	PC	Nutrients	910	M	Natural	8600	H
						Organic Enrich/DO	1200	M			
606	3696	CRESCENT L	RAYMOND	716	TS	Organic Enrich/DO	1200	H	Unknown	9000	H
607	3714	SEBAGO L (LITTLE)	WINDHAM	1898	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
607	3734	HIGHLAND (DUCK) L	FALMOUTH	634	AL, TS	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
615	3942	HOLLAND(SOKOSIS) P	LIMERICK	192	PC	Nutrients	910	M	Dam Construction	7300	S
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	M
									Urban Runoff	4300	M
616	5040	WATCHIC P	STANDISH	448	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
623	3838	MOUSAM L	ACTON	900	TS	Nutrients	910	M	Residential Development	4702	M
						Organic Enrich/DO	1200	M	Shoreline Develop.	4701	M
						Siltation	1100	M			
623	3916	SQUARE P	ACTON	910	AL	Organic Enrich/DO	1200	H	Shoreline Develop.	4701	H
625	119	ELL (L) P	WELLS	32	AL, PC	Organic Enrich/DO	1200	H	Construction	3000	H
626	5596	SCITUATE P	YORK	41	PC	Nutrients	910	H	Residential Development	4702	H
630	3876	NORTHEAST P	LEBANON	778	AL	Nutrients	910	M	Shoreline Develop.	4701	H
						Organic Enrich/DO	1200	M			

Table 8. Threatened Lakes in Maine - 1998 Assessment

Maine Lakes designated as 'Threatened' are listed by waterbody (WB#) in the following table. The column following 'Acres' indicates whether the lake is Evaluated (E) or Monitored (M). The Designated Use(s) the lake is considered threatened for appears in the next column (AL=Aquatic Life Support, SW=Swimming, TS=Trophic Stability). The basis for the designation is indicated in the column to the right; please refer to the text for additional information (Bloom=lake has experienced one summer algal bloom, 96 DO Criteria=lake was considered 'Partially Supporting' according to the dissolved oxygen criteria used in 1996 but is not considered such under the current criteria, Vul.Model=vulnerability modeling indicates that that inherent characteristics of the lake put it at risk.)

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
109	1554	HUNNEWELL L	ST JOHN PLT	64	E	AL, PC, TS	Bloom
109	1560	PELLETIER B L (3RD)	T16 R09 WELS	83	M	AL, PC, TS	96 DO Crit.
119	1914	MUSQUACOOK L (1ST)	T12 R11 WELS	698	M	AL, PC, TS	96 DO Crit.
119	1920	MUSQUACOOK L (4TH)	T10 R11 WELS	749	M	AL, PC, TS	96 DO Crit.
119	2814	HAYMOCK L	T07 R11 WELS	704	M	AL, PC, TS	96 DO Crit.
119	2866	INDIAN P	T07 R12 WELS	1222	M	AL, PC, TS	96 DO Crit.
120	1470	ROUND P	T13 R12 WELS	697	M	AL, PC, TS	96 DO Crit.
120	1892	LONG L	T11 R13 WELS	1203	M	AL, PC, TS	96 DO Crit.
120	1896	UMSASKIS L	T11 R13 WELS	1222	M	AL, PC, TS	96 DO Crit.
125	1672	SQUARE L	T16 R05 WELS	8150	M	AL, PC, TS	96 DO Crit.
130	3004	MILLIMAGASSETT L	T07 R08 WELS	1410	M	AL, PC, TS	96 DO Crit.
130	4152	MOOSE P (LITTLE)	T07 R10 WELS	25	E	PC, TS	96 DO Crit.
130	4156	MILLINOCKET L	T07 R09 WELS	2701	M	AL, PC, TS	96 DO Crit.
150	1006	WHITEHEAD L	BRIDGEWATER	21	E	AL, PC, TS	Bloom
151	1008	PORTLAND L	BRIDGEWATER	41	E	AL, PC, TS	96 DO Crit.
151	1018	CONROY L	MONTICELLO	25	M	AL, PC, TS	96 DO Crit.
152	1744	COCHRANE L	NEW LIMERICK	79	M	AL, PC, TS	Bloom, '96 DO Crit.
201	2920	PINE P (BIG)	T03 R13 WELS	164	E	AL, PC, TS	96 DO Crit.
201	9861	LONG P	T03 R05 BKP WKR	845	M	AL, PC, TS	96 DO Crit.
202	576	POLLYWOG P	T01 R11 WELS	147	M	AL, PC, TS	96 DO Crit.
202	716	KIDNEY P	T03 R10 WELS	96	M	AL, PC, TS	96 DO Crit.
202	984	JO-MARY L (LOWER)	T01 R10 WELS	1910	M	AL, PC, TS	96 DO Crit.
202	2126	PARTRIDGE B FLOWAGE	EAST MILLINOCKET	125	E	PC, TS	Vul.Model
204	2118	FERGUSON L	MILLINOCKET	250	E	PC, TS	Vul.Model
206	2202	SHIN P (UPPER)	MT CHASE	544	M	AL, PC, TS	96 DO Crit.
206	2700	LEADBETTER P (LT)	T07 R11 WELS	147	M	AL, PC, TS	Bloom
206	2704	THIRD L	T07 R10 WELS	474	M	AL, PC, TS	96 DO Crit.

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
206	2822	BRANCH P (EAST)	T07 R11 WELS	45	M	AL, PC, TS	Bloom
208	1686	MATTAWAMKEAG L	ISLAND FALLS	3330	M	AL, PC, TS	96 DO Crit.
209	1750	SPAULDING L	OAKFIELD	125	M	AL, PC, TS	96 DO Crit.
211	3056	PLUNKETT P	BENEDICTA	435	M	AL, PC, TS	96 DO Crit.
212	2238	HOUSE P	LEE	12	E	PC, TS	Vul.Model
212	2242	MATTAKEUNK L	LEE	570	M	PC, TS	Vul.Model
212	2244	MERRILL P	LEE	62	E	PC, TS	Vul.Model
212	2246	MILL P	LEE	28	E	PC, TS	Vul.Model
214	260	MAYFIELD P	MAYFIELD TWP	140	M	AL, PC, TS	96 DO Crit.
214	298	PIPER P	ABBOT	420	M	AL, PC, TS	96 DO Crit.
215	368	SPECTACLE PONDS	MONSON	177	E	AL, PC, TS	Bloom
215	410	WILSON P (UPPER)	BOWDOIN COL GR WEST	940	M	AL, PC, TS	96 DO Crit.
215	780	RUM P	GREENVILLE	245	M	AL, PC, TS	96 DO Crit.
215	844	BENNETT P (BIG)	GUILFORD	61	E	AL, PC, TS	Bloom
215	894	ONAWA L	ELLIOTTSVILLE	1344	M	AL, PC, TS	96 DO Crit.
215	9665	UNNAMED P	GREENVILLE	12	E	PC, TS	Vul.Model
216	438	LYFORD P (BIG)	SHAWTOWN TWP	152	M	AL, PC, TS	96 DO Crit.
218	758	MANHANOCK P	PARKMAN	420	M	AL, PC, TS	96 DO Crit.
218	4130	BRANNS MILL P	DOVER-FOXCROFT	271	E	PC, TS	Vul.Model
218	4132	GARLAND P	SEBEC	28	M	AL, PC, TS	96 DO Crit., Vul. Model
218	4138	DOW P	SEBEC	19	E	PC, TS	Vul.Model
220	2214	CAMBOLASSE P	LINCOLN	211	M	PC, TS	Vul.Model
220	2216	CARIBOU,EGG,LONG P	LINCOLN	825	M	PC, TS	96 DO Crit., Vul. Model
220	2218	CENTER P	LINCOLN	192	M	PC, TS	Vul.Model
220	2220	CROOKED P	LINCOLN	220	M	PC, TS	Vul.Model
220	2222	FOLSOM P	LINCOLN	282	M	PC, TS	Vul.Model
220	2226	MATTANAWCOOK P	LINCOLN	832	M	PC, TS	Vul.Model
220	2228	SNAG (STUMP) P	LINCOLN	160	E	PC, TS	Vul.Model
220	9562	UNNAMED P	LINCOLN	15	E	PC, TS	Vul.Model
220	9564	UNNAMED P	LINCOLN	10	E	PC, TS	Vul.Model
221	2146	COLD STREAM P	ENFIELD	3628	M	AL, PC, TS	96 DO Crit.
221	2224	ROUND P (LITTLE)	LINCOLN	75	E	PC, TS	Vul.Model
221	2232	COLD STREAM P(UPPER)	LINCOLN	685	M	PC, TS	Vul.Model
221	2258	MADAGASCAL P(LITTLE)	T03 R01 NBPP	40	E	PC, TS	Vul.Model
221	4682	EGG P	LEE	20	E	PC, TS	Vul.Model
221	4684	WEIR P	LEE	45	E	PC, TS	Vul.Model

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
223	80	PUSHAW L	OLD TOWN	5056	M	PC, TS	Vul.Model
223	2154	PUG P	ALTON	12	E	PC, TS	Vul.Model
223	2278	MUD P	OLD TOWN	343	E	PC, TS	Vul.Model
223	9622	ROLLINS MILL P	CHARLESTON	15	E	PC, TS	Vul.Model
224	4126	GARLAND P (WEST)	GARLAND	32	M	PC, TS	Vul.Model
225	2274	ETNA P	ETNA	361	E	AL, PC, TS	Bloom
225	2282	BEN ANNIS P	HERMON	25	E	PC, TS	Vul.Model
225	2284	GEORGE P	HERMON	46	M	PC, TS	Vul.Model
225	2290	TRACY P	HERMON	52	E	PC, TS	Vul.Model
225	2292	PATTEN P	HAMPDEN	46	E	PC, TS	Vul.Model
226	2150	HOLLAND P	ALTON	92	E	PC, TS	Vul.Model
226	2152	PICKEREL P	ALTON	77	E	PC, TS	Vul.Model
226	4276	EDDINGTON (DAVIS) P	EDDINGTON	417	M	PC, TS	Vul.Model
226	4282	FIELDS P	ORRINGTON	182	M	PC, TS	96 DO Crit.
226	4284	BREWER L	ORRINGTON	881	M	AL, PC, TS	Bloom
226	5546	TROUT P	ORRINGTON	12	E	PC, TS	Vul.Model
227	4316	LONG P	BUCKSPORT	222	M	AL, PC, TS	96 DO Crit.
227	4318	HANCOCK P	BUCKSPORT	59	M	AL, PC, TS	Bloom
227	4334	HOTHOLE P	ORLAND	51	E	PC, TS	Vul.Model
227	4586	GEORGE P	HOLDEN	12	E	PC, TS	Vul.Model
227	5538	WILLIAMS P	BUCKSPORT	112	M	AL, PC, TS	96 DO Crit., Vul. Model
227	5544	SWETTS (SWEETS) P	ORRINGTON	125	M	PC, TS	96 DO Crit., Vul. Model
228	7655	JONES BOG	MONROE	10	E	PC, TS	Vul.Model
228	7727	UNNAMED P	BROOKS	10	E	PC, TS	Vul.Model
3??	7725	UNNAMED P	BURNHAM	17	E	PC, TS	Vul.Model
301	2682	ATTEAN P	ATTEAN TWP	2745	M	AL, PC, TS	96 DO Crit.
302	2524	FISH P	THORNDIKE TWP	211	E	AL, PC, TS	96 DO Crit.
303	400	MUD P (LITTLE)	GREENVILLE	13	E	PC, TS	Vul.Model
303	2954	DUCK P (BIG)	E MIDDLESEX CANAL GR	79	M	AL, PC, TS	Bloom
304	4050	MOXIE P	EAST MOXIE TWP	2370	M	AL, PC, TS	96 DO Crit.
307	5090	JIM P (LITTLE)	JIM POND TWP	64	M	AL, PC, TS	96 DO Crit.
308	2356	REED P	EUSTIS	10	E	PC, TS	Vul.Model
309	2317	STRATTON BROOK P	WYMAN TWP	26	E	PC, TS	Vul.Model
309	5128	DEER P	KING & BARTLETT TWP	30	E	AL, PC, TS	96 DO Crit.
310	5110	BAKER P	T05 R06 BKP WKR	270	E	AL, PC, TS	96 DO Crit.
310	5122	SPECTACLE P	KING & BARTLETT TWP	45	E	AL, PC, TS	96 DO Crit.

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
312	202	ROWE P	PLEASANT RIDGE PLT	205	M	AL, PC, TS	96 DO Crit.
312	278	AUSTIN P	BALD MTN TWP T2R3	684	E	PC, TS	Vul.Model
313	12	PORTER L	STRONG	527	M	AL, PC, TS	96 DO Crit.
313	36	REDINGTON P	CARRABASSETT VALLEY	64	M	AL, PC, TS	Bloom
313	50	JEWETT P	PLEASANT RIDGE PLT	32	M	AL, PC, TS	Bloom
313	56	BUTLER P	LEXINGTON TWP	28	E	PC, TS	Vul.Model
314	70	WESSERUNSETT L	MADISON	1446	M	PC, TS	Vul.Model
314	2580	WENTWORTH P	SOLON	213	M	AL, PC, TS	96 DO Crit.
315	2344	MOUNT BLUE P	AVON	134	E	AL, PC, TS	96 DO Crit.
315	3566	SANDY RIVER P (MID)	SANDY RIVER PLT	70	E	AL, PC, TS	96 DO Crit.
316	5307	TORSEY (GREELEY) P	MOUNT VERNON	770	M	PC, TS	96 DO Crit., Vul. Model
320	2592	MORRILL P	HARTLAND	134	M	AL, PC, TS	96 DO Crit.
320	2608	LAKE GEORGE	CANAAN	335	M	AL, PC, TS	96 DO Crit., Vul. Model
320	2612	SIBLEY P	CANAAN	380	M	PC, TS	96 DO Crit.
320	2614	OAKS P	SKOWHEGAN	102	M	PC, TS	Vul.Model
320	2616	ROUND P	SKOWHEGAN	15	E	PC, TS	Vul.Model
321	5268	MOOSE P	MOUNT VERNON	64	M	PC, TS	Vul.Model
321	5270	INGHAM P	MOUNT VERNON	50	E	PC, TS	Vul.Model
321	5272	LONG P	BELGRADE	2714	M	AL, PC, TS	96 DO Crit.
321	5276	HAMILTON P	BELGRADE	19	M	PC, TS	96 DO Crit.
321	5278	STUART P	BELGRADE	12	E	PC, TS	Vul.Model
321	5282	WARD P	SIDNEY	52	M	PC, TS	Vul.Model
321	5284	JOE P	SIDNEY	40	M	AL, PC, TS	Bloom
321	5290	GOULD P	SIDNEY	19	E	AL, PC, TS	96 DO Crit.
321	5294	FIGURE EIGHT P	SIDNEY	29	M	AL, PC, TS	96 DO Crit.
321	5298	TYLER P	MANCHESTER	17	M	AL, PC, TS	96 DO Crit.
321	5336	WHITTIER P	ROME	21	M	PC, TS	Vul.Model
321	5338	WATSON P	ROME	66	M	PC, TS	Vul.Model
321	5348	MCGRATH P	OAKLAND	486	M	PC, TS	Vul.Model
321	8105	BOG P	READFIELD	25	E	PC, TS	Vul.Model
324	742	LILY P	DEXTER	12	E	PC, TS	Vul.Model
324	746	RIPLEY P	RIPLEY	240	M	AL, PC, TS	Bloom
324	2582	COMO L	HARMONY	80	E	PC, TS	Vul.Model
324	2584	PERRY P	HARMONY	20	E	PC, TS	Vul.Model
324	2590	MOOSE P	HARTLAND	3584	M	AL, PC, TS	96 DO Crit.
324	2596	STAFFORD P	HARTLAND	122	E	PC, TS	Vul.Model

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
324	5466	MAINSTREAM P	RIPLEY	208	E	PC, TS	Vul.Model
325	744	PUFFERS P (ECHO L)	DEXTER	96	M	AL, PC, TS	96 DO Crit., Vul. Model
325	2234	FAY SCOTT BOG	DEXTER	10	E	PC, TS	Vul.Model
325	5468	HICKS P	PALMYRA	25	E	PC, TS	Vul.Model
325	5480	NOKOMIS P	NEWPORT	199	E	PC, TS	Vul.Model
327	5724	DUTTON P	CHINA	57	M	AL, PC, TS	Bloom, '96 DO Crit.
333	5288	LILY P	SIDNEY	44	E	PC, TS	Vul.Model
333	5410	SPECTACLE P	VASSALBORO	139	M	PC, TS	Vul.Model
333	5418	DAM P	AUGUSTA	98	M	PC, TS	Vul.Model
333	5420	TOLMAN P	AUGUSTA	62	M	PC, TS	Vul.Model
333	5422	ANDERSON (EVERS) P	AUGUSTA	12	E	PC, TS	Vul.Model
333	9959	MUD P	WINDSOR	52	E	PC, TS	Vul.Model
334	103	NARROWS P (LOWER)	WINTHROP	255	M	AL, PC, TS	96 DO Crit., Vul. Model
334	3814	COCHNEWAGON P	MONMOUTH	410	M	AL, PC, TS	Bloom, Vul. Model
334	3828	BERRY P	WINTHROP	174	M	PC, TS	96 DO Crit., Vul. Model
334	3830	DEXTER P	WINTHROP	111	M	PC, TS	Vul.Model
334	3834	APPLE VALLEY L	WINTHROP	99	E	PC, TS	Vul.Model
334	5238	SAND P (TACOMA LKS)	LITCHFIELD	177	M	AL, PC, TS	96 DO Crit., Vul. Model
334	5242	BUKER P	LITCHFIELD	75	M	PC, TS	96 DO Crit., Vul. Model
334	5244	JIMMY P	LITCHFIELD	40	M	AL, PC, TS	96 DO Crit., Vul. Model
334	5246	LOON P	LITCHFIELD	26	E	PC, TS	Vul.Model
334	5265	DESERT P	MOUNT VERNON	23	E	PC, TS	Vul.Model
334	5300	SHED P	MANCHESTER	37	E	PC, TS	Vul.Model
334	5302	JAMIES (JIMMIE) P	MANCHESTER	107	M	PC, TS	Vul.Model
334	5304	HUTCHINSON P	MANCHESTER	100	M	PC, TS	Vul.Model
334	5306	BRAINARD P	READFIELD	20	E	PC, TS	Vul.Model
334	5310	CARLTON P	WINTHROP	207	M	PC, TS	96 DO Crit.
334	5312	MARANACOOK L	WINTHROP	1673	M	AL, PC, TS	96 DO Crit., Vul. Model
334	5316	KEZAR P	WINTHROP	18	M	PC, TS	Vul.Model
334	8137	UNNAMED P	MONMOUTH	35	E	PC, TS	Vul.Model
334	8147	MUD P	MONMOUTH	18	E	PC, TS	Vul.Model
334	8151	UNNAMED P	LITCHFIELD	15	E	PC, TS	Vul.Model
335	5378	NEHUMKEAG P	PITTSTON	178	E	PC, TS	Vul.Model
335	5406	GARDINER P	WISCASSET	78	M	PC, TS	Vul.Model
335	5428	TOGUS P (LITTLE)	AUGUSTA	93	E	PC, TS	96 DO Crit., Vul. Model
335	5430	TOGUS P (LOWER)	CHELSEA	230	M	AL, PC, TS	Bloom, Vul. Model

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
335	5432	GREELEY P	AUGUSTA	51	M	PC, TS	Vul.Model
335	5436	TINKHAM P	CHELSEA	17	E	PC, TS	Vul.Model
335	5450	GIVENS(LONGFELLOW) P	WHITEFIELD	20	E	PC, TS	Vul.Model
335	8215	WELLMAN P	WINDSOR	20	E	PC, TS	Vul.Model
4??	3771	UNNAMED P	OXFORD	20	E	PC, TS	Vul.Model
401	3104	STURTEVANT P	MAGALLOWAY PLT	518	M	AL, PC, TS	96 DO Crit.
404	3532	GULL P	DALLAS PLT	281	M	AL, PC, TS	96 DO Crit.
405	3102	UMBAGOG L	MAGALLOWAY PLT	7850	E	AL, PC, TS	96 DO Crit.
405	3316	SUNDAY P	MAGALLOWAY PLT	30	E	AL, PC, TS	96 DO Crit.
406	3520	HOWARD P	HANOVER	128	M	AL, PC, TS	Bloom, Vul. Model
407	3504	ELLIS (ROXBURY) P	BYRON	920	M	PC, TS	96 DO Crit.
409	3672	WEBB (WELD) L	WELD	2173	M	AL, PC, TS	96 DO Crit.
410	3604	ANASAGUNTICOOK L	HARTFORD	568	M	AL, PC, TS	Bloom, '96 DO Crit.
410	3816	LONG P	LIVERMORE	208	E	PC, TS	Vul.Model
410	5650	MOSHER P	FAYETTE	70	M	PC, TS	96 DO Crit.
410	8797	UNNAMED P	JAY	11	E	PC, TS	Vul.Model
411	3812	BONNY P	MONMOUTH	20	E	PC, TS	Vul.Model
411	3836	ANDROSCOGGIN L	LEEDS	3980	M	AL, PC, TS	96 DO Crit., Vul. Model
411	5182	FLYING P	VIENNA	360	M	AL, PC, TS	96 DO Crit.
411	5186	PARKER P	FAYETTE	1513	M	AL, PC, TS	96 DO Crit.
411	5658	TILTON P	FAYETTE	115	M	PC, TS	96 DO Crit.
412	3608	BRETTUN'S P	LIVERMORE	165	M	AL, PC, TS	Bloom, '96 DO Crit., Vul. Model
412	3616	NORTH P	SUMNER	164	M	AL, PC, TS	96 DO Crit.
412	3626	CRYSTAL (BEALS) P	TURNER	47	M	AL, PC, TS	96 DO Crit., Vul. Model
412	3736	LILY P	TURNER	25	E	PC, TS	Vul.Model
412	3798	LARD P	TURNER	14	E	AL, PC, TS	Bloom
412	3800	ROUND P	TURNER	12	M	PC, TS	96 DO Crit.
412	3820	BARTLETT P	LIVERMORE	28	E	PC, TS	Vul.Model
412	3822	PLEASANT P	TURNER	189	M	AL, PC, TS	96 DO Crit., Vul. Model
413	3744	MUD P	TURNER	12	E	PC, TS	Vul.Model
413	3748	AUBURN L	AUBURN	2260	M	AL, PC, TS	96 DO Crit., Vul. Model
413	3784	WILSON P (LITTLE)	TURNER	111	M	AL, PC, TS	Bloom, '96 DO Crit., Vul. Model
413	3788	ALLEN P	GREENE	183	M	AL, PC, TS	96 DO Crit., Vul. Model
413	3794	BERRY P	GREENE	31	E	PC, TS	Vul.Model
413	8969	UNNAMED P	LEWISTON	10	E	PC, TS	Vul.Model
414	367	PENNESSEEWASSEE (LT)	NORWAY	96	M	AL, PC, TS	Bloom, Vul. Model

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
414	3428	ROUND P	NORWAY	15	E	PC, TS	Vul.Model
414	3432	SAND P	NORWAY	141	M	AL, PC, TS	96 DO Crit., Vul. Model
414	3434	PENNESSEEWASSEE L	NORWAY	922	M	AL, PC, TS	96 DO Crit., Vul. Model
414	3438	MOOSE P	OTISFIELD	160	M	PC, TS	Vul.Model
414	3440	SATURDAY P	OTISFIELD	179	M	PC, TS	Vul.Model
414	3444	THOMPSON L	OXFORD	4426	M	PC, TS	Vul.Model
414	3464	BRYANT P	WOODSTOCK	278	M	AL, PC, TS	96 DO Crit.
414	3478	TWITCHELL P	GREENWOOD	179	M	AL, PC, TS	96 DO Crit.
414	3500	NORTH P	NORWAY	175	M	AL, PC, TS	Bloom, Vul. Model
414	3688	RANGE P (UPPER)	POLAND	391	M	AL, PC, TS	96 DO Crit., Vul. Model
414	3756	MUD P	OXFORD	19	M	PC, TS	Vul.Model
414	3760	RANGE P (LOWER)	POLAND	290	M	AL, PC, TS	96 DO Crit., Vul. Model
414	3762	RANGE P (MIDDLE)	POLAND	366	M	AL, PC, TS	96 DO Crit., Vul. Model
414	3768	GREEN P	OXFORD	38	M	PC, TS	Vul.Model
414	3770	HOGAN P	OXFORD	177	M	PC, TS	96 DO Crit., Vul. Model
414	3772	WHITNEY P	OXFORD	170	M	PC, TS	Vul.Model
414	8943	ESTES BOG	POLAND	30	E	PC, TS	Vul.Model
415	3764	WORTHLEY P	POLAND	42	E	PC, TS	Vul.Model
415	3776	MARSHALL P	HEBRON	142	M	PC, TS	96 DO Crit., Vul. Model
418	3790	SABATTUS P (LITTLE)	GREENE	25	E	PC, TS	Vul.Model
418	3792	DEANE P	GREENE	10	E	PC, TS	Vul.Model
418	3802	NO NAME P	LEWISTON	143	M	PC, TS	96 DO Crit., Vul. Model
418	3806	LOON (SPEAR) P	SABATTUS	70	M	PC, TS	Vul.Model
419	5258	CAESAR P	BOWDOIN	60	E	PC, TS	Vul.Model
419	7801	UNNAMED P	BOWDOIN	18	E	PC, TS	Vul.Model
420	5220	BRADLEY P	TOPSHAM	34	E	PC, TS	Vul.Model
420	5256	MEACHAM P	BOWDOIN	16	E	PC, TS	Vul.Model
501	121	SPEDNIK L	VANCEBORO	17219	M	AL, PC, TS	96 DO Crit.
502	135	TOMAH L	FOREST TWP	56	M	AL, PC, TS	96 DO Crit.
502	1332	LAMBERT L	LAMBERT LAKE TWP	605	M	AL, PC, TS	96 DO Crit.
502	4688	SYSLADOBSIS L (UP)	LAKEVILLE PLT	1142	M	AL, PC, TS	96 DO Crit.
502	4690	LOMBARD L	LAKEVILLE PLT	225	M	AL, PC, TS	96 DO Crit.
502	4700	KEG L	LAKEVILLE PLT	378	M	PC, TS	96 DO Crit.
502	4702	BOTTLE L	LAKEVILLE PLT	281	M	AL, PC, TS	96 DO Crit.
502	4708	JUNIOR L	T05 R01 NBPP	3866	M	AL, PC, TS	96 DO Crit.
504	1418	NASHS L	CALAIS	627	M	AL, PC, TS	96 DO Crit.

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
508	1404	BOYDEN L	PERRY	1702	M	AL, PC, TS	Bloom
509	1358	GARDNER L	EAST MACHIAS	3886	M	AL, PC, TS	Bloom
510	1226	HADLEY L #2	T24 MD BPP	36	E	AL, PC, TS	Bloom
512	1228	SPRUCE MOUNTAIN L	BEDDINGTON	448	M	AL, PC, TS	96 DO Crit.
512	4524	BEDDINGTON L	BEDDINGTON	404	E	AL, PC, TS	Bloom
514	435	LAKE WOOD	BAR HARBOR	16	M	PC, TS	Vul.Model
514	447	LONG P	MOUNT DESERT	38	E	PC, TS	Vul.Model
514	4452	BUBBLE P	BAR HARBOR	32	M	PC, TS	Vul.Model
514	4458	WITCH HOLE P	BAR HARBOR	28	M	AL, PC, TS	96 DO Crit., Vul. Model
514	4460	BAY P (LOWER WEST)	GOULDSBORO	59	E	PC, TS	Vul.Model
514	4462	CHICKEN MILL P	GOULDSBORO	27	E	PC, TS	Vul.Model
514	4464	FORBES P	GOULDSBORO	208	E	PC, TS	Vul.Model
514	4466	JONES P	GOULDSBORO	467	E	PC, TS	Vul.Model
514	4468	BIRCH HARBOR P	WINTER HARBOR	19	E	PC, TS	Vul.Model
514	4470	LILY P	GOULDSBORO	19	E	PC, TS	Vul.Model
514	4588	AUNT BETTY'S P	BAR HARBOR	34	M	PC, TS	Vul.Model
514	4606	EAGLE L	BAR HARBOR	436	M	PC, TS	Vul.Model
514	4608	JORDAN P	MOUNT DESERT	187	M	PC, TS	Vul.Model
514	4610	HADLOCK P (LOWER)	MOUNT DESERT	39	M	PC, TS	Vul.Model
514	4612	HADLOCK P (UPPER)	MOUNT DESERT	35	M	AL, PC, TS	96 DO Crit., Vul. Model
514	4614	SOMES P	MOUNT DESERT	104	M	PC, TS	Vul.Model
514	4616	RIPPLE P	MOUNT DESERT	12	E	PC, TS	Vul.Model
514	4618	ROUND P (LITTLE)	MOUNT DESERT	16	E	PC, TS	Vul.Model
514	4620	ROUND P	MOUNT DESERT	38	M	PC, TS	Vul.Model
514	4622	LONG (GREAT) P	MOUNT DESERT	897	M	PC, TS	Vul.Model
514	4624	ECHO L	MOUNT DESERT	237	M	AL, PC, TS	96 DO Crit., Vul. Model
514	4628	HODGDON P	MOUNT DESERT	35	M	PC, TS	Vul.Model
514	4630	SEAL COVE P	TREMONT	283	M	PC, TS	Vul.Model
514	4668	GOOSE P	SWANS ISLAND	38	M	PC, TS	Vul.Model
514	8477	ECHO L (LITTLE)	MOUNT DESERT	18	E	PC, TS	Vul.Model
514	8577	HAMILTON L	BAR HARBOR	51	E	PC, TS	Vul.Model
515	4498	ALLIGATOR L	T34 MD	1159	M	AL, PC, TS	96 DO Crit.
517	441	SECOND P	DEDHAM	64	M	AL, PC, TS	96 DO Crit.
517	4324	DUCK P (LITTLE)	ELLSWORTH	59	E	PC, TS	Vul.Model
517	4326	ROCKY P (LITTLE)	ELLSWORTH	61	M	PC, TS	Vul.Model
517	4540	SPRINGY P (LOWER)	OTIS	114	M	AL, PC, TS	96 DO Crit.

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
518	4328	BRANCH L	ELLSWORTH	2703	M	AL, PC, TS	96 DO Crit., Vul. Model
518	4376	BOG P	ELLSWORTH	10	E	PC, TS	Vul.Model
520	4342	PATTEN P (UPPER)	ORLAND	361	M	AL, PC, TS	96 DO Crit., Vul. Model
520	4344	PATTEN P (LOWER)	SURRY	741	M	PC, TS	Vul.Model
520	4640	WALKER P	BROOKSVILLE	697	M	AL, PC, TS	96 DO Crit.
520	4654	FOURTH P	BLUE HILL	50	E	PC, TS	Vul.Model
520	4656	NOYES (NORRIS) P	BLUE HILL	23	E	PC, TS	Vul.Model
520	5548	TORRY P	DEER ISLE	20	M	PC, TS	Vul.Model
520	5550	LILY P	DEER ISLE	37	M	PC, TS	Vul.Model
520	5556	BURNTLAND P	STONINGTON	20	E	PC, TS	Vul.Model
521	4844	TILDEN P	BELMONT	383	M	PC, TS	Vul.Model
521	4846	COLEMAN P	LINCOLNVILLE	223	M	PC, TS	96 DO Crit., Vul. Model
521	4848	PITCHER P	NORTHPORT	367	M	PC, TS	Vul.Model
521	5492	SWAN L	SWANVILLE	1370	M	AL, PC, TS	96 DO Crit.
521	5496	PASSAGASSAWAUKEAG L	BROOKS	118	E	PC, TS	96 DO Crit., Vul. Model
521	5522	CAIN P	SEARSPORT	38	E	PC, TS	Vul.Model
521	5524	MCCLURE P	SEARSPORT	46	E	PC, TS	Vul.Model
521	5528	KNIGHT P	NORTHPORT	102	M	PC, TS	Vul.Model
522	4808	HOSMER P	CAMDEN	53	M	AL, PC, TS	Bloom, Vul. Model
522	4836	LEVENSELLER P	SEARSMONT	34	E	PC, TS	Vul.Model
522	4838	MOODY P	LINCOLNVILLE	61	M	PC, TS	Vul.Model
522	4852	MEGUNTICOOK L	CAMDEN	1305	M	AL, PC, TS	96 DO Crit., Vul. Model
522	5504	FRESH P	NORTH HAVEN	85	E	PC, TS	Vul.Model
523	4796	LILY P	HOPE	29	E	PC, TS	Vul.Model
523	4802	FISH P	HOPE	142	M	PC, TS	Vul.Model
523	4810	CRAWFORD P	UNION	591	M	AL, PC, TS	96 DO Crit., Vul. Model
523	4812	GRASSY P	ROCKPORT	188	E	PC, TS	Vul.Model
523	4832	QUANTABACOOK L	SEARSMONT	693	M	PC, TS	96 DO Crit.
523	4834	LAWRY P	SEARSMONT	83	M	PC, TS	Vul.Model
523	4840	SHERMAN'S MILL P	APPLETON	36	E	PC, TS	Vul.Model
523	4842	MANSFIELD P	HOPE	40	E	PC, TS	Vul.Model
523	4884	CARGILL P	LIBERTY	69	E	PC, TS	Vul.Model
523	4886	STEVENS P	LIBERTY	336	M	PC, TS	96 DO Crit., Vul. Model
523	4914	MUD P	MONTVILLE	14	E	PC, TS	Vul.Model
523	5682	SENNEBEC P	APPLETON	532	E	PC, TS	96 DO Crit., Vul. Model
523	5684	ROUND P	UNION	250	M	PC, TS	96 DO Crit.

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
523	5686	SEVEN TREE P	UNION	523	M	PC, TS	96 DO Crit., Vul. Model
523	5690	NORTH P	WARREN	338	M	AL, PC, TS	96 DO Crit.
523	7521	UNNAMED P	SEARSMONT	11	E	PC, TS	Vul.Model
523	7839	UNNAMED P	WALDOBORO	14	E	PC, TS	Vul.Model
524	4814	MIRROR L	ROCKPORT	109	E	PC, TS	Vul.Model
524	4816	ROCKY P	ROCKPORT	10	E	PC, TS	Vul.Model
524	4820	MACES P	ROCKPORT	29	M	PC, TS	Vul.Model
524	4822	CHICKAWAUKIE P	ROCKPORT	352	M	PC, TS	Vul.Model
524	4823	TOLMAN P	ROCKPORT	38	E	AL, PC, TS	Bloom, Vul. Model
524	4866	HOWARD P	ST GEORGE	12	E	PC, TS	Vul.Model
524	5718	HAVENER P	WALDOBORO	83	E	PC, TS	Vul.Model
525	343	IRON P	WASHINGTON	11	E	PC, TS	Vul.Model
525	4894	WASHINGTON P	WASHINGTON	551	M	PC, TS	Vul.Model
525	5692	MEDOMAK P	WALDOBORO	237	M	PC, TS	Vul.Model
525	8049	UNNAMED P	APPLETON	12	E	PC, TS	Vul.Model
526	35	CLARK COVE P	SOUTH BRISTOL	31	M	AL, PC, TS	Bloom
526	4857	WEBBER P	BREMEN	219	M	PC, TS	Vul.Model
526	4858	ROSS P	BRISTOL	16	E	PC, TS	Vul.Model
526	5364	BOYD P	BRISTOL	85	M	PC, TS	Vul.Model
526	5704	PEMAQUID P	NOBLEBORO	1515	M	AL, PC, TS	96 DO Crit., Vul. Model
526	5706	LITTLE P	DAMARISCOTTA	80	M	AL, PC, TS	Bloom, '96 DO Crit., Vul. Model
526	5708	PARADISE (MUDDY) P	DAMARISCOTTA	166	M	PC, TS	Vul.Model
526	5712	MCCURDY P	BREMEN	192	M	PC, TS	Vul.Model
526	7871	LITTLE P	BRISTOL	15	E	PC, TS	Vul.Model
527	4904	SPRING (MUDDY) P	WASHINGTON	18	E	PC, TS	Vul.Model
527	5400	DAMARISCOTTA L	JEFFERSON	4381	M	AL, PC, TS	96 DO Crit.
528	371	MILLPOND	SOMERVILLE	29	E	PC, TS	Vul.Model
528	4898	COLBY P	LIBERTY	26	E	PC, TS	Vul.Model
528	4906	TURNER P	SOMERVILLE	193	E	PC, TS	Vul.Model
528	4910	CHISHOLM P	PALERMO	41	E	PC, TS	Vul.Model
528	5438	MOODY P	WINDSOR	32	E	PC, TS	Vul.Model
528	5440	FOX P	WINDSOR	10	E	PC, TS	Vul.Model
528	5454	FRENCH P	SOMERVILLE	11	M	PC, TS	Vul.Model
528	5726	BEECH P	PALERMO	59	E	PC, TS	Vul.Model
528	5730	BELDEN P	PALERMO	24	E	PC, TS	96 DO Crit.
528	5744	SABAN P	PALERMO	11	E	PC, TS	Vul.Model

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
528	5748	FOSTER (CROTCH) P	PALERMO	31	E	PC, TS	Vul.Model
528	5754	BRANCH P	CHINA	316	M	AL, PC, TS	96 DO Crit., Vul. Model
528	7663	MUD P	PALERMO	13	E	PC, TS	Vul.Model
529	5368	KNICKERBOCKER P	BOOTHBAY	105	M	AL, PC, TS	96 DO Crit., Vul. Model
529	5374	WILEY P	BOOTHBAY	18	M	PC, TS	Vul.Model
529	5404	SHERMAN L	EDGECOMB	216	M	PC, TS	Vul.Model
530	39	LILY P	BATH	11	E	PC, TS	Vul.Model
530	277	CENTER P	PHIPPSBURG	82	M	PC, TS	Vul.Model
530	5222	NEQUASSET P	WOOLWICH	392	M	AL, PC, TS	96 DO Crit., Vul. Model
530	5676	SILVER L	PHIPPSBURG	11	E	PC, TS	Vul.Model
601	299	WAT-TUH L	PHIPPSBURG	24	E	PC, TS	Vul.Model
601	5226	HOUGHTON P	BATH	14	E	PC, TS	Vul.Model
603	3700	SABBATHDAY L	NEW GLOUCESTER	340	M	AL, PC, TS	96 DO Crit., Vul. Model
603	3702	LILY P	NEW GLOUCESTER	38	E	PC, TS	Vul.Model
603	3706	NOTCHED P	RAYMOND	77	M	PC, TS	Vul.Model
603	3708	CRYSTAL L (DRY P)	GRAY	189	M	AL, PC, TS	96 DO Crit., Vul. Model
603	3786	RUNAROUND P	DURHAM	91	E	PC, TS	Vul.Model
605	3272	KEEWAYDIN L	STONEHAM	307	M	AL, PC, TS	96 DO Crit.
605	3386	OWL P	CASCO	20	E	PC, TS	Vul.Model
605	3388	PARKER P	CASCO	166	M	PC, TS	Vul.Model
605	3396	ADAMS P	BRIDGTON	45	M	AL, PC, TS	96 DO Crit., Vul. Model
605	3416	KEOKA L	WATERFORD	467	M	AL, PC, TS	96 DO Crit.
605	3418	LONG (MCWAIN) P	WATERFORD	473	M	AL, PC, TS	96 DO Crit.
605	3420	BEAR P	WATERFORD	218	M	AL, PC, TS	96 DO Crit.
605	3436	LITTLE P	OTISFIELD	23	E	PC, TS	Vul.Model
605	3448	ISLAND P	WATERFORD	166	M	AL, PC, TS	96 DO Crit., Vul. Model
605	3450	BOG P	HARRISON	11	E	PC, TS	Vul.Model
605	3452	CRYSTAL(ANONYMOUS) P	HARRISON	461	M	PC, TS	Vul.Model
605	3456	WOOD P	BRIDGTON	442	M	PC, TS	Vul.Model
605	3458	OTTER P	BRIDGTON	90	M	PC, TS	Vul.Model
605	3492	SPECK P #2	NORWAY	14	E	PC, TS	Vul.Model
606	519	UNNAMED P	STANDISH	61	E	PC, TS	Vul.Model
606	523	UNNAMED P	STANDISH	26	E	PC, TS	Vul.Model
606	3188	INGALLS (FOSTER'S) P	BRIDGTON	141	M	PC, TS	Vul.Model
606	3370	HOLT P	BRIDGTON	25	E	PC, TS	Vul.Model
606	3374	PEABODY P	SEBAGO	735	M	AL, PC, TS	96 DO Crit.

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
606	3376	COLD RAIN P	NAPLES	38	M	AL, PC, TS	96 DO Crit., Vul. Model
606	3382	TRICKEY P	NAPLES	311	M	PC, TS	Vul.Model
606	3390	COFFEE P	CASCO	137	M	AL, PC, TS	96 DO Crit., Vul. Model
606	3445	RICH MILL P	STANDISH	77	E	PC, TS	Vul.Model
606	3690	RAYMOND P	RAYMOND	346	M	AL, PC, TS	96 DO Crit., Vul. Model
606	3694	PANTHER P	RAYMOND	1439	M	AL, PC, TS	96 DO Crit., Vul. Model
606	3698	DUMPLING P	CASCO	30	E	PC, TS	Vul.Model
606	3716	PETTINGILL P	WINDHAM	42	M	AL, PC, TS	96 DO Crit., Vul. Model
606	3718	CHAFFIN P	WINDHAM	14	M	PC, TS	96 DO Crit., Vul. Model
606	8873	UNNAMED P	SEBAGO	15	E	PC, TS	Vul.Model
606	8897	UNNAMED P	CASCO	10	E	PC, TS	Vul.Model
607	3712	FOREST L	WINDHAM	210	M	AL, PC, TS	96 DO Crit., Vul. Model
607	3724	TARKILL P	WINDHAM	28	E	PC, TS	Vul.Model
607	3726	MILL P	WINDHAM	17	E	PC, TS	Vul.Model
607	3728	COLLINS P	WINDHAM	42	M	PC, TS	Vul.Model
607	3730	DUCK P (LITTLE)	WINDHAM	43	E	PC, TS	Vul.Model
607	5781	FARWELL BOG	RAYMOND	15	E	PC, TS	Vul.Model
611	5648	GREAT P	CAPE ELIZABETH	169	M	AL, PC, TS	Bloom
613	401	PEQUAWKET L	BROWNFIELD	87	M	PC, TS	Vul.Model
613	3130	SAND (WALDEN) P	DENMARK	256	M	AL, PC, TS	96 DO Crit.
613	3132	HANCOCK P	DENMARK	858	M	AL, PC, TS	96 DO Crit.
613	3134	MOOSE P	DENMARK	1694	M	AL, PC, TS	96 DO Crit., Vul. Model
613	3136	BARKER P	HIRAM	206	M	AL, PC, TS	Bloom, '96 DO Crit.
613	3174	CLEMONS P (BIG)	HIRAM	85	M	AL, PC, TS	96 DO Crit., Vul. Model
613	3176	CLEMONS P (LITTLE)	HIRAM	25	M	PC, TS	Vul.Model
613	3200	FARRINGTON P	LOVELL	89	E	PC, TS	Vul.Model
613	3232	KEYS P	SWEDEN	192	M	AL, PC, TS	96 DO Crit.
613	3254	LOVEWELL P	FRYEBURG	1120	M	AL, PC, TS	96 DO Crit.
613	3372	INGALLS P	BALDWIN	25	E	PC, TS	Vul.Model
613	3394	SAND P	BALDWIN	61	E	AL, PC, TS	Bloom, Vul. Model
613	3398	WATCHIC P (LITTLE)	STANDISH	55	E	PC, TS	Vul.Model
613	5572	BURNT MEADOW P	BROWNFIELD	63	M	AL, PC, TS	96 DO Crit., Vul. Model
613	5582	BEAVER P	BRIDGTON	66	M	PC, TS	96 DO Crit., Vul. Model
614	351	BLACK P	PORTER	50	M	PC, TS	Vul.Model
614	3166	PLAIN P	PORTER	16	E	PC, TS	Vul.Model
614	3168	CHAPMAN P	PORTER	13	E	PC, TS	Vul.Model

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
614	3170	SPECTACLE P #1	PORTER	57	M	PC, TS	Vul.Model
614	3172	SPECTACLE P #2	PORTER	45	M	PC, TS	Vul.Model
614	3178	JAYBIRD P	HIRAM	14	M	PC, TS	Vul.Model
614	3180	TRAFTON P	PORTER	56	M	PC, TS	Vul.Model
615	157	POVERTY P (BIG)	NEWFIELD	166	M	PC, TS	Vul.Model
615	3408	HORNE (PEQUAWKET) P	LIMINGTON	166	M	AL, PC, TS	96 DO Crit., Vul. Model
615	3410	WARDS P	LIMINGTON	44	E	PC, TS	Vul.Model
615	3890	ADAMS P (ROCK HAVEN)	NEWFIELD	210	E	PC, TS	Vul.Model
615	3892	SYMMES P	NEWFIELD	36	E	AL, PC, TS	96 DO Crit., Vul. Model
615	3894	TURNER P (MIRROR L)	NEWFIELD	32	M	PC, TS	Vul.Model
615	3896	PINKHAM P (HIDDEN L)	NEWFIELD	49	E	PC, TS	Vul.Model
615	3898	BALCH & STUMP PONDS	NEWFIELD	704	M	PC, TS	96 DO Crit., Vul. Model
615	3904	MANN P	NEWFIELD	11	E	PC, TS	Vul.Model
615	3906	SPICER P	SHAPLEIGH	10	E	PC, TS	Vul.Model
615	3908	GRANNY KENT P	SHAPLEIGH	70	M	PC, TS	Vul.Model
615	3914	SHY BEAVER P	SHAPLEIGH	25	E	PC, TS	Vul.Model
615	3926	MOOSE P	ACTON	27	E	PC, TS	Vul.Model
615	3928	HANSEN P	ACTON	30	E	PC, TS	Vul.Model
615	3930	SWAN P	ACTON	11	E	PC, TS	Vul.Model
615	3932	SMARTS P	NEWFIELD	20	E	PC, TS	Vul.Model
615	3938	NORTHWEST P	WATERBORO	38	E	PC, TS	Vul.Model
615	3940	PICKEREL P	LIMERICK	46	M	PC, TS	Vul.Model
615	3950	SHAPLEIGH P (NORTH)	SHAPLEIGH	80	M	PC, TS	96 DO Crit., Vul. Model
615	5006	DOLES P	LIMINGTON	25	E	PC, TS	Vul.Model
615	5008	BOYD P	LIMINGTON	26	M	PC, TS	Vul.Model
615	5010	ISINGLASS P	WATERBORO	30	M	AL, PC, TS	96 DO Crit., Vul. Model
615	5024	OSSIPEE L (LITTLE)	WATERBORO	564	M	AL, PC, TS	96 DO Crit., Vul. Model
615	6889	WEBSTER'S MILL P	LIMINGTON	40	E	PC, TS	Vul.Model
615	9697	POVERTY P (LITTLE)	SHAPLEIGH	13	E	PC, TS	Vul.Model
615	9715	OSSIPEE FLOWAGE(LIT)	WATERBORO	1005	E	PC, TS	Vul.Model
616	3982	BRIMSTONE P	ARUNDEL	12	E	PC, TS	Vul.Model
616	5014	KILLICK P	HOLLIS	45	E	AL, PC, TS	Bloom, Vul. Model
616	5016	DEER P	HOLLIS	32	M	AL, PC, TS	96 DO Crit.
616	5026	BARTLETT P	WATERBORO	30	E	PC, TS	Vul.Model
616	5030	TARWATER P	LYMAN	11	E	PC, TS	Vul.Model
616	5032	SWAN P	LYMAN	147	M	PC, TS	Vul.Model

Table 8. Threatened Lakes in Maine - 1998 Assessment (continued).

WB #	Lake #	Lake Name	Town	Acres	Monit./ Eval.	Designated Use(s)	Threatened Basis
616	5034	ROBERTS & WADLEY PDS	LYMAN	203	M	PC, TS	Vul.Model
616	5036	PARKER (BARKER) P	LYMAN	26	E	PC, TS	Vul.Model
616	5042	BONNY EAGLE L	STANDISH	211	M	PC, TS	Vul.Model
622	3984	ALEWIFE P	KENNEBUNK	37	E	PC, TS	Vul.Model
622	3998	KENNEBUNK P	LYMAN	224	M	PC, TS	Vul.Model
623	137	GOOSE P	SHAPLEIGH	50	E	PC, TS	Vul.Model
623	317	RODERIQUE P	ROCKWOOD STRIP-WEST	44	E	PC, TS	Vul.Model
623	3846	STUMP P	SANFORD	50	E	PC, TS	Vul.Model
623	3848	NUMBER ONE P	SANFORD	100	M	PC, TS	Vul.Model
623	3936	BRANCH P (MIDDLE)	WATERBORO	38	M	PC, TS	Vul.Model
623	3976	SHAKER P	ALFRED	78	M	PC, TS	Vul.Model
623	3980	BUNGANUT P	LYMAN	280	M	PC, TS	96 DO Crit., Vul. Model
623	3986	OLD FALLS P	SANFORD	100	E	PC, TS	Vul.Model
623	6793	UNNAMED P	SANFORD	29	E	PC, TS	Vul.Model
623	6985	UNNAMED P	ALFRED	10	E	PC, TS	Vul.Model
623	9695	LOON P	ACTON	94	M	PC, TS	Vul.Model
625	3850	CURTIS P	SANFORD	11	E	AL, PC, TS	Bloom, Vul. Model
625	3852	OLD FISHING P	SANFORD	18	E	PC, TS	Vul.Model
625	3856	PICTURE P	SANFORD	10	M	PC, TS	Vul.Model
625	3862	SAND P	SANFORD	29	M	PC, TS	Vul.Model
625	3868	CIDER MILL P	NORTH BERWICK	10	E	PC, TS	Vul.Model
625	3884	KNIGHT P	SOUTH BERWICK	49	M	PC, TS	Vul.Model
625	3992	BAUNEAG BEG L	NORTH BERWICK	200	M	AL, PC, TS	Bloom, '96 DO Crit., Vul. Model
625	5584	WARREN P	SOUTH BERWICK	45	M	AL, PC, TS	96 DO Crit., Vul. Model
625	6869	UNNAMED P	NORTH BERWICK	10	E	PC, TS	Vul.Model
625	6967	BEAVER DAM P	BERWICK	19	E	PC, TS	Vul.Model
625	9875	COX P	SOUTH BERWICK	18	M	PC, TS	Vul.Model
626	9713	YORK P	ELIOT	47	M	PC, TS	Vul.Model
627	3920	WILSON L	ACTON	288	M	AL, PC, TS	96 DO Crit., Vul. Model
627	3931	MURDOCK P	BERWICK	300	E	AL, PC, TS	Bloom
628	7	ESTES L	SANFORD	387	M	PC, TS	Vul.Model
628	3842	JAGGERS P	SANFORD	60	E	PC, TS	Vul.Model
629	117	LEIGH'S MILL P	SOUTH BERWICK	37	M	PC, TS	Vul.Model
630	155	MILTON P	LEBANON	214	E	AL, PC, TS	96 DO Crit., Vul. Model
630	3872	SPAULDING P	LEBANON	118	E	PC, TS	Vul.Model
630	3874	TOWN HOUSE P	LEBANON	150	E	AL, PC, TS	96 DO Crit., Vul. Model

APPENDIX II

STATE OF MAINE 1998 WATER QUALITY ASSESSMENT

SUPPLEMENTARY DATA AND DOCUMENTATION

Appendix II. Chapter 1. Maine Section 303(d) Waters - 1998

Section 303(d) of the Clean Water Act requires the State of Maine to identify waterbody segments that do not attain water quality standards or are imminently threatened, and are not expected to meet state water quality standards even after the implementation of technology-based controls for both point sources and non-point sources of pollution. In the development of the 303(d) list, the 305(b) Water Quality Assessment report, including the 304(l) lists, the 314(a) Clean Lakes list and the 319 State Non-Point Source Assessment are reviewed. The agency also considered results of predictive modeling and reports of water quality problems identified by local, state or federal agencies or the public. The 303(d) process subsequently requires the establishment of Total Maximum Daily Loads (TMDLs) or other control methods in order to assure the attainment of water quality standards.

The State is required by 40 CFR 130.7 to identify a timetable to develop TMDLs within the next two years. USEPA national policy also requires each state to determine a schedule for all TMDLs over the next thirteen year period. High priority waters, for which TMDLs will be first initiated, were selected after considering the severity of the problem and the feasibility of correction, the value of the resource, and the level of local interest and support for restoring and protecting a water. Other factors that determine the timetable include pending state wastewater and National Pollutant Discharge Elimination System (NPDES) permits, water quality certifications (hydroelectric facilities) and treatment plant construction proposals. TMDLs for point sources may consist of discharge limitations, while those for non-point sources may include activities that control factors causing non-attainment. Many waters have been given a timeframe of 10-13 years for completion of the TMDL process. In many cases, this may be attributed to the need for more current water quality data (these are noted in the 'new data required' column). Many lakes are in the 10-13 year category because nonpoint source controls are being implemented and the expected response time of these waterbodies to attain standards is slow.

Maine currently has a fish consumption advisory for all freshwaters due to the presence of elevated mercury levels in fish tissue, therefore, **all freshwaters are "listed"** due to this contamination problem. Although Maine has and continues to control local sources of mercury, most of the mercury sources are air emissions, the majority of which originate beyond Maine's jurisdictional borders via long range atmospheric transport and deposition. Since the mercury contamination problem is common throughout the nation, Maine recommends that the USEPA take the lead in developing a protocol for preparing a technically feasible TMDL for mercury in surface waters.

Maine also has fish and shellfish consumption advisories for all marine waters for lobster tomalley, striped bass and bluefish, therefore **all marine waters are "listed"** due to this contamination problem. Due to the migratory nature of these organisms, it would be difficult to identify and quantify the source of contaminants (dioxins, PCBs, mercury) that cause these advisories, therefore, it is technically infeasible to perform a TMDL analysis.

Some waterbodies included on these lists do not attain water quality standards because of activities that have no known or feasible controls. Contamination from PCBs presents a problem that cannot be adequately addressed through the TMDL process. PCBs may contribute to the overall toxic load in waters listed by the state for fish consumption advisories. Studies in Maine show that PCBs are ubiquitous in the environment. Typically the presence of PCB is not associated with any identifiable source but is rather a legacy of practices that predate its ban in 1979. Waters are listed on the 303(d) list where discrete sources of PCB are known or suspected, and where fish advisories are in effect.

Tables 1-3 contain the lists of water quality limited waterbodies needing TMDLs along with causes of nonattainment and proposed dates for completion of TMDLs. Tables 1a, 1b and 3a list water quality limited waters where enforceable controls are in place but where the department is waiting implementation and follow-up assessment. Waterbodies removed from the 1996 list are found in Tables 4-6.

TABLE 1. WATER QUALITY LIMITED RIVERS AND STREAMS - 1998.

WBS#	Name	Town	Class	Non-attain category-Pollutant/ Source**	TMDL preparation	New Data Required*
140R	Presque Isle Str	Presque Isle/Mapleton	B	Nutrient/ps,nps	<2000 TMDL submitted, draft license	
	Dudley Bk	Chapman	B	Aq. life/nps	2008-2011	yes
142R	Caribou Str	Caribou	B	Aq. life, habitat/nps	2008-2011	
143R	Everett Bk	Fort Fairfield	B	DO/nps	2008-2011	yes
149R	Prestile Str	Mars Hill	A	Aq. life/nps	2003-2008	
152R	Meduxnekeag R	Houlton	B	Nutrient/ps,nps	<2003, interim TMDL submitted	monitoring
205R	W Br Penobscot R	TA R7 WELS	C	BOD, SOD	<2003	
	W Br Penobscot R	Millinocket	C	Habitat	2008-2011	
216R	Blood Bk	T6R9 NWP	A	Aq. life/nps	2008-2011	
224R	Burnham Br	Garland	B	DO/nps	2003-2008	yes
	French Str	Exeter	B	Aq. life/nps	2008-2011	
	Unnamed Bk(Pushaw)	Bangor	B	Aq. life/nps	2008-2011	
	Unnamed Bk(Ohio)	Bangor	B	Aq. life/nps	2008-2011	
	Unnamed Bk(Valley)	Bangor	B	Aq. life/nps	2008-2011	
226R	Meadow Bk	Bangor	B	Aq. life/nps	2008-2011	
227R	Mill Str	Orrington	B	Aq. life/nps	2008-2011	
311R	Dead R	T3R4 BKP	AA/A	Aq. life	2003-2008, pending hydro WQC	
314R	Wesserunsett Str	Skowhegan	B	Bacteria/nps	2008-2011	yes
316R	Baker Str	Farmington	B	DO/nps	2008-2011	yes
320R	Carrabassett Str	Canaan	B	DO/nps	2008-2011	yes
	Currier Bk	Skowhegan	B	Bacteria	2003-2008	
	Whitten Bk	Skowhegan	B	Bacteria	2003-2008	
322R	Fish Bk	Fairfield	B	DO/nps	<2003	
325R	E Br Sebasticook R	Corinna	C	Aq. life,	2003-2008	monitoring

				toxics/ps,nps		
	Mulligan Str	St. Albans	B	DO/nps	2008-2011	yes
327R	Mill Str	Albion	B	DO/nps	2008-2011	
329R	Twelvemile Bk	Clinton	B	DO/nps	2008-2011	yes
330R	W Br Sebasticook R	Hartland	C	Dioxin,PCB	2008-2011	monitoring
332R	Sebasticook R	Burnham	C	DO/hydro	<2003	
333R	Bond Bk	Augusta	B/C	BMPs constructed		monitoring
334R	Mud Mills Str	Monmouth	B	DO/nps	2008-2011	yes
	Potters Bk	Litchfield	B	DO/nps	2008-2011	yes
	Tingley Bk	Readfield	B	DO/nps	2008-2011	yes
	Mill Str	Winthrop	B	Habitat	2008-2011	
	Jock Str	Wales	B	Nutrients/nps	<2000, draft TMDL submitted	
335R	Kimball Bk	Pittston	B	DO/nps	2008-2011	yes
	Togus Str	Chelsea	B	DO/ps	<2003	
338R	Kennebec R	Norridgewock	B	Aq. life	2003-2008	monitoring
340R	Kennebec R	Augusta	C	PCB,Aq. life	2003-2008	monitoring
413R	Jepson Bk	Lewiston	B	Habitat/nps	2008-2011	
	Penley Bk	Auburn	B	Habitat/nps	2008-2011	
	Stetson Bk	Lewiston	B	Habitat/nps	2008-2011	
	Logan Bk	Auburn	B	DO/CSO,nps	2008-2011	yes
415R	Davis Bk	Poland	B	DO/nps	2008-2011	yes
418R	Sabattus R	Sabattus	C	DO,TP/ps,nps	<2003	
	No Name Bk	Lewiston	C	DO, Bacteria	2008-2011	yes
420R	Abagadasset R	Richmond	B	DO/nps	2008-2011	yes
424R	Androscoggin R	Turner	C	DO/ps,nps	<2003	monitoring
511R	Bog Bk	Deblois	B	DO, Aq life/ps	<2000	
512R	McCoy Bk	Deblois	B	Aq life/nps	2008-2011	
520R	Carleton Str	Blue Hill	C	Aq life, metals	2008-2011	
521R	Warren Bk	Belfast	B	DO/nps	2008-2011	
527R	Damariscotta R	Newcastle	B	Habitat	<2000, pending hydro WQC	
528R	W Br Sheepscot R	Windsor	AA	DO, Bact/nps	<2003	monitoring
	Dyer R	Alna	B	DO, Bact/nps	<2003	
602R	Frost Gully Bk	Freeport	A	Aq.lf., DO/nps	<2003	monitoring

	Concord Gully	Freeport	A	DO, Bact/nps	<2003	
	Mare Bk	Brunswick	B	Aq life/nps	<2003	monitoring
603R	Eddy Bk	New Gloucester	B	Aq life/ps	<2000	
	Hatchery Bk	Gray	B	Aq life/ps	<2000	
607R	Black Bk	Windham	B	DO/nps	2008-2011	yes
	Colley Wright Bk	Windham	B	DO/nps	2008-2011	yes
	Piscataqua R	Falmouth	B	DO/nps	2008-2011	yes
	E Br Piscataqua R	Falmouth	B	DO/nps	2008-2011	yes
	Hobbs Bk	Cumberland	B	DO/nps	2008-2011	yes
	Inkhorn Bk	Westbrook	B	DO/nps	2008-2011	yes
	Mosher Bk	Gorham	B	DO/nps	2008-2011	yes
	Otter Bk	Windham	B	DO/nps	2008-2011	yes
	Thayer Bk	Gray	B	DO/nps	2008-2011	yes
609R	Presumpscot R	Falmouth	C	BOD, TSS, color/ps	<2000, final TMDL submitted	monitoring
610R	Capisic Bk	Portland	C	Aq. life/nps	2008-2011	monitoring
	Clark Bk	Westbrook	C	DO/nps	2008-2011	yes
	Long Cr	S. Portland	C	DO/nps	2008-2011	yes

	Stroudwater R	Gorham	B	nps	2008-2011	yes
	Barberry Cr	S. Portland	C	nps	2008-2011	yes
	Trout Bk	S. Portland	C	Aq. life/nps	2008-2011	
	Red Bk	Scarborough	C	PCB/nps	2008-2011	
611R	Phillips Bk	Scarborough	C	DO/nps	2008-2011	yes
612R	Goosefare Bk	Saco	B	Toxics/nps	<2003	monitoring
613R	Wards Bk	Fryeburg	C	DO/nps	2008-2011	yes
	Deep Bk	Saco	B	Aq.lf.,DO/nps	2008-2011	monitoring
624R	Stevens Bk	Ogunquit	B	DO/nps	2008-2011	yes
625R	Adams Bk	Berwick	B	DO/nps	2008-2011	yes
626R	Smelt Bk	York	B	DO/nps	<2003 (revise site permit)	
628R	Mousam R	Sanford	B	Toxics, TP /ps, nps	2003-2008	monitoring
630R	Salmon Falls R	S. Berwick	B	BOD, SOD, bacteria/ps, nps	<2000, draft TMDL submitted	monitoring

*yes = new data required monitoring = monitoring currently being conducted **ps = point source nps = nonpoint source

Table 1a. Water-quality limited waters where enforceable control measures apply - attainment status pending followup monitoring

WBS #	Name	Town	Class	Reason
145R	Little Madawaska R	Caribou	B	Superfund remediation project; in progress; PCBs
	Greenlaw Str	Caribou	B	Superfund remediation project in progress; PCBs
231R	Penobscot R	Lincoln	C	Dioxin/color legislation*; PCBs & dioxins
232R	Penobscot R	Enfield	B/C	Dioxin/color legislation*; PCBs & dioxins
233R	Penobscot R	Old Town	B	Dioxin/color legislation*; PCBs & dioxins
234R	Penobscot R	Veazie/Bangor	B/C	Dioxin/color legislation*, PCBs & dioxins
323R	Messalonskee Str	Waterville	C	Received new license in 1996; DO, nutr/P
332R	Sebasticook R	Winslow	C	Water quality certificate issued 1996; DO
333R	Riggs Bk	Augusta	C	Superfund remediation complete 1997; PCBs
339R	Kennebec R	Fairfield	B/C	Dioxin/color legislation *; PCBs & dioxins
417R	Little Androscoggin R	Auburn	C	CSOs remaining, Master Plan developed
421R	Androscoggin R	Gilead	C	Dioxin/color legislation *; PCBs & dioxins
422R	Androscoggin R	Rumford	C	Dioxin/color legislation *; PCBs & dioxins
423R	Androscoggin R	Jay	C	Dioxin/color legislation *; PCBs & dioxins
425R	Androscoggin R	Lewiston	C	Dioxin/color legislation *; PCBs & dioxins
426R	Androscoggin R	Brunswick	C	Dioxin/color legislation *; PCBs & dioxins
427R	Merrymeeting Bay	Bath	C	Dioxin/color legislation *; PCBs & dioxins
618R	Saco R	Fryeburg	AA/A	Water Quality Certification issued (hydro); habitat
	Saco R	Saco	B	Water Quality Certification issued (hydro); habitat
	Saco R	Dayton	A	Water Quality Certification issued (hydro); habitat
	Saco R	W Buxton	A	Water Quality Certification issued (hydro); habitat
619R	Saco R	Standish	A/B	Water Quality Certification issued (hydro); habitat

*Legislation passed in 1997 establishes standards for discharges from bleach kraft pulp mills of "nondetectable quantity" of dioxin by July 31, 1998 and furan by December 31, 1998, both as measured at the bleach plant. "After December 31, 2002 a mill may not discharge dioxin to its receiving waters." Compliance is also measured by comparing fish-tissue samples taken upstream and downstream of the mill's wastewater outfall. The law also establishes compliance dates for color standards.

Table 1b. Maine CSO Communities and Affected Receiving Waters. The following communities are under enforceable actions to develop and implement long term control plans to meet water quality standards for bacteria.

#CSOs	Community	Receiving Waters
8	Auburn SD	Androscoggin R., Little Androscoggin R.
29	Augusta	Kennebec R.; Kennedy Bk.; Bond Bk.; Riggs Bk.
14	Bangor	Penobscot R.; Kenduskeag Str.
6	Bar Harbor	Frenchman's Bay
6	Bath	Kennebec R.
(SSO)	Belfast	Belfast HarBor
14	Biddeford	Saco R.; Thatcher Bk.
7	Brewer	Penobscot R.
2	Bucksport	Penobscot R.
1	Cape Elizabeth	Danford Cove, Casco Bay
5	Corinna	E. Br. Sebasticook R.
1	Dover-Foxcroft	Piscataquis R.
3	Fairfield	Kennebec R.
2	Gardiner	Kennebec R.; Rolling Dam Bk.
1	Hallowell	Kennebec R.
1	Hamden	Souadabscook R.
3	Kennebec STD	Kennebec R.
4	Kittery	Piscataqua R.; Spruce Ck.
36	Lewiston	Androscoggin R.; Jepson Bk.; Gully Bk.; Goff Bk.
1	LAWPCA	Androscoggin R.
1	Lincoln S.D.	Mattanawcook Bk.
(SSO)	Lisbon	Androscoggin R.
1	Livermore Falls	Androscoggin R.
2	Machias	Machias R.
2	Madawaska	St. John R.

3	Mechanic Falls S.D.	Little Androscoggin R.
2	Milo	Sebec R.
1	N. Anson	Carrabassett R.
2	Oakland	Messalonskee Str.
1	Old Town	Penobscot R.
1	Orono	Penobscot R.
1	Paris	Little Androscoggin R.
37	Portland	Back Cove; Presumpscott R.; Portland Harbor; Fall Bk.; Fore R.; Casco Bay; Capisic Bk.
1	Presque Isle	Presque Isle Stream
6	Rockland	Rockland Harbor; Lermon Cove
8	Saco	Saco R. impoundment; Saco R. estuary; Tappan Bk.; Sawyer Bk.; Bear Bk.
1	Sanford	Mousam R.
9	Skowhegan	Kennebec R.
12	S. Portland	Portland Harbor; Long Creek; Casco Bay; Calvary Pond; Barberry Ck.; Fore R.; Trout Bk.
7	Westbrook	Presumpscot R.
2	Winslow	Sebasticook R.
1	Winterport S.D.	Penobscot R.

TABLE 2. WATER QUALITY LIMITED LAKES – 1998 Assessment

ID# MIDAS#	Name	Town	Acres	Cause	TMDL Preparation	New Data Required
124 1665	Daigle P	New Canada	36	Blooms	2008-2011	
124 1666	Black L	Fort Kent	51	Blooms	2008-2011	
124 1674	Cross L	T17 R05 WELS	2515	Blooms	2008-2011	
132 1654	Squapan L	T11R04 WELS	5120	Habitat	2008-2011	
140 0409	Arnold Brook L	Presque Isle	395	Blooms	2008-2011	
140 1776	Echo L	Presque Isle	90	Blooms	2008-2011	
140 9767	Hanson Brook L	Mapleton	118	Blooms	2008-2011	
143 1820	Monson P	Fort Fairfield	160	Blooms	2008-2011	
145 1802	Madawaska L	T16 R04 WELS	1526	Blooms,Trend	<2000	
146 9779	Trafton L	Limestone	85	Blooms	2008-2011	
149 9525	L Christina	Fort Fairfield	400	Blooms	2003-2008	
201 2516	Canada Falls L	Pittston Acad. Grant	2627	Habitat	2003-2008	
201 2936	Ragged L	T2R13 WELS	2712	Habitat	2003-2008	
201 4012	Caucogomuc L	T7R15 WELS	5081	Habitat	2003-2008	
201 4048	Seboomook L	Seboomook Twp	6448	Habitat	2003-2008	
225 2274	Etna P	Etna	361	Blooms	2008-2011	
225 2286	Hermon P	Hermon	461	Blooms	2008-2011	
225 2294	Hammond P	Hampden	83	Blooms	2008-2011	
303 0269	Fitzgerald P	Big Squaw TWP	550	Blooms	2008-2011	
305 4120	Brassua L	Tomhegan Twp	8979	Habitat	2008-2011	
309 0038	Flagstaff L	T3R4 BKPWKR	20300	Habitat	<2003	
315 2336	Toothaker P	Phillips	30	Blooms	2008-2011	yes, source removed
321 5296	Fairbanks P	Manchester	14	Blooms	2008-2011	
321 5349	East P	Smithfield	1725	Blooms	<2003	
325 2264	Sebasticook L	Newport	4288	Blooms	<2000	monitoring, improv.

326 5172	Unity P	Unity	2528	Blooms	2003-2008	
327 5176	Lovejoy P	Albion	324	Blooms	2008-2011	
328 5448	China L	China	3845	Bloom	<2003	monitoring, improv.
329 5458	Pattee P	Winslow	712	Blooms	2008-2011	
333 5408	Webber P	Vassalboro	1201	Blooms	2008-2011	yes, improving trend
333 5416	Threemile P	Vassalboro	1132	Blooms	2008-2011	
333 5424	Threecornered P	Augusta	182	Blooms	2008-2011	
334 0098	Upper Narrows P	Winthrop	279	DO	2008-2011	
334 5236	Cobbosseecontee L.	Winthrop	5543	Blooms	<2000, draft TMDL submitted	
334 5254	Pleasant (Mud) P	Gardiner	746	Blooms	2003-2008	
334 8065	Cobbosseecontee (Little)	Winthrop	75	Blooms	2008-2011	
334 9961	Annabessacook L	Monmouth	1420	Blooms	2003-2008	
335 9931	Togus P	Augusta	660	Blooms	2008-2011	
401 3290	Aziscohos L	Parkertown Twp	6700	Habitat	2008-2011	
404 3208	Lower Richardson L	Township C	2900	Habitat	<2000	
404 3308	Upper Richardson L	Richardson Twp	4200	Habitat	<2000	
418 3796	Sabattus P	Greene	1962	Blooms	2008-2011	improving trend *
517 4350	Graham L	Mariaville	7865	Habitat	2008-2011	
522 0083	Lilly P	Rockport	29	Bloom, toxics	2008-2011	post remediation
526 5702	Duckpuddle P	Nobleboro	293	Blooms	2003-2008	
529 5372	West Harbor P	Boothbay Harbor	84	DO	2008-2011	brackish water, may not be Class GPA
605 3454	Highland L	Bridgton	1401	DO	2008-2011	
605 5780	Long L	Bridgton	4867	DO	2008-2011	
607 3734	Highland (Duck) L	Falmouth	634	Trend	2008-2011	
623 3838	Mousam L	Acton	900	Trend	<2003	
625 0119	Ell (L) P	Wells	32	Blooms	2008-2011	
626 5596	Scituate P	York	41	Blooms	2008-2011	
628 0007	Estes L	Sanford	387	Blooms/ps	2003-2008	

TABLE 3. WATER QUALITY LIMITED MARINE WATERS – 1998 Assessment

Closed Shellfish Areas Requiring TMDLs

Area #	Location	Pollutant /Source	TMDL preparation	Data required
1	Spruce Creek, Kittery	Bact/OBD	<2003	
17-A	Bunganuc Stream, Freeport-Brunswick	Bacteria	2003-2008	
17-B	Wharton Point, Brunswick	Bacteria	2003-2008	
18	Ash Point Cove, Harpswell	Bact/OBD	2003-2008	
19	Sebasco, Phippsburg	Bacteria	2008-2011	
20	Kennebec River	Bact/ps,nps	2008-2011	
25	Great Salt Bay, Newcastle-Damariscotta	Bacteria	2008-2011	yes
30	Saturday and Kelly Coves, Little River, Northport	Bacteria	2008-2011	yes
33	Stockton Harbor, Stockton Springs	Bact/OBD	<2000	
38-B	Burnt Cove, Stonington	Bact/OBD	<2003	
42	Bass Harbor, Tremont	Bacteria,toxics	2008-2011	
50-B	Springer Brook, Franklin	Bacteria	<2003	
50-D	Flanders Bay, Harrington	Bacteria/nps	2008-2011	yes
52-G	Tucker Creek, Gouldsboro	Bacteria/nps	2008-2011	yes
54	Jonesport	Bacteria	<2003	
54-B	Indian River, Addison	Bacteria	2008-2011	
54-K	S.E. Alley Bay, Beals	Bacteria	<2003	

OBD = overboard discharge

Other marine waters requiring TMDLs (nonattainment other than shellfishing)

WBS #	Name	Town	Class	Pollutant/ Source	TMDL preparation	New Data Required
900M	Medomak R Estuary	Waldoboro	SB	DO/ps	<2003	
900M	Royal River Estuary	Yarmouth	SB	DO,SOD/ps,nps	<2003	
900M	Fore River	S. Portland	SC	DO, toxics	2008-2011	yes
900M	Saco Estuary	Saco-Biddeford	SC	Toxicity/Cu	<2003	yes
900M	Mousam R Estuary	Kennebunk	SB	DO/ps	<2003	monitoring
900M	Piscataqua R Estuary	S. Berwick	SB	DO,SOD/ps,nps	<2000, draft TMDL submitted	monitoring

Table 3a. Water-quality limited marine waters where enforceable control measures apply - attainment status pending followup monitoring.

900M	Penobscot Estuary, Hampden	Dioxin/color legislation passed; PCBs & dioxins

TABLE 4. RIVERS AND STREAMS REMOVED FROM PREVIOUS 303d LIST

Waters included on previous list where current data indicate these waters attain standards

WBS #	Name	Town	Class	
124R	Dickey Br	St. Agatha	B	included in Cross Lake TMDL
	Daigle Br	St. Agatha	B	included in Cross Lake TMDL
	Unnamed Bk	Corinth	B	natural condition
316R	Unnamed Bk	New Sharon	B	natural condition
324R	Thompson Bk	Hartland	B	natural condition
	Brackett Bk	Palmyra	B	natural condition
329R	Farnham Bk	Pittsfield	B	natural condition
	Unnamed Bk	Benton	B	natural condition
333R	Vaughn Bk	Hallowell	B	
414R	Thompson L. Outlet	Oxford	C	new license, segment attains standards
415R	Morgan Bk	Minot	B	natural condition
416R	Little Androscoggin R	Paris	C	CSO removed, segment attains standards
505R	St. Croix R	Baileyville	C	
512R	Narraguagus R	Cherryfield	B	discharge removed, attains standards
528R	Sheepscot R	Whitefield	AA	
603R	Chandler R	N. Yarmouth	B	
	Unnamed Bk	N. Yarmouth	C	
623R	Carpenter Bk	Waterboro	B	
611R	Alewife Bk	Cape Elizabeth	A	
629R	Great Works R	N Berwick	B	license modification; attains standards

TABLE 5. LAKES REMOVED FROM PREVIOUS 303d LIST

Waters included on previous list where current data indicates these waters attain standards

ID# MIDAS#	Name	Town	Acres	
125 1672	Square L	T16 R05 WELS	8150	
143 1808	Fischer L	Fort Fairfield	10	Class B water erroneously listed in 1996 as GPA, impaired due to blooms. No bloom criteria apply to Class B waters, and no evidence of Class B standards violations due to algae.
209 1728	Pleasant L	T04 R03 WELS	1832	
215 0894	Onawa L	Elliottsville	1344	
224 4128	Garland P	Garland	102	
303 0404	Spencer P	E. Middlesex Grant	980	
304 0328	Notch (Big) P	Little Squaw Twp	12	
317 3680	Varnum P	Wilton	331	
317 3682	Wilson P	Wilton	563	
317 5198	Pease P	Wilton	109	
325 5460	Halfmoon P	St. Albans	36	
326 5174	Sandy (Freedom) P	Freedom	430	
404 3526	Quimby P	Rangeley	165	
407 3504	Ellis (Roxbury) P	Byron	920	
412 3624	Bear P	Hartford	432	
412 3626	Crystal P (Beals P)	Turner	47	
412 3800	Round P	Turner	12	
412 3822	Pleasant L	Turner	189	
413 3784	Little Wilson	Turner	111	
414 3434	Pennessewassee	Norway	922	

414 3444	Thompson L	Oxford	4426
414 3464	Bryant P (L Christopher)	Woodstock	278
414 3500	North P	Norway	175
414 3688	Range P (Upper)	Poland	391
414 3758	Tripp L	Poland	768
414 3760	Range P (Lower)	Poland	290
414 3762	Range P (Middle)	Poland	366
415 3750	Taylor P	Auburn	625
415 3780	Halls P	Paris	51
508 1404	Boyden L	Perry	1702
514 0447	Long P	Mount Desert	38
521 4846	Coleman P	Lincolnville	223
527 5400	Damariscotta L	Jefferson	4381
529 5366	Adams P	Boothbay	73
530 9943	Sewall P	Arrowsic	46
603 3700	Sabathday L	New Gloucester	340
606 3692	Nubble P	Raymond	23
607 3712	Forest L	Windham	210
615 3410	Wards P	Limington	44
615 5024	Little Ossipee P	Waterboro	564
625 3992	Bauneg Beg L	N. Berwick	200

Waters where lake restoration efforts have been established, standards are attained

123 1682	Long L	T17 R04 WELS	6000	St Agatha POTW removed
321 5352	Salmon L (Ellis P)	Belgrade	666	314 restoration complete
404 3534	Haley P	Dallas Plt.	170	Rangeley POTW removed
524 4822	Chickawaukie P	Rockport	352	314 restoration complete

TABLE 6. MARINE WATERS REMOVED FROM PREVIOUS 303d LIST

Shellfish areas

Area #	Location	Reason
8	Turbats Creek, Kennebunkport	Attains standards
8	Little River, Kennebunkport	Attains standards, open
8	Smith Brook, Kennebunkport	Attains standards, depuration harvest
17	Kelsey Brook, Frost Gully Brook, and Haraseeket River	Attains standards, POTW present
18	Stover Cove, Harpswell	Attains standards
	Basin Cove, Harpswell	Attains standards, open
22	Sheepscot Falls, Wicasset-Newcastle	Attains standards, open
25-B	Pemaquid River, Bristol	Attains standards
26	Meetinghouse Cove, Medomak Estuary	Attains standards
28-D	Long Cove, St. George	Attains standards, open
28-H	Mosquito Harbor, St. George	Attains standards, open
29-A	Lucia, Crocketts and Crescent Beaches, Owls Head	Attains standards
48-C	Northwest Cove, Bar Harbor	Attains standards, open
49-A	Jellison Cove, Hancock	Attains standards, open
53	Narraguagus River, Milbridge	Attains standards, POTW present
53-F	Monhonan Cove, Milbridge	Attains standards, open
54-H	Chandler River, Jonesboro	Attains standards, open
55	Machias and East Machias Rivers	Attains standards, POTW present

Appendix II. Chapter 2. Shellfish Harvesting Closure Documentation

Table 7. Shellfish Area Closures Through April 1998

CLOSED AREA	Location	Date
1	Piscataqua River, Kittery, Eliot, So Berwick	3/21/97
1-B	Jaffrey Point, N. H. to Seal Head Pt., York	3/21/97
2	York River - York Harbor	11/19/93
3	East Point to Bald Head Cliff, York	11/27/89
4	Ogunquit River – Ogunquit & Moody Beaches	4/1/97
4-A	Bald Head Cliff, York to Israels Head, Ogunquit	11/27/89
5	Webhannet River & Beaches of Wells & Kennebunk	2/12/98
6	Mousam and Kennebunk Rivers	6/24/97
8	Cape Porpoise Harbor - Goosefare Bay	6/24/97
8-A	Cape Porpoise Harbor - Kennebunkport	8/8/97
8-B	Timber Point to Fortunes Rocks, Biddeford	11/16/93
9	Saco River and Saco Bay	3/21/97
11	Northern Saco Bay & Scarboro River	3/20/98
12	Prouts Neck, Scarborough	2/7/89
13	Prouts Neck – Spurwink River	4/16/98
13-A	Spurwink River, Scarborough to McKenney Point Cape Elizabeth	11/19/93
14	Chandler Cove & Little Chebeague Island Portland – Falmouth Area	11/14/97
14-C	Cape Elizabeth – Cliff Island, Portland	11/14/97
14-D	Great Chebeague Island, Cumberland	5/26/95
15	Sunset Point to Parker Point, Yarmouth	2/11/97
16	Royal River & Cousins River, Yarmouth And Freeport	2/25/98
16-C	Cousins & Littlejohn Islands, Yarmouth	6/30/95
17	Harraseeket River, Freeport	1/29/98
17-B	Maquoit Bay, Brunswick	4/27/98
17-D	Bustins Island, Freeport	12/29/94
18	Potts Harbor, Merriconeag Sound and Harpswell Sound, Harpswell	1/15/98
18-A	Gurnet Strait, Harpswell	4/22/98
18-B	New Meadows River, Brunswick - West Bath	8/21/97
18-C	Mere Point Neck, Brunswick	1/31/95
18-D	Eastern Bailey-Orr's Island, Western Quahog Bay, Harpswell	2/10/98
18-E	Cundy's Harbor and Dingley Island, Harpswell	12/11/97
18-G	Birch Island, Harpswell	2/24/94
18-H	Ewin Narrows, Harpswell	12/20/94
18-I	Harpswell Fuel Depot, Harpswell	4/22/94
18-J	Lombos Hole, Harpswell Sound	11/13/89
18-K	High Head, Harspwell	11/13/89
18-L	Southwestern Mill Cove, Harpswell Sound	11/13/89
18-M	Lookout Point & Wilson Cove, Harpswell	7/25/90
18-O	Bethel Point, Harpswell	11/13/89
18-Q	Eastern Dingley Island, Harpswell	12/11/97
18-R	East Harpswell and Long Island, Harpswell	12/11/97
18-S	Indian Point, Harpswell	12/11/97
18-T	Strawberry Creek, Harpswell	4/26/90

18-U	Barnes Point, Harpswell	10/23/95
18-W	Woodward Point, New Meadows River, Brunswick	5/17/93
18-X	Hen Island and unnamed cove located east of Big Hen Island, Cundys Harbor, Harpswell	12/19/94
18-Z	Cliff Island to Bailey Island, Casco Bay	11/14/97
18-AA	Little Yarmouth Island, Harpswell	2/17/94
19	Wood Island to Harbor Island, Phippsburg	9/18/92
19-A	Birch Point, West Bath - Bear Island, Phippsburg	5/24/93
19-B	West Point, Phippsburg	1/5/84
19-C	Foster Point to Birch Point, West Bath	5/26/95
20-B	Back River, Wiscasset and Westport	1/15/98
20-E	N. Robinhood Cove, So. Robinhood Cove, & Knubble Bay, Georgetown/Westport	7/25/96
20-F	Oak Island - Montsweag Bay	6/21/94
20-H	Lower Kennebec, Phippsburg/Georgetown	3/27/98
20-J	Western Sagadahoc Bay, Georgetown	7/14/95
21	Indian Point, Georgetown, to Fowle Pt., Westport	10/12/95
22	Sheepscot River and Tributaries	7/2/97
22-B	Sawyer Island, Hodgdon Island, Merrow Island and Adjacent Shores, Boothbay	9/5/96
22-E	Western Barters Island, Boothbay	1/2/97
22-F	Gooseberry Island - Oven Mouth, Boothbay-Edgecomb	3/29/94
22-G	Upper Sheepscot River & Tributaries	7/2/97
23	Boothbay Harbor - Damariscove Island Area	5/11/92
23-A	Ebencook Harbor & Vicinity, Southport - Boothbay Harbor	5/4/89
23-B	Southwestern Southport Island	2/17/88
24	East Boothbay to Reeds Island	5/27/93
24-A	Dodge Lower Cove, Edgecomb	10/4/94
25	Damariscotta River, Newcastle - Damariscotta	2/18/98
25-A	South Bristol	5/27/93
25-B	Pemaquid River, Bristol	9/20/90
25-C	New Harbor, Bristol	7/16/86
25-D	Long Cove Point to Muscongus Harbor, Bristol	10/9/91
25-E	Inner Heron Island	9/30/71
25-F	Pemaquid Neck, Bristol	2/22/88
25-G	Soldiers Cove, Bristol	10/18/88
25-H	Keene Narrows, Medomak - Bremen	1/11/90
25-I	Muscongus Harbor, Bristol-Bremen	1/20/89
25-J	Eastern Farmers Island, South Bristol	4/10/90
25-L	Northern End of Hog Island, Bremen	5/10/90
25-M	Greenland Cove, Bremen	5/10/90
25-N	High Island to McFarlands Cove, South Bristol	5/9/90
25-O	Louds Island, Bristol & Bremen, Long Island Areas	5/14/92
25-Q	Western Branch of Broad Cove in Bremen and Waldoboro	12/13/94
26	Medomak River, Waldoboro	4/24/98
26-A	Monhegan Island	9/30/71
26-B	Friendship Harbor	10/22/97
26-D	Hawthorne Point - Bailey Point, Cushing	7/9/91
26-H	Broad Cove, Cushing	5/20/92
26-K	Meduncook River and Hornbarn Cove - Crotch Island, Cushing	4/21/98
26-M	Davis Cove, Cushing	1/27/95
26-N	South & North Ends of Maple Juice Cove, Cushing	12/3/97
26-0	Long Island - Harbor Island & Vicinity, Friendship	2/3/95
26-P	Back River, Friendship	5/20/96

27	St. George River	4/6/98
27-A	Eastern Wheeler Bay, St. George	3/5/97
27-B	Deep Cove to Watts Point, St. George	10/24/97
28	Tenants Harbor to Mosquito Head, St. George	6/17/97
28-A	Port Clyde and the St. George Islands St. George and Cushing	5/22/97
28-B	Spruce Head Island, So. Thomaston to Spaulding Island, Owl's Head	12/6/96
28-C	No End of Rackliff Island, St. George	3/9/90
28-D	Long Cove, St. George	3/3/97
28-E	Spaulding Island to Ash Point, Owl's Head	3/11/96
28-G	Seavey Cove, St. George	3/3/97
28-H	Marshall Point, Mosquito Head, St. George	6/17/97
28-I	Weskeag River, So. Thomaston	12/6/96
29	Rockland (Rockland Habor, Broad & Deep Coves)	7/5/77
29-A	Owl's Head	5/12/87
29-B	Matinicus Island	8/17/62
29-C	Owl's Head Bay	3/1/89
30	Rockport Area	7/5/77
30-A	Southwestern Vinalhaven	3/22/91
30-B	Arey Cove, Vinalhaven	6/11/87
30-C	Pulpit Harbor, North Haven	6/9/87
30-D	Northwestern Vinalhaven & Vicinity	8/2/90
30-E	Old Harbor, Vinalhaven	9/2/83
30-G	Northeastern Vinalhaven & Vicinity	3/6/92
30-H	Kent Cove, North Haven	12/15/97
30-I	North Haven Island	6/15/90
30-J	Vinal Cove - Starboard Rock, Vinalhaven	8/2/90
30-K	Northeastern End of Southern Harbor, North Haven	9/14/90
30-L	Ames Creek Area, North Haven	9/14/90
30-M	Roberts Harbor, Vinalhaven	3/22/91
30-N	Indian Point to Burnt Island, North Haven	10/15/93
31	Camden	10/15/82
31-A	Rockport Harbor to Ducktrap Harbor, Lincolnville	3/29/94
31-B	Spruce Head to Kelleys Cove, Northport	6/28/91
32	Belfast Bay	3/4/83
32-A	Saturday Cove Area (Northport)	6/2/87
33	Searsport-Stockton Springs	10/8/97
35	Penobscot River	9/16/77
36	Penobscot & Bagaduce Rivers, Towns of Castine, Penobscot, Sedgwick & Brooksville	3/6/98
36-F	Islesboro	2/21/92
37	Condon Point, Brooksville, to the Herricks village, Brooksville	9/10/96
37-A	Deer Isle	10/25/78
37-B	Blastow Cove, Deer Isle	8/17/88
37-C	Sylvester Cove - Dunham Point, Deer Isle	5/15/89
37-D	Weir Cove, Brooksville	12/1/88
37-E	Eggemoggin, Little Deer Isle	5/22/89
37-G	Tinken Ledges to Thompson Cove, No. Deer Isle	12/6/90
37-I	Western Cove, Stinson Neck, Deer Isle	4/3/91
38	Stinson Point, Deer Isle, to Webb Cove, Stonington	12/17/93
38-A	Inner Harbor, Stonington-Deer Isle	10/25/78
38-B	Burnt Cove, West Stonington	10/2/90
38-C	Whig Island & Huckleberry Island Coves in Long Cove, Deer Island	5/12/92

39	Blue Hill Harbor to Blue Hill Falls	1/25/90
39-A	Center Harbor - Brooklin	9/10/96
39-B	Sedgwick	6/6/77
39-C	McHerd Cove - Webber Cove, East Blue Hill	12/17/93
39-D	Western Blue Hill Bay, Watson Brook & E. Naskeag Brook	9/22/95
39-F	Benjamin River, Sedgwick	11/8/93
40	Union River Bay, Patten Bay &	
42	Bass Harbor & Eastern Duck Cove, Tremont	11/6/95
42-A	Lunt Harbor, Frenchboro	8/25/97
42-B	Burnt Coat Harbor, Swans Island	8/7/91
42-C	Swans Island and Round Island	7/10/89
42-D	Red Point, Swans Island	9/19/91
42-E	Mackerel Cove, Swans Island	3/30/98
43	Southwest Harbor	5/9/86
44	Somes Harbor, Southern Mt. Desert Island & Cranberry Isles	3/5/92
45	Northeast Harbor	5/9/86
45-B	Clark Cove, Mt. Desert	3/14/96
46	Seal Harbor	6/17/87
46-A	Otter Cove, Mt. Desert - Bar Harbor	1/26/90
47	Bar Harbor	1/26/90
48	Thomas Bay, Bar Harbor	4/17/92
48-A	Goose Cove and Mt. Desert Narrows, Trenton	1/25/95
48-B	Clark Cove and Indian Point, Bar Harbor	8/1/96
49	Salisbury Cove, Bar Harbor	5/9/86
49-A	Jellison Cove, Hancock	9/10/96
49-B	REPEALED	
49-C	Kilkenny Cove, Hancock	5/30/89
49-D	Easternmost Cove in Youngs Bay, Hancock	5/30/89
49-E	Mud Creek, Lamoine	12/4/89
50	Sorrento	9/10/96
50-A	West Sullivan to Falls Point and Long Cove, Sullivan	7/29/97
50-B	Springer Brook, W. Franklin	1/23/95
50-D	Northwest End Flanders Bay, Sullivan-Sorrento	10/14/92
50-E	Egypt Bay, Hancock & Franklin	1/23/95
51	Winter Harbor	1/26/90
51-A	Arey Cove, Winter Harbor	8/18/76
51-B	Grindstone Neck, Winter Harbor	12/4/89
52	Prospect Harbor, Gouldsboro	9/19/94
52-A	Corea Harbor	8/23/72
52-C	Bunkers Harbor, Gouldsboro	9/19/94
52-D	Southwestern Petit Manan Point, Steuben	10/30/90
52-E	Dyer Harbor - Pinkham Bay, Steuben	10/13/94
52-F	Birch Harbor, Gouldsboro	2/11/91
52-G	Tucker Creek, Gouldsboro & Steuben Harbor	2/21/91
52-H	Wonsqueak Harbor, Gouldsboro	9/19/94
52-J	Over Cove, Dyer Bay, Steuben	10/13/94
53	Narraguagus River, Milbridge	9/21/95
53-A	Lower Wass Cove, Harrington; Mash Harbor Pleasant River, Addison	10/20/94
53-B	Tom Leighton Point, Pigeon Hill Bay, Milbridge	9/25/95
53-C	Back Bay, Milbridge	1/14/92
53-D	Flat Bay, Harrington	9/3/93
53-E	Upper Harrington River	11/19/91
53-F	Monhonen Cove, Milbridge	9/21/95

53-G	Smith Cove, Milbridge	9/21/95
53-H	Mash Harbor, Cape Split, Eastern Harbor, Addison	4/11/97
54	Jonesport and West Jonesport	2/8/96
54-A	North End of Beals Island	1/11/95
54-B	West River - Indian River, Addison-Jonesport	1/11/95
54-D	East & West Branches, Little Kennebec Bay, Machias & Machiasport	11/13/96
54-E	Hall Cove, Steele Harbor Island, Jonesport	10/7/91
54-F	Sandy River & Popplestone Beach, Jonesport	1/24/92
54-G	Masons Bay, Jonesport	5/22/96
54-H	Chandler River, Jonesboro	8/29/97
54-I	Black Duck Cove, Beals	9/22/95
54-K	Southeastern Alley Bay & Pig Island Gut, Beals	7/26/96
54-L	Sanford Cove, Roque Bluffs	1/24/92
54-M	Lamesen Brook in West River, Addison	1/11/95
54-N	Eastern Great Wass Island, Beals	9/20/95
55	Machias & E. Machias Rivers	3/27/98
55-A	Little River - Cutler Harbor	4/7/95
55-B	Howard Cove - Starboard Cove, Bucks Harbor	12/12/89
55-C	Whiting - Cutler	8/2/93
55-E	Cross Island (Cutler)	8/20/90
55-G	Money Cove, Cutler	1/16/90
55-H	Bucks Harbor, Machiasport	9/20/95
55-I	Indian Head, Machiasport	9/24/90
56	Denny's River & NE Denny's Bay, Edmunds & Pembroke	10/8/96
56-A	Pennamaquan Bay, Pembroke	3/12/92
56-C	Moose Cove & Haycock Harbor, Trescott	9/10/91
56-F	Trescott Cove, Straight Bay, Trescott	8/26/92
56-I	Canal Cove, Seward Neck, Lubec	11/1/91
56-J	Sipp Bay, Perry & Pembroke	12/19/96
57	Eastport	10/6/66
57-A	Pleasant Point, Perry	10/29/97
57-B	Carrying Place Cove, Eastport	12/3/96
58	Lubec and South Lubec	8/26/92
58-C	North Lubec	3/10/92
58-E	Federal Harbor, West Lubec	8/20/90
58-F	The Haul-Up, South Bay, West Lubec	8/20/90
59	Quoddy Village, Eastport	11/16/73
60	Little River, Perry	7/25/88
62	St. Croix River - Passamaquoddy Bay	5/30/96
500	New Hampshire Boundary to Seal Island, Matinicus	4/22/96

REPEALED

19-D	Long Cove, West Bath - REPEALED	8/16/96
30-F	Isle au Haut – REPEALED	8/27/97
48-C	Mill Cove, Mount Desert – REPEALED	7/9/97
55-D	Crane Mill Brook, Edmunds – REPEALED	10/8/96
56-B	Hobart Stream (Edmunds) – REPEALED	9/23/97
56-H	Ox Cove, Pembroke - REPEALED	10/16/96