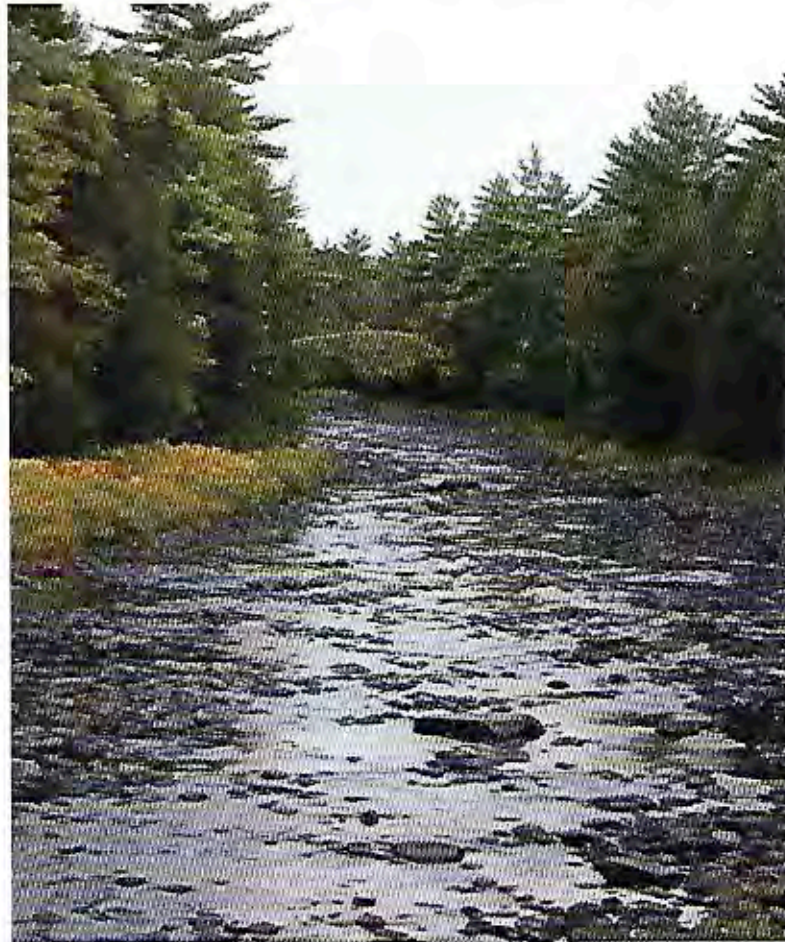


NARRAGUAGUS RIVER WATERSHED NONPOINT SOURCE POLLUTION MANAGEMENT PLAN



Prepared for the:
Narraguagus River Watershed Council
in partnership with
Project SHARE

January 2003

*A Maine Department of Environmental Protection
319 Nonpoint Source Pollution Control Project*

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January 2003

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KEY TO AGENCY ABBREVIATIONS

The following is a list of the full names and abbreviations of agencies, organizations, and businesses commonly referred to throughout this document.

ASC	Atlantic Salmon Commission
CES	Civil Engineering Services
CFI	Cherryfield Foods, Incorporated
DERC&D	Down East Resource Conservation and Development Council
DLT	Downeast Land Trust
DSF	Downeast Salmon Federation
IP	International Paper
LURC	Land Use Regulation Commission
MBPC	Maine Board of Pesticides Control
MDEP	Maine Department of Environmental Protection
MDOC	Maine Department of Conservation
MDOT	Maine Department of Transportation
MIF&W	Maine Department of Inland Fish and Wildlife
MSPO	Maine State Planning Office
NFWF	National Fish and Wildlife Foundation
NMFS	National Marine Fisheries Service
NRCS	Natural Resource Conservation Service
NRWC	Narraguagus River Watershed Council
UM	University of Maine
USGS	United States Geological Survey
USFW	United States Fish & Wildlife
WCRPC	Washington County Regional Planning Commission
WCS&WCD	Washington County Soil and Water Conservation District
WYMANS	Jasper Wyman and Son

1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

In April 2001, the Narraguagus River Watershed Council (NRWC) undertook the development of the Narraguagus River Watershed Nonpoint Source Pollution Management Plan (NRWMP) as part of the Maine Department of Environmental Protection Nonpoint Source Pollution Control Program under the Federal Clean Water Act Section 319. The goal of state-supported management plans is to achieve locally supported watershed management in order to encourage widespread usage of best management practices (BMPs) and other management measures to restore or protect water resources.



The goal of the Narraguagus River Watershed Nonpoint Source Management Plan is to maintain areas of high water quality, improve or remediate areas of poor water quality and NPS pollution, and prevent future sources of nonpoint source pollution.

The NRWC established a workgroup of watershed stakeholders who dedicated 18 months to the development of the Plan. The process enabled several unprecedented events to occur:

- 1) The process brought together area stakeholders that had not previously worked together.
- 2) The process enabled stakeholders to focus on the entire watershed rather than individual lakes, tributaries, or just the main stem.
- 3) The process facilitated the gathering and organization of research and data specific to the watershed for the first time.
- 4) The Plan presents a clear overview of the watershed to the public and its stakeholders for the first time.

The primary goal of this document is to provide a resource that will be used to plan, fund, and implement:

- continued NPS surveying for new sites,
- continued water quality monitoring of new and existing sites,
- remediation of existing NPS sites,
- evaluation of repaired NPS sites,
- the development of public outreach programs, and
- the creation of an NPS Coordinator's position.

As a consequence of this and other related NPS projects, the following actions have resulted in the past 12-18 months:

- the formation of an NPS Restoration Working Group dedicated to assisting managers with the use of BMPs at NPS sites, the creation of an NPS Prioritization Scheme and the development of Priority Atlantic Salmon Subwatershed Habitat Maps,

- the development of a multi-layer (over 20 layers) GIS database containing scientific data, maps, photographs, and documentation information specific to NPS sites.
- the establishment of an ATV/Snowmobile Trail Stewardship program and involvement of the National Park Service Rivers and Trails Program.
- the creation of three local NPS training workshops,
- the remediation of over 60 NPS sites, and
- the evaluation and follow-up of approximately 30 repaired NPS sites.

1.2 DESCRIPTION OF WATERSHED

The Narraguagus River Watershed is located in eastern Hancock and western Washington Counties, Maine. The river originates at Eagle Lake in T34MD and flows 43 miles to head of tide in Cherryfield and an additional 5 miles to its mouth in Milbridge, Maine. Portions of eight organized towns (Beddington, Deblois, Cherryfield, Columbia, Franklin, Milbridge, Steuben and Eastbrook) and eight unorganized townships (T10SD, T16MD, T18MD, T22MD, T28MD, T29MD, T34MD, T35MD) are within the watershed boundaries.

The watershed drains an area of 232 square miles (148,480 acres) and includes 250 miles of tributaries and a lake and pond surface area of 2,167 acres. It is recognized as a Priority Watershed by the Maine DEP, is on the Nonpoint Source Priority Watershed List, and is recognized as one of the eight rivers protected in the Maine Atlantic Salmon Conservation Plan and the Federal Endangered Species Act.

Land use in the watershed can be classified into four major categories: 1) small private landholdings (27%), 2) timber management landholdings (63%), 3) blueberry cultivation landholdings (5%), and 4) public lands and roadways (5%).

1.3 WATER QUALITY SUMMARY

The Narraguagus River and its tributaries are classified as Class AA, A, and B in accordance with the MDEP Water Classification Program (2001). Although, the majority of the Narraguagus River Watershed currently meets its legal classification status, sampling from several sites in the watershed indicate possible attainment issues. These sites fall into three categories:

- 1) sites associated with peat discharge at McCoy Brook,
- 2) sites associated with sewage discharge in the lower reaches,
- 3) sites not attaining aquatic life standards due to agricultural NPS, lake outlet effect, or sedimentation.

In addition, recent MDEP water quality monitoring (1999-2002) indicates concern and need for continued monitoring of dissolved oxygen, temperature, pH, bacteria, total suspended solids, pesticides, and nutrients.

1.4 NPS ASSESSMENT

Surveying and documentation of NPS sites (places in the watershed where nonpoint source pollution has been identified) in the Narraguagus River Watershed have occurred since 1999. In total, seven surveys have been conducted in a three-year period, and approximately 75% of the watershed has been surveyed to date. Collectively, the seven surveys documented over 175 NPS sites.

1.5 STAKEHOLDER INVOLVEMENT

Over the past three years, the NRWC, Project SHARE, WCS&WCD, NRCS, and the primary stakeholders have all been effectively working to remediate NPS sites in the watershed. Although 175 sites have been documented between 1999 and 2001, approximately 50% of these sites have either been fully repaired or are in the process of completion. The following agencies, businesses, and organizations work with the NRWC to identify and repair NPS and other restoration and protection projects: Project SHARE, Downeast Salmon Federation, Washington County Soil and Water Conservation District, USDA Natural Resource Conservation Service, Down East Resource and Conservation Development Council, Maine Department of Environmental Protection, International Paper, Cherryfield Foods, Jasper Wyman and Son, National Marine Fisheries Service, Maine Department of Conservation, Narraguagus and Acadia ATV Clubs, and the Municipalities of Cherryfield, Milbridge, Deblois, and Beddington.

1.6 PLAN GOAL AND OBJECTIVES

GOAL:

The goal of the Narraguagus River Watershed Management Plan is to maintain areas of high water quality, to improve or remediate areas of poor water quality and NPS pollution, and to prevent future sources of nonpoint source pollution.

OBJECTIVES:

1. Eliminate or reduce existing nonpoint sources of pollution:
 - Develop an implementation strategy for abatement of the 175 NPS sites that have been documented between 1999 and 2001.
 - Create partnerships with residents, businesses, and governments for cost-sharing opportunities for NPS abatement.
 - Pursue financial resources necessary to implement site remediation.
2. Prevent future NPS sources of pollution:
 - Create a reference and guidance document for residential, commercial, government, and community decision makers.
 - Continue water quality monitoring and NPS surveying.
 - Encourage and support better commercial and community planning and more effective use of existing plans.
 - Promote and support residential, commercial, and governmental NPS best management practices.

- Increase public awareness, involvement, training, and advocacy with regard to watershed issues.

1.7 THREATS TO WATER QUALITY

The first task undertaken by the NWMP Workgroup was to identify the potential threats to water quality in the Narraguagus River Watershed. The group identified 13 potential sources of NPS pollution in the watershed as represented in the NPS database and in the water quality data. These sources include: all terrain vehicle use, poorly maintained logging roads, blueberry roads and state and town roads, sand/salt facilities, peat harvesting, timber harvesting practices, faulty septic systems, phosphorous and other nutrients, pesticide drift and runoff, agricultural water withdrawal, beaver activity, acid precipitation, landfill seepage and runoff.

1.8 PROJECT MANAGEMENT

The NWRC is a grassroots organization of volunteers that have a common interest in the welfare of the Narraguagus River Watershed. The Council office is located in the LURC Office at 7 Campbell Hill (Route 1) in Cherryfield.

The NWRC and Project SHARE (the fiscal partner for the NPS Management Plan) will take the lead on ensuring that the action items in this plan are initiated. Together the two organizations will provide the leadership necessary to carry out the action items in this plan. Project SHARE and the NWRC will develop effective partnerships with large landowners, municipalities, community organizations, and state and federal government agencies.

1.9 REMEDIATION STRATEGY

Objective #1 of the Plan is to "Eliminate or reduce existing nonpoint sources of pollution." Table 10.1 is designed to meet this objective. It summarizes the remediation and implementation strategy that will be used (or is being used) to repair the 175 NPS sites in the Narraguagus River Watershed. The Remediation Strategy lists the Problem, Action, Responsible Party, Time Frame, Cost, Technical Assistance, and Priority. Approximately 50% of the sites are either repaired or in the process of being repaired using the appropriate BMPs for each critical area.

1.10 PREVENTION STRATEGY

Objective #2 of the Plan states that the NRWC and its partners will work to "prevent future sources of NPS pollution." This objective contains several components designed to help the stakeholders achieve NPS Prevention. These components include:

- better planning and use of existing plans and BMPs.
- continued water quality monitoring and NPS surveying.

- increased public awareness, involvement, and advocacy with regard to watershed issues.

Table II.1 is a listing of action items for each specific land use or NPS issue discussed during the eighteen-month NRWMP planning process. Although the list is extensive, it is designed to act as a menu of possible action items that the stakeholders can choose from in order to meet their objectives. In addition, many of the action items are currently in progress or have been completed within the past year.

Lastly, it should be noted that while the Narraguagus River Watershed Management Plan was initiated by the Council, it is a product of the WMP Working Group which includes the NRW and all of its partners from industry, government, and the community. As such, the Responsible Party for these action items may be the NRW or any one of its partners (i.e., LURC, WCS&WCD, DEP, DSF, MASC, IP, Wymans, Project SHARE, etc).

2. DESCRIPTION OF WATERSHED

2.1 LOCATION

The Narraguagus River Watershed is located in eastern Hancock and western Washington Counties, Maine. The river originates at Eagle Lake in T34MD and flows 43 miles to head of tide in Cherryfield and an additional 5 miles to its mouth in Milbridge, Maine (see Map 2.1). Portions of eight organized towns (Beddington, Deblois, Cherryfield, Columbia, Franklin, Milbridge, Steuben and Eastbrook) and eight unorganized townships (T10SD, T16MD, T18MD, T22MD, T28MD, T29MD, T34MD, T35MD) are within the watershed boundaries. The public can access the main stem at the ice-control dam in Cherryfield, the Milbridge Town Landing, and in areas where the river crosses the Stud Mill Road, Route 193, and Route 1.



The Narraguagus River is recognized as a Priority Watershed by the Maine DEP and is recognized as one of the eight rivers protected in the Maine Atlantic Salmon Conservation Plan and the Federal Endangered Species Act.

2.2 PHYSICAL FEATURES

Size/Streamflow

The Narraguagus River Watershed drains an area of 232 square miles (148,480 acres) and includes 250 miles of tributaries and a lake and pond surface area of 2,167 acres (Baum and Jordan, 1982). The average annual precipitation is 49 inches and is somewhat evenly distributed (USGS, 2000).

Discharge in the Narraguagus River is currently unregulated (i.e., naturally fluctuating). The two dams in the watershed do not inhibit water flow: the Stillwater Dam in Cherryfield controls ice, and the Bog Brook Dam creates an impoundment managed for aquatic wildlife (MSPO, 2001). While both dams are equipped with fishways, fish passage for some species may be problematic. The monthly median streamflows, as recorded by the USGS streamgaging station at Cherryfield, show that high flows typically occur in early spring and late fall, and low flows generally occur in the summer and early fall (USGS, 2000). For the period 1948-1992, monthly median streamflows ranged from 93.0 ft³/s (August) to 1,000 ft³/s (April).

Topography

The Narraguagus River flows primarily from north to south originating at Eagle Lake, which is 406 feet above sea level. Topography of the headwater area is rugged and includes rocky hills and ridges ranging from 200 to 1,475 feet in elevation. Mountains in this part of the watershed include Lead Mountain (1,475 feet) and Eagle Mountain (1,079 feet) to the west and Pleasant Mountain (1,374 feet) and Spruce Mountain (1,076 feet) to the east.

In the towns of Deblois and Cherryfield, the elevation drops to between 100 and 200 feet and the landscape is characterized by extensive flat "barrens" with scattered drumlins (low, rounded hills of glacial till) and kettles (depressions in glacial debris) produced by the melting ice during the last period of glaciation.

The estuary of the Narraguagus River is about five miles long and extends from just north of the Route 1 Bridge in Cherryfield, through Milbridge to Narraguagus Bay. The estuary is relatively narrow and shallow, and the surrounding elevation is generally less than 50 feet.

Soil and Vegetation

Soils in the upper portion of the watershed are variations of the Monadnock-Hermon-Dixfield Complex which are generally loamy, well drained, and stony to extremely bouldery (MIF&W, 1994). Areas of the Brayton-Colonel Association are also common and are generally more hydric. The upland soils support forests of northern hardwoods (oak, maple, birch and beech); red, white, and black spruce; red and white pine; balsam fir; and eastern hemlock. Bedrock here is a dark gray metamorphosed shale phyllite schist (Baum and Jordan, 1982).

The barrens occurring in Deblois and Cherryfield consist of well-drained, sandy-gravelly soils and bedrock of biotite, biotite-muscovite granite, and a hornblende form of granite (Baum and Jordan, 1982). Vegetation here includes low bush blueberry, sweetfern, rhodora, and viburnums. Low lying areas in this section of the watershed may consist of poorly drained soils forming lowland swamps or peat bogs and vegetation including alders, sweetfern, and sphagnum moss. Flowage soils have been classified as Wonsqueak and Bucksport mucks and are unsuitable for land use practices (MIF&W, 1994).

2.3 DESCRIPTION OF WATERBODIES

There are over 250 miles of river and streams in the Watershed. The Narraguagus River has one major tributary, the West Branch of the Narraguagus River. Other significant bodies of water include the more than 30 lakes and ponds, which collectively drain 2,167 acres. Six lakes in the watershed are over 200 acres in surface area (see Table 2.1).

Table 2.1. Major Lakes in the Narraguagus River Watershed

NAME	LOCATION	PUBLIC ACCESS	USE	SURFACE ACREAGE
Eagle Lake	T34	Boat Launch at North End	Recreation	260 acres
Beddington Lake	Beddington	Boat Launch on South Shore	Recreation	402 acres
Spruce Mountain Lake	Beddington	Private Boat Launch at North End	Recreation	448 acres
Bog Brook Flowage	Beddington/Deblois	Boat Launch at North End near Dam	Recreation and Wildlife Management	565 acres
Schoodic Lake	Cherryfield/Columbia/ T18	Boat Launch at North End in T18	Recreation and Agricultural Water Withdrawal	389 acres
Narraguagus Lake	T16, T10, T9	Rough landing near Mill Stream	Recreation	426 acres

The West Branch of the Narraguagus River

The West Branch of the Narraguagus River (West Branch) originates in T22 at an elevation of 460 feet. It drains 70 square miles and flows 24 miles in a southeasterly direction before joining the main stem of the river in Cherryfield (Baum and Jordan, 1982). There are several points of access to the West Branch including a boat launch at Sprague Falls Road in Cherryfield. The West Branch is used for both recreation and agricultural water withdrawal.

2.4 WATERSHED RESOURCES

Scenic River Status

The Narraguagus River, from Fickett Point in Milbridge to its headwaters in T34, was designated "as meriting special protection" under the "Maine Rivers Policy" in 1982 (WCRPC, 1984). As such, the river is protected from unwise development and new dam construction.

Wildlife Management Areas

Included in this watershed are two wildlife management areas under the authority of the Maine Department of Inland Fish and Wildlife (MIF&W): the Narraguagus Wildlife Management Area and the Bog Brook Wildlife Management Area.

Narraguagus Wildlife Management Area (NWMA) is located in the peninsula occurring between the West Branch and the main stem of the Narraguagus River in the town of Cherryfield. It consists of approximately 1,450 acres of forested uplands and is managed for wetland habitat, upland habitat, and public recreation (both consumptive and non-consumptive). Specifically, the NWMA is managed for small game, furbearers, migratory game, big game, and fisheries. Two management compartments have been delineated: a riparian zone and an upland compartment. Although no forest management activities are scheduled at this time, wetland habitat enhancement has been accomplished by placing 20 artificial waterfowl nesting structures in wetland areas (MIF&W, 1994). An unpaved road from the north provides access to two points along the northern boundary. Boat access is possible via the main stem and the West Branch.

Bog Brook Wildlife Management Area (BBWMA) is located in the towns of Beddington and Deblois and is formed by an impoundment on Bog Brook approximately 0.4 mile east of its confluence with the Narraguagus River. The BBWMA consists of a 924-acre impoundment with a 250-foot riparian buffer surrounding much of the flowage (MIF&W, 1990). The impoundment is a concrete dam, and a small clearing to the west of the dam serves as the primary access site. The land is owned by International Paper Corporation and Jasper Wyman and Son but is leased and managed by MIF&W. Three management compartments have been delineated. Wetland bird species that are known to inhabit the flowage include the bald eagle, blue heron, American bittern, kingbird, belted kingfisher, double-crested cormorant, common loon, and osprey. A warm-water fishery is also maintained at the flowage and includes small mouth bass, alewives, eel, and pickerel.

Rare and Endangered Wildlife

Rare or protected animal species in the watershed include the bald eagle, gray wolf, peregrine falcon, and the yellow lampmussel (Carlson, 1999). In addition, upland sandpipers, a state-listed threatened species, nest on nearby commercial blueberry barrens (MIF&W, 1990).

Aquatic habitat conditions on the Narraguagus River have been studied for many years. Recent observations of the occurrence of stoneflies and mayflies in the upper reaches of the river did not reveal any chronic pattern of absence (Siebenmann, 1995). Further studies are indicated in the lower reaches due to failure of some sites to attain water classification status (DEP, 1999).

Fish

Various waters of the Narraguagus River support important inland sport fisheries of brook trout, landlocked salmon, smallmouth bass, and pickerel. Other waters support lesser fisheries for rainbow smelt and yellow perch.

Of special note in the watershed is the brook trout fishery. Brook trout are distributed throughout the drainage where water temperatures are cold. The West Branch, in particular, is one of the premier wild brook trout fisheries in eastern Maine. Special restrictive harvest and gear regulations are in place to capitalize on this water's proven ability to grow good numbers of 8-10 inch trout, along with some 13-16 inch fish (Personal Communication, Ron Brokaw, IF&W, May 10, 2002). The West Branch is particularly noted for its spring fishery especially near its confluence with Pork Brook, which serves as a significant natural brook trout spawning and nursery area (Baum and Jordan, 1982). In addition, Pineo and West Pike Brook Ponds also support very good stocked trout fisheries.

Atlantic Salmon

The Narraguagus River has historically supported a wild Atlantic salmon fishery that has been augmented by state-managed stocking programs. The Atlantic salmon has an anadromous life history: juveniles rear in freshwater until migrating to sea as smolts, typically at age two. Adults return to their natal river after spending at least one, but typically two or more years at sea. Returning adults spawn in the fall in gravel-dominated areas with suitable water depth, velocity, and dissolved oxygen. Their progeny emerge from the gravel the following spring. Juvenile salmon use areas of the river where there is sufficient cover, flow, and substrate to provide aquatic macroinvertebrates used as food.

Population Decline

The number of adult salmon returning to the Narraguagus River has dropped dramatically in recent years. Returning adults have been counted in the fishway trap at the Stillwater ice-control dam in Cherryfield since 1962 (ASC, 1997). The number of adults collected in the fishway has declined:

- between 1962-1974, an average of 173 adult salmon were counted,
- between 1991-1997, an average of 62 adults were counted, and
- between 1997-2001 an average of 29 adults were counted (ASC, 2001).

In addition, the number of redds (depressions in the gravel created by spawning females) in the Narraguagus has decreased from 78 in 1997 to 24 in 2001 (ASC, 2001).

The Atlantic salmon population declines in Maine rivers may be the result of inadequate spawning escapement due to mortality of adults at sea or the inability of freshwater habitats in Maine to produce juvenile salmon at levels that assure population viability (ASC, 2001). Additionally, Maine lies near the southern extent of the range of the Atlantic salmon, and

relatively minor fluctuations in climate resulting in increased water temperature or decreased stream flow may diminish habitat suitability for adult and juvenile salmon.

Population Management

As a result of population declines, the Narraguagus River has been identified as one of the seven rivers in the state of Maine protected under the state's Atlantic Salmon Conservation Plan (MASTF, 1997). The management goal for the Atlantic salmon population in the Narraguagus River, as stated in the 1997 Plan, is listed in Table 2.2 below. In addition, the Atlantic salmon was placed on the Federal Endangered Species List in 2000 and will be protected and managed under the Federal Recovery Plan, which is expected to be completed in 2003.

Table 2.2. Atlantic Salmon Management Goals (MASTF, 1997)

Waterbody	Units of Habitat (100 m ²)	Smolt Production Goal (3/unit)	Minimum Spawning Requirement	Recreational Harvest Goal	Minimum Total Run
Narraguagus River Watershed	6,013	18,045	401	100	501

Salmon Habitat

Recovery of Atlantic salmon is dependent on the quantity and quality of habitat available during the freshwater stages of the fish's life cycle. This includes adequate spawning habitat, suitable rearing habitat for juveniles, ready access to habitats, and holding pools for adults (Baum and Jordan, 1982). Suitable spawning habitat is characterized by riffles and a stream bottom consisting of loose rubble, 0.5-4.0 inches in diameter. Parr prefer coarser bottom substrates in riffles or rapids at a depth of up to one meter.

The ASC estimates that the Narraguagus River has a total of 6,013 units (one unit = 100m²) of suitable spawning and rearing habitat (ASC, 2002) of which:

- 4,752 units are in the main stem,
- 393 units are in the West Branch, and
- 868 units are in the tributaries.

Habitat Prioritization

In 2002, the ASC developed a subwatershed prioritization mapping system that divides each watershed into subwatersheds based on the quality and quantity of available habitat and access to that habitat. The purpose of these maps is to provide guidance for the prioritization of watershed restoration and NPS projects. Based on the Narraguagus Priority Subwatershed Map (see Map 2.2), the three areas of highest priority in the river are: Area 1 - Outlet of Deer Lake to the outlet of Beddington Lake, Area 2 - Beddington Lake Outlet to Deblois Falls, and Area 3 - Deblois Falls to Little Falls.

3. WATER BODY AND LAND USAGE

3.1 WATER BODY USAGE: RECREATIONAL

River

Historically the Narraguagus River and its tributaries were used extensively for the lumber industry. The river was used to transport logs downstream to sawmills, and several dams were built along the river to create sawmill ponds. Today these dams have been removed and the river and its tributaries are used primarily for recreation. The river boasts an excellent canoe and kayak destination. Points of entry include the Stud Mill Road, Route 9 in Beddington, the inlet and outlet of Beddington Lake, Route 193 in Deblois, the confluence with Schoodic Brook, and the Sprague Falls Road in Cherryfield. The estuary is becoming a popular sea-kayaking destination with entry at the public landings in Milbridge and Cherryfield.

In addition, the river, its tributaries, and surrounding lands are used for the trapping of beaver, muskrat, mink, marten, otter, fox, coyote, and fisher. Hunting includes deer, moose, bear, waterfowl, and upland game birds. As stated earlier, the river is also used by fishermen seeking trout in the inland waterways and smelt and striped bass in the estuary.



While hunting, fishing, and small boating have extremely low NPS impact, the recent increase in ATV use for hunting and recreational purposes has created more serious NPS problems.

According to recent MDOC statistics, the number of riders, the number of roads, and the amount of miles traveled per day have all increased significantly. NPS pollution related to ATV use includes stream fording, stream bank erosion, shoulder erosion, and loss of vegetation (See Section 7.2).

Lakes

Beddington and Schoodic Lakes both have a high number of seasonal camps, which are possible sources of NPS pollution (sewage, phosphorous, and sedimentation). This may affect water quality for swimming and may contribute to increased water temperatures and possible algal blooms. Also, both Beddington and Schoodic Lakes and a few of the smaller lakes have high recreational use especially the use of motorboats, which may cause oil leaks and spills (see Section 7.10).

3.2 WATER BODY USAGE: COMMERCIAL/AGRICULTURAL

Today, the primary commercial use of the Narraguagus River, its tributaries, lakes, and ponds is as a source of irrigation water for the blueberry industry. The two major companies, Wymans and Cherryfield Foods, both withdraw water from numerous locations in the watershed. Excessive withdrawal can have serious effects on water quality (see Section 7.12).

3.3 WATER BODY USAGE: RESIDENTIAL

No body of water in the Narraguagus River Watershed serves as a source of public drinking water. The lower portion of the main stem of the river does receive treated and possibly untreated effluent from individual overboard discharge sewage systems (Cherryfield and Milbridge) and one municipal sewage treatment facility (Milbridge).

3.4. LAND USE INVENTORY

The area of the Narraguagus River Watershed is approximately 148,480 acres. Using information from the Project SHARE NPS database, land use in the watershed can be classified into four major categories: 1) small private landholdings (primarily residential), 2) timber management landholdings, 3) blueberry cultivation landholdings, and 4) public lands and roadways. The categories, primary landowners, amount of acreage, and percentage of the watershed are as follows:

Table 3.1. Land Use in the Narraguagus River Watershed.

LAND USE CATEGORY: PRIMARY LANDOWNER	APPROXIMATE ACREAGE	% OF WATERSHED
Timber Management:		
International Paper	82,900	56%
Other	10,000	7%
Blueberry Cultivation:		
Jasper Wyman & Son,	6,500	4%
Cherryfield Foods	500	<1%
Private Growers	500	<1%
Small Private Landholdings:		
* Actual land use unknown, mostly residential	41,080	27%
Public lands, roads, lakes, etc.	7,000	5%

Figure 3.1. Land Use in the Narraguagus River Watershed.



Land use in the watershed varies depending on the location. Timber management is the primary land use in the upper regions of the watershed: T34, T35, T28, T22, T16, T10, Devereaux Township, and Beddington (see Map 3.1). International Paper Corporation is the primary corporate landowner holding 82,900 acres of forested land in the upper watershed. NPS issues related to timber harvesting include erosion and sedimentation, poorly constructed or maintained logging roads, and loss of buffer in unregulated areas. These topics are discussed in more detail in Sections 7.3 and 7.8.

Blueberry barrens occur in Deblois, Beddington, T16, and T22. Jasper Wyman and Son own over 6,000 acres and Cherryfield Foods owns approximately 500 acres (see Map 3.2). Although the number of acres owned by smaller blueberry growers is unknown, it is estimated to be less than 1,000 acres. NPS issues related to blueberry cultivation include the use of pesticides and fertilizers, water withdrawal, and erosion and sedimentation from access roads. This topic is discussed in more detail in Sections 7.4 and 7.11.

Also in this region, is a peat harvesting operation. Located in Deblois and T22, Denbo heath is a source of peat that is processed as a retail and wholesale gardening product and as a wholesale fuel source. The major NPS issue associated with peat harvesting is the release of peat into area tributaries and the main stem of the river (see Section 7.7).

Small private landowners primarily in the towns of Cherryfield and Milbridge own the remaining 41,000 acres in the watershed. NPS issues related to residential and municipal development include sewage discharge, sand/salt discharge, erosion, and landfill leaching (see Sections 7.9, 7.6, and 7.15, respectively).

4. WATER QUALITY ASSESSMENT

4.1 CLASSIFICATION

The Narraguagus River and its tributaries are classified as Class AA, A, and B in accordance with the MDEP Water Classification Program (2001). The purpose of the Classification Program is to allow the state to manage surface waters "so as to protect the quality of those waters and, where water quality standards are not being achieved, to enhance water quality." The standards used to classify waters and the classification of waters in the Narraguagus River Watershed are listed below.

Table 4.1. MDEP Classification Standards

Water Quality Class	Biological Standards
AA	No direct discharge of pollutants; aquatic life shall be as naturally occurs.
A	Natural habitat for aquatic life; aquatic life shall be as naturally occurs.
B	Unimpaired habitat for aquatic life; discharges shall not cause adverse impact to aquatic life in that the receiving waters shall be of sufficient quality to support all aquatic species indigenous to the receiving waters without detrimental changes in the resident biological community.
C	Habitat for aquatic life; discharges may cause some changes to aquatic life, provided that the receiving waters shall be 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.

Classification of Waters in the Narraguagus River Watershed:

Class AA Waters in the Narraguagus River Watershed:

- Main stem between outlet of Eagle Lake and confluence with the West Branch
- West Branch
- Baker Brook
- Pork Brook
- Schoodic Brook
- Shorey Brook

Class A Waters in the Narraguagus River Watershed:

- All other tributaries entering the main stem above the confluence with the West Branch (e.g., Lawrence Brook, Crotch Camp Brook, Bobcat Brook, and Sinclair Brook)

Class B Waters in the Narraguagus River Watershed:

- Main Stem from the confluence with the West Branch to tidewater in Cherryfield
- All tributaries entering below the river confluence with the West Branch

4.2 ATTAINMENT STATUS

According to the MDEP 2000 Maine Water Quality Assessment Report (Draft, Unpublished), the Narraguagus River attains its legal water classification status, with the exception of McCoy Brook.

Located in Deblois, McCoy Brook drains Denbo Heath and flows approximately one mile to the southeast where it enters the main stem of the Narraguagus River. The headwater of the brook is impounded and serves as a settling basin for Worcester Peat peat-harvesting operations (see Section 7.7). Problems at McCoy Brook are related to a peat discharge incident occurring in 1993. Although the problem has been corrected, the peat is still present in the tributary and possibly in the main stem. McCoy Brook's non-attainment status is defined as "not attaining aquatic life standards" and is based on biomonitoring sampling conducted in 1993 and 1996 (MDEP, 1999). In addition, this segment appears on the Total Maximum Daily Loads List (MDEP, 1998) and as such, the state is required to develop control measures to assure attainment in the next 10-13 years.

Other Areas of Concern



Although, the majority of the Narraguagus River Watershed currently meets its legal classification status, sampling from several sites, such as McCoy Brook, Bog Brook, and Cherryfield Village, indicate possible attainment issues.

Sites within the watershed that indicate possible attainment issues, as well as those associated with McCoy Brook, are summarized in Table 4.2. The findings are based on five MDEP reports and unpublished data (See Table 4.2 Key below). These sites fall into three categories:

- 1) sites associated with peat discharge at McCoy Brook,
- 2) sites associated with sewage discharge in lower reaches,
- 3) sites not attaining aquatic life standards due to agricultural NPS, lake outlet effect, or sedimentation in the upper reaches of the main stem.

In 2001, MDEP conducted macroinvertebrate studies at three sites: Cherryfield, at the Rt. 1 Bridge; Deblois, above Rt. 193 bridge; and the West Branch, at Sprague Falls. The results of these studies will be available in Fall 2002 and should indicate any changes in the attainment status listed in Table 4.2.

Table 4.2. Attainment of Waterbodies in the Narraguagus Watershed

Waterbody	Location	Legal Class	Model Result	Description of Failure Pollution Source	Date	Reference
Bog Brook	Beddington: 0.5 km below dam	A	B	Does not attain aquatic life standards Lake Outlet Effect	1996	3
Narraguagus River	Deblois: above Rt. 193 bridge	AA	B	Does not attain aquatic life standards Agricultural NPS	1996	3
Narraguagus River	Deblois: 30 m above confluence w/McCoy	AA	A	Does not attain aquatic life standards Source Unknown	1993	3
McCoy Brook	Deblois: between peat bog & main stem	A	C	Does not attain aquatic life standards Peat Discharge	1993, 1996	2, 3, 4, 5
Narraguagus River	Deblois: 30 m below confluence w/McCoy	AA	A	Does not attain aquatic life standards Peat Discharge	1993	2, 3, 4, 5
Narraguagus River	Cable Pool	B	N/A	Regularly high E. coli count Residential & Industrial Discharge	2001 2002	1
Narraguagus River	Downtown: above Rt. 1 bridge	B	C	Regularly high E. coli count; does not attain aquatic life standards Residential & Industrial Discharge	'93, '96 '99, '01 '02	1, 3, 5

Reference Key:

- 1 - MDEP, 2001 & 2002, Maine Salmon Rivers Water Quality Monitoring Data (Whiting), Unpublished.
- 2 - MDEP, 2000, Section 305(b) Report: Maine Water Quality Assessment. Unpublished.
- 3 - MDEP, 1999, Biomonitoring Retrospective: Fifteen-Year Summary for Maine Rivers and Streams.
- 4 - MDEP, 1998, Section 303(d) Report: Total Maximum Daily Load (TMDL) Waters.
- 5 - MDEP, 1996, Section 305(b) Report: Water Quality Assessment

4.3 SALMON RIVER WATER QUALITY MONITORING PROGRAM

In response to the Maine Atlantic Salmon Conservation Plan, the MDEP instituted a water quality monitoring initiative in the eight Atlantic salmon rivers in 1999. The MDEP has sponsored and facilitated volunteer water quality monitoring in the Narraguagus River since 1999 and plans to continue for the next several years (see Map 4.1). MDEP staff and NRWC volunteers have collected information on dissolved oxygen, temperature, pH, bacteria, total suspended solids, pesticides, and nutrients. The following summarizes the data from 1999-2002 (Whiting, Unpublished).

Dissolved Oxygen

Within the watershed, dissolved oxygen (DO) generally ranges from 7.5 ppm to 11.5 ppm with the lower values occurring in the slower moving regions and in the tributaries, and the higher values occurring in the fast moving portion of the main stem. These values are well above the level considered stressful to coldwater fish (5 ppm) and most other organisms (3-5 ppm).

Although DO appears to be in sufficient quantity in the watershed, only a few sites have been sampled between 1999-2002. More sites need to be sampled in order to obtain a true representation of DO levels in a watershed this large. In addition, class A and AA waters may not have less than 7 ppm DO and it appears that several sites in the watershed are approaching this level. Again, more information and more samples are needed.

pH

Baseline pH measurements in the watershed typically range from 6.5 to 7.4 throughout the main stem and tributaries. However, while this range is sufficient for most aquatic organisms, it does not reflect the effects of occasional pulses in acidity that have occurred in several areas (Table 4.3). Several sites have experienced drops in pH (< 6.2) sufficient to effect salmon and other cold-water aquatic life (See Section 7.14). Preliminary analysis indicates that the baseline pH values for some tributaries are more acidic than the main stem suggesting a dilution effect in the main stem. For instance, the West Branch of the Narraguagus is more acidic and more humic than the main stem.

Higher "exchangeable" aluminum levels appear to be associated with the lower pH values. Many sites in the Narraguagus River Watershed have a significant amount of aluminum: 53 to 226 ug/L. Values greater than 300 ug/L are considered harmful to cold-

water fish. The highest aluminum values tend to be found in the smaller tributaries, especially those draining boggy areas. Some forms of aluminum are known to be toxic to a wide range of plant and animal species, including salmon. Aluminum may be washed out of forest soils due to natural processes or due to acid rain. At the observed pH ranges in the salmon rivers, aluminum is not thought to be a significant problem for fish health. However, brief acidic pulses may lead to conditions where aluminum could be converted to toxic forms.

Table 4.3. Acidic Pulses in the Narraguagus River Watershed.

LOCATION	pH	DATE
Main Stem at Route 193	5.78	9/18/1999
Bog Brook	5.84	7/26/2000
West Branch at Sprague Falls	5.52	12/18/2000
Main Stem at Cable Pool	6.19	5/6/2001
Pork Brook	5.17	3/14/2002
Baker Brook	5.35	3/14/2002
Bobcat Brook	5.34	3/14/2002
Humpback Brook	5.66	3/14/2002

Temperature

During the summer months the water temperature in the main stem of the river (Crane Camp and Little Falls) ranges between 18° to 25° C. Atlantic salmon are severely stressed whenever water temperatures are above 22.5° C (Elliot, 1991). If the exposure lasts for more than a few hours there is a deterioration of body condition. There has been no record of fish kills in the watershed due to extremely high water temperature despite record low water levels in 2001. This is most likely due to the presence of the cold-water springs that keep the water temperature moderate and provide a refuge for cold-water fish.

Bacteria

Recent samples collected in the lower reaches of the watershed (Cherryfield and Milbridge villages) indicate high *Escherichia coli* (E. coli) counts ranging from 17 to 365 colonies. Class B waters may not exceed a geometric mean of 64 colonies per 100 milliliters or an instantaneous level of 427 colonies per 100 milliliters.

The source of these bacteria appears to be improperly maintained septic systems in the villages of Cherryfield and Milbridge (see Section 7.9). In fact the shellfish beds in this area have been historically closed to clam digging because of high E. coli counts.

Total Suspended Solids

The amount of total suspended solids (TSS) in the river varies greatly from site to site. Most sites have a baseline TSS ranging between 1 to 3 mg/L. Stormwater samples from Little Falls have been as high as 6.7 mg/L and from the Raker's Registration site in Cherryfield Village as high as 19 mg/L. While both of these were one-time sampling events, they do indicate the need for increased monitoring of all sites during storm

events. Studies indicate that exposure to more than 6 days of 10 mg/L TSS is moderately stressful to juvenile and adult salmonids (Newcomb and Jensen, 1996).

Pesticides

In 1997, the MBPC began a survey of the Maine salmon rivers (see Section 7.11). Of 33 different pesticides or pesticide residues tested, only Hexazinone (Velpar) was detected in the rivers. Hexazinone was found in 19 of the 64 samples taken, and was only found in the Narraguagus, Pleasant, and Machias Rivers. The concentrations ranged from 0.1-1.7 ppb – well below standards for vertebrates and invertebrates (Chizmas, 1999).

The Narraguagus was resampled in 1999. Six of eleven samples from the Narraguagus (54%) were positive for Hexazinone (Chizmas, 2000). The MBPC report concluded that the pathway for Hexazinone into the salmon rivers is likely to be groundwater discharge since it is detected in the river year round, it is detected in many area wells, and it is water-soluble.

A cursory study of drift during aerial pesticide applications was also conducted during the 1999 field season. Hexazinone was found in 11 of 13 samples taken from the Narraguagus and Pleasant Rivers. The highest Hexazinone detection (3.8 ppb) also had some Terbicil (0.148 ppb).

In the 2000 field season, the MBPC concentrated on the detection of pesticide drift. Both Hexazinone and Phosmet were found in off-target areas on filter paper. Water samples were also analyzed. Hexazinone was found in most water samples taken near blueberry barrens. The insecticide Phosmet (Imidan) was found in three agricultural ponds that are tributaries to the Narraguagus and Pleasant River. The ponds are located immediately adjacent to blueberry fields and are used seasonally as sources of irrigation water. The ponds overflow in the spring but not in the summer. The concentrations of Phosmet in the ponds ranged from 0.08-0.52 ppb (Chizmas, 2001). All of these occurrences are well below levels considered toxic to humans and wildlife (see Section 7.11).

Nutrients

Total phosphorous in the river and tributaries usually ranges from 3.5 to 20 ppb. Areas within the watershed having higher than usual values of phosphorus include the main stem at Rout 9 with 22 ppb, the main stem at Route 193 with 24 ppb, and the Cable Pool with 24 ppb. Potential sources of phosphorous input include unpaved roads, exposed soils, and agricultural and home fertilizer use (see Section 7.10). Studies indicate that values approaching 30 ppb may contribute to increased plant/algae growth in aquatic systems (LaMotte Test Kit). These areas need more investigation to account for such high values. It is suggested that more storm water and periphyton samples be taken, especially in the tributaries.

4.4 LAKE WATER QUALITY

Most lakes in this area are oligotrophic, meaning that nutrient contributions are generally low. Most of the lakes have boulder-strewn bottoms and water clarity (sechchi disc measurements) ranging from 3.6 to 5 meters (DEP Lakes Data, Unpublished). Lakes

with readings between 4-7 m are considered moderately productive. Although the threat of severe algal blooms is rare, both Spruce Mountain and Beddington Lakes were listed as threatened by the MDEP in 1998 (MDEP, 1998). Spruce Mountain Lake was listed as threatened based on low dissolved oxygen and Beddington Lake has experienced at least one summer algal bloom. Although the lakes do not appear on the MDEP Total Maximum Daily Load (TMDL) List in 2002, the past listing indicates the need for monitoring and surveying for potential sources of nutrient loading. For more information on lakes and nutrient loading, see Section 7.10.

5. WATER QUALITY GOALS AND OBJECTIVES

The Narraguagus Watershed Management Plan Workgroup developed one major goal, to improve water quality, and two major objectives: 1) elimination of existing NPS problems and 2) prevention of future problems. Within these two general objectives there are several specific objectives that correlate with the many action items outlined in the Remediation Strategy (Section 10) and the Prevention Strategy (Section 11).

GOAL:

The goal of the Narraguagus River Watershed Management Plan is to

- ☐ maintain areas of high water quality,
- ☐ remediate areas of poor water quality and NPS pollution, and
- ☐ prevent future sources of nonpoint source pollution.



OBJECTIVE #1

Eliminate or reduce existing nonpoint sources of pollution:

- Develop an implementation strategy for NPS abatement of the 175 sites that have been documented between 1999 and 2002.
- Create partnerships with residents, businesses, and governments for cost-sharing opportunities for NPS abatement.
- Pursue financial resources necessary to implement site remediation.

OBJECTIVE #2

Prevent future NPS sources of pollution:

- Create a reference and guidance document for residential, commercial, government, and community decision makers.
- Continue water quality monitoring and NPS surveying.
- Encourage and support better commercial and community planning and more effective use of existing plans.
- Promote and support NPS best management practices on all sites.
- Increase public awareness, involvement, training, and advocacy with regard to watershed issues.

6. NPS INVENTORY AND ASSESSMENT

6.1 NONPOINT SOURCE POLLUTION SURVEYING

Surveying and documentation of NPS sites in the Narraguagus River Watershed have



Seven surveys were conducted between 1999 and 2001, and approximately 75% of the watershed has been surveyed to date. Collectively, the seven surveys documented over 175 NPS sites.

occurred since 1999 (see Table 6.1). Documentation of NPS sites includes GPS location information, site description, sketch, and photograph. In addition, each site is given a priority ranking (high medium, low) based on cost of repair, technical assistance required, and proximity to Atlantic salmon habitat.

Today the documentation of these sites exists both in their original paper format and in the Project SHARE NPS GIS Database in which the user can sort sites by type, landowner, location, agency, or date as well as view the sites on GIS maps with various land use information. The database and mapping system are designed to assist

land managers with prioritizing the sites for remediation and analysis. Map 6.1 illustrates the 175 sites documented between 1999 and 2001.

Table 6.1. History of NPS Surveying in the Narraguagus River Watershed

AGENCY/SURVEY TYPE	DATE	LOCATION
LURC/NPS	1999, 2000, 2001	Unorganized Territories
Project SHARE/DEP 319 NPS	1999	Milbridge, Cherryfield, T34, T35
Project SHARE/Riparian Buffer	1999	Salmon habitat throughout the watershed
NRCS & WCS&WCD/NPS	2000	Cherryfield Village
NRWC/DEP 319 NPS	2001	Beddington, Deblois, Cherryfield

Of the 175 sites documented between 1999 and 2001, approximately 50% of the sites have received some form of corrective action (see Map 6.2).

6.2 NPS SITES AND LAND USE

Figure 6.1 illustrates the 175 documented NPS sites as classified by land use. The sites are categorized by the land use associated with the documented problem and are described as follows:

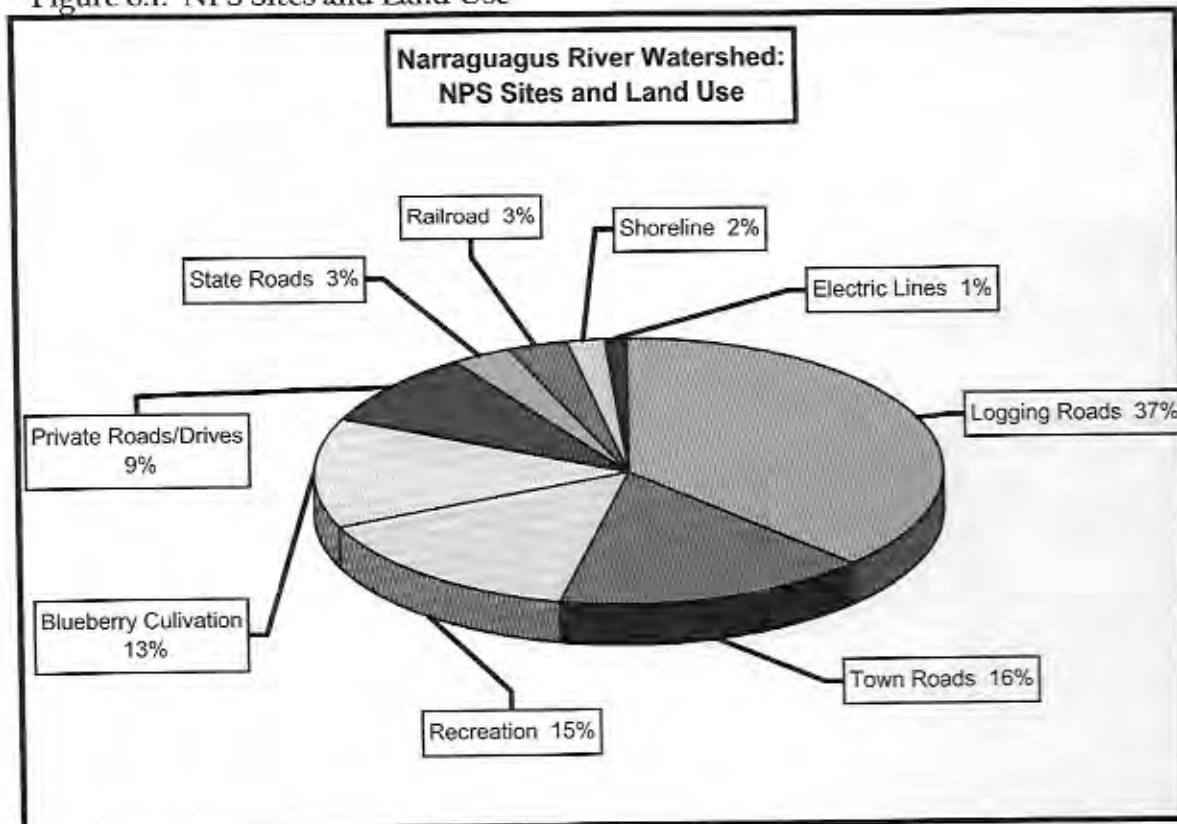
Logging

Approximately 37% of the documented sites are associated with poorly maintained logging roads on land owned by the area's major forest products industry, International Paper (IP). The problems on these roads include faulty culverts, poor ditching, road runoff, and unstable shoulders. One documented site is associated with timber harvesting and that is described as a thin buffer.

Town Roads

Approximately 16% of NPS sites are associated with roads that are owned and maintained by the towns. These sites include both paved and unpaved roads and problems include faulty culverts, poor ditching, road runoff, and unstable shoulders.

Figure 6.1. NPS Sites and Land Use



Recreation

Approximately 15% of NPS sites are associated with recreation. These sites occur on land owned by small private landowners as well as the two major commercial landowners, IP and Wymans. Problems on these sites include erosion from ATV and snowmobile trails and boat launches, stream fording, and bank erosion.

Blueberry Cultivation

Approximately 13% of NPS sites are associated with blueberry cultivation on land owned primarily by Jasper Wyman and Sons. The sites include thin buffers between areas under cultivation and waterways as well as poorly maintained access roads. The high percentage of NPS sites may be attributed to the many access roads connecting the fields.

Private Roads and Driveways

Approximately 9% of NPS sites are associated with private roads and driveways. These roads are generally unpaved and maintained by small private landowners. The problems on these roads include faulty culverts, poor ditching, road runoff, and unstable shoulders.

Railroad

Approximately 3% of the NPS sites are associated with the currently inactive railroad line that runs from Ellsworth to Calais and is maintained by the MDOT. Problems associated with the railroad line include unstable shoulders, pesticide drift and the recently constructed discharge which runs along the railroad line shoulder.

State Roads

Approximately 3% of the NPS sites are associated with state roads: Routes 1, 9, 182, and 193. The problems on these roads include faulty culverts, poor ditching, road runoff, sand/salt buildup, and unstable shoulders.

Natural Shoreline Erosion

Three documented NPS sites appear to be associated with subsidence in the estuarine portion of the watershed. It is unclear at this time whether the problem is natural or man-made. Further examination is needed.

Power Lines

Two sites are associated with a high-voltage power line that is owned and maintained by Bangor Hydro and which crosses the river in the town of Deblois. The power line lacks erosion controls and is a potential source of pesticide drift.

6.3 NPS SITES AND SOURCES OF POLLUTION

Classification of NPS sites based on the source of the NPS problem is illustrated in Figure 6.2. Most of the 175 documented sites have multiple sources of NPS pollution. For instance, a single site may have an unstable shoulder, faulty culvert, and poor ditching.

Bank Erosion

Approximately 30% of the sites exhibit some form of bank erosion or sedimentation. Some bank erosion may be natural but most is associated with poorly maintained roads, lack of riparian buffer, and lack of erosion controls.

ATV Trail Erosion

Approximately 23 % of the NPS sites are associated with ATV trails and include fording through streams, the creation of mud holes, lack of ditching, and poorly maintained bridges and trails.

Unpaved Roads

The greatest source of NPS pollution in the watershed is associated with private, commercial, and town unpaved roads (approximately 37%). This group can be further divided into more specific categories: faulty culverts = 13%, unstable shoulders = 12%, inadequate ditching = 5%, road runoff = 5%, and unstable bridge abutments = 2%.

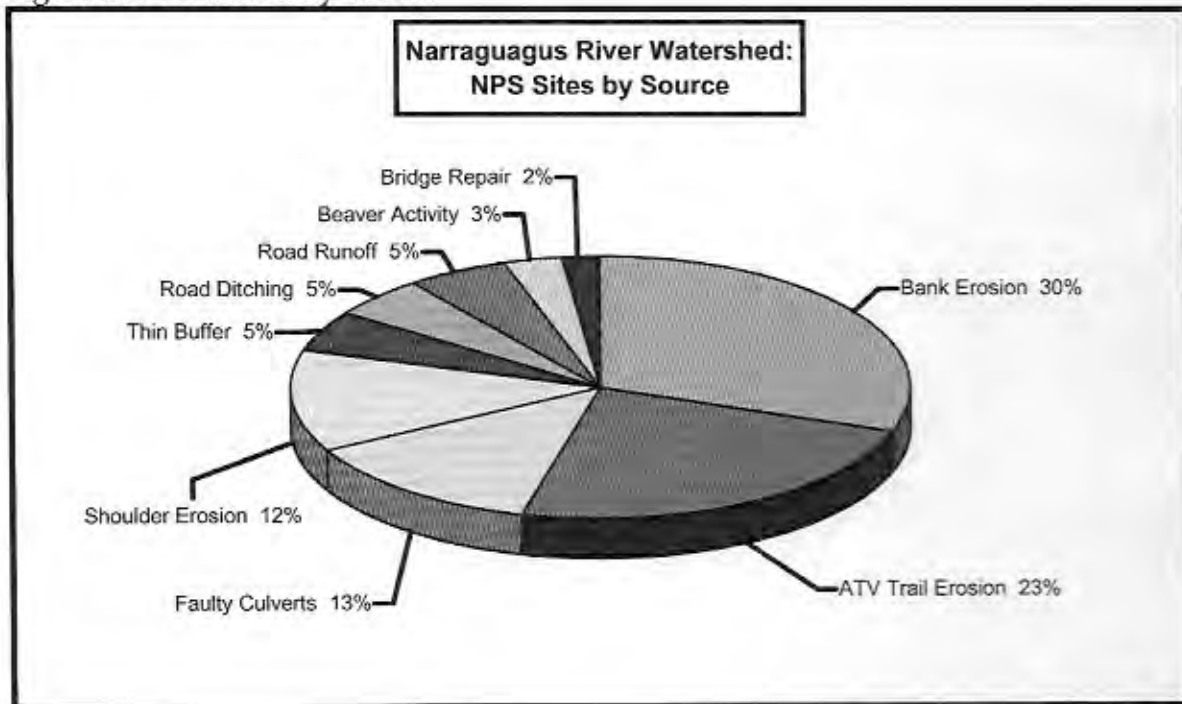
Riparian Buffer

Approximately 5% of the NPS sites are described as having a thin buffer. Thin buffers are documented primarily at agricultural and logging sites. The width of the buffer varies among sites but the best professional judgment of the surveyor was used in determining the buffer problems.

Beaver Activity

Approximately 3% of the NPS sites are described as being caused by beaver activity and include dams in culverts, under crossings, along the shore, and in the river or stream channel.

Figure 6.2. NPS Sites by Source



6.4 NPS SITES AND PRIORITY SALMON HABITAT

As mentioned in Section 2, the ASC has developed a subwatershed prioritization mapping system that divides each watershed into subwatersheds based on the quality and quantity of available habitat and access to that habitat. Classification of the 175 documented NPS sites based on their subwatershed location is illustrated in Table 6.2 and Map 6.3. The subwatershed with the greatest percentage of NPS sites (33%) is Subwatershed #1 (the headwaters and main stem between Deer Lake and Beddington Lake). The remaining sites are somewhat evenly distributed among the other freshwater subwatersheds. The estuary has a somewhat greater number of NPS sites (18%) due to the high number of faulty septic systems in Cherryfield and Milbridge village.

Table 6.2. NPS Sites and Priority Salmon Habitat

SUBWATERSHED LOCATION	PRIORITY	PERCENT OF NPS SITES
Deer Lk. Outlet to Beddington Lk. Outlet	1	33%
Beddington Lk. Outlet to Deblois Falls	2	11%
Deblois Falls to Little Falls	3	13%
Rock Dam to Sprague Falls	4	14%
Other Freshwater	5	11%
Estuary	6	18%

7. THREATS TO WATER QUALITY

7.1 SUMMARY OF THREATS

Some threats to water quality and forms of NPS pollution are clearly visible and easy to document, as in the case of erosion and sedimentation from poor road maintenance, peat discharge, and all terrain vehicle use.

Some sources of NPS pollution, however, are less visible and more difficult to document, as in the case of pesticide drift, faulty septic systems, and acid deposition. The first task undertaken by the NWMP Workgroup was to identify all of the potential threats to water quality in the Narraguagus River Watershed. The group identified 14 potential sources of NPS pollution in the watershed. Those sources that are clearly visible are documented in the NPS database of 175 NPS sites (Section 6). The less- visible sources are represented in the water quality data (Section 4).

After establishing the list of potential threats, the group then set forth each meeting to:

- a. investigate the cause of the water quality threat,
- b. understand the environmental consequences,
- c. develop a strategy for the remediation of existing NPS problems, and
- d. develop a strategy for the prevention of future NPS problems.

The following subsections are the results of this investigation and discussion. A table summarizing the environmental consequences of each type of NPS pollution is located at the end of this section (see Table 7.4). The Remediation and Prevention Strategy Tables are located in Sections 10 and 11, respectively.

7.2 ALL TERRAIN VEHICLE USE

Background

NPS pollution has increased in the watershed due to recent increases in All Terrain Vehicle (ATV) use and the number of ATV trails. MDOC 2001 statistics indicate that ATV use has increased significantly over recent years:

- ATV registration has increased approximately 10% every year for the last five years.
- There has been an increase in registration by out-of-state ATV users.

POTENTIAL THREATS TO WATER QUALITY

1. all terrain vehicle use
2. logging roads
3. blueberry roads
4. state/town roads
5. sand/salt facilities
6. peat harvesting
7. timber harvesting
8. faulty septic systems
9. phosphorous and other nutrients
10. pesticide drift and runoff
11. agricultural water withdrawal
12. beaver activity
13. acid precipitation
14. landfill seepage and runoff



- There has been an increase in ATV use as measured by the number of miles per month per user.
- The number of approved trails statewide has increased from approximately 700 miles in 1995 to approximately 2000 miles in the year 2000. The number of spur trails associated with camps and popular destinations has increased.
- The use of ATVs for other activities, such as hunting, fishing, and trapping has increased.
- ATV use during mud season has increased.
- Due to its open land policy, Washington County trails are experiencing increased usage by ATV users from other more-restricted states and counties.

Additional problems cited by landowners and concerned ATV users are a lack of information, lack of trail maps, and disrespect by many ATV users for the authorized trails.

Specific Sites in the Watershed

Approximately 23% of the documented NPS sites in the watershed are associated with ATV use. The specific problems include:

- stream fording in which vehicles drive through the streams and brooks disturbing the bottom sediment and eroding the banks,
- trails, which run parallel to the stream or river, or pass through spring holes thereby causing pooling and disturbing natural drainage,
- improperly created or maintained trail beds, shoulders, and ditches,
- the increased number of trails ultimately increases vegetation loss and erosion, and
- use of trails during mud season causes drainage problems.



NRWC

Environmental Consequences

- Increased sedimentation may lead to diminished water quality and loss of aquatic habitat.
- Increased number of trails reduces vegetation.
- Fording causes bank erosion.
- Compressed or rutted soil may cause lack of drainage and anaerobic conditions.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Repair the existing 26 ATV-related NPS sites over the next 3 years.
2. Sponsor the formation of a local ATV Club to assist with education and stewardship:

- Create stewardship/safety brochure.
 - Develop relationship with AMC/NPS Rivers and Trails Program
 - Establish "Trailwatchers" Program.
 - Conduct stewardship workshops.
3. Work with the MDOC to develop a better trail system:
- Develop local trail maps to promote the use of authorized trails.
 - Develop and install universal sign.
 - Reroute trails; deter the use of unauthorized trails.
 - Post trails during mud season.

7.3 LOGGING ROADS

Background

The high number of NPS sites associated with logging roads is indicative of the recent change in road maintenance management. Previously, IP, the major landowner, used "in-house" road crews to maintain its logging roads. More recently, however, the landowner is employing contractors to maintain roads. This change in policy has led to a breakdown in communication regarding sites and decreased accountability.

Since documentation of NPS sites began in 1999, the NRW, LURC, and Project SHARE have alerted the landowner to current problems. The landowner, with the assistance of state and federal cost-sharing programs, has repaired many of the sites. To date, repair evaluation, and maintenance are still needed.

Specific Sites in the Watershed

Approximately 65 NPS sites are associated with poorly maintained logging roads, specifically due to poor road construction or poor maintenance of older and currently-used logging roads occurring primarily in Townships 10, 16, 18, 22, 28, 29, 34, and 35. Specific problems include unstable culverts, unstable stream banks, surface and shoulder erosion, inadequate ditching, inadequate vegetation, and beaver dam construction in culverts.

Additional problems associated with logging stem primarily from the creation of skidder trails and the loss of vegetation near small tributaries. Although no such sites have been documented in recent years, recent changes in landholdings and transfers of property from one major landowner to several small landowners suggests a strong need for increased monitoring of harvesting operations near tributaries.

Environmental Consequences

(Reference: Stafford, 1996; Cormier, 1996)

- Loss of cover and poorly constructed and maintained roads increase erosion and sedimentation in tributaries and water-bodies. ➡
- The increased number of roads increases recreational use, which in turn increases erosion (NPS 319



Surveys 1999 and 2001; LURC Surveys 2000 and 2001).

- Loss of cover near water bodies and tributary crossings increases water temperature and causes thermal stress to organisms.
- Poorly constructed and unstable culverts create an obstruction to fish passage.
- The increased number of logging roads, culverts, and ditches encourages the creation of beaver dams ultimately causing a decreased water flow, increased water temperature, erosion, and river widening (319 NPS Survey 1999 and 2001).

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Work with landowner to repair the existing 60 sites associated with logging roads. The primary timber management landowner has agreed to pay for and repair the sites. Investigate cost-sharing funding.
2. Educate road contractors and landowners about proper logging and road-building BMPs. Sponsor training sessions for timber harvesting and road building.
3. Work with land trust organizations to develop boilerplate wording that addresses logging road and timber harvesting BMPs to be included in conservation easement contracts.
4. Encourage landowners to participate in the Sustainable Forestry Initiative (SFI), a program in which independent auditors police timber harvesting activities.
5. Advocate and encourage state-certified road-building training
6. Encourage landowners to use only state-certified road building and timber harvesting contractors.
7. Decommission roads where possible.

7.4 BLUEBERRY FIELD ACCESS ROADS

Background

There are over 6,000 acres of land in blueberry cultivation within the Narraguagus watershed. The landowners access these fields by way of a 200-mile network of unpaved roads and fire lanes. Most of the access roads are historic and very few new roads have been built in the last ten years. Unpaved agricultural access roads are potential sources of nonpoint source pollution in the form of runoff, erosion, and phosphorus loading.

Both of the major blueberry companies, Cherryfield Foods and Wymans, maintain an open access policy that allows the general public to use most of the access roads for recreational purposes such as hunting, fishing, snowmobiling, and ATV use. In addition, some of the roads provide access to neighboring businesses (e.g., Heritage Salmon Hatchery) and private camps.

In general, permits (from DEP or LURC) are required for new culvert placement, water crossing activity, and drainage of wetlands. Both agencies use the permit-by-rule process in which the landowners are granted a permit as long as they agree to abide by agency standards and rules. New access roads are inspected by the Washington County Soil and

Water Conservation District. Maintenance of the roads and culvert replacement do not require permits. Road maintenance activities include:

- raking to remove rocks,
- grading to eliminate or reduce washboards,
- regravelling to fill in and smooth out road surfaces,
- installing water bars to divert water off road surfaces,
- maintaining culverts over streams and brooks, and
- providing turnouts to provide passing opportunities to keep people from driving on blueberry fields and, secondarily, to serve as bee yards.

Specific Sites in the Watershed

There are approximately 21 NPS sites associated with agricultural access roads. Most of these sites are associated with poor road maintenance (faulty culverts, unstable shoulders, etc) but additional road problems include the use of 4-wheel drive vehicles, ATVs, and heavy-duty trucks during mud season. Vehicles using roads during mud season cause severe ruts and washboarding.

In addition, some access roads are located in biologically sensitive areas, such as Bog Brook and Bog Brook Flowage. The riparian corridor along Bog Brook has certain management restrictions. Wymans owns the adjacent property and has a written agreement with the IF&W for certain activities. Access roads located near irrigation ponds are also sensitive areas.

Environmental Consequences

Same as Logging Roads. See section 7.3.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Work with landowner to find cost-sharing opportunities to repair the 21 sites associated with blueberry field access roads.
2. Encourage the landowner to use BMPs specific for unpaved roads.
3. Conduct BMP training workshop.
4. Encourage landowners to follow DEP and LURC permitting guidelines and standards.
5. Conduct NPS survey of access roads to document sites of erosion, siltation, faulty culverts, and bank destabilization. Council could work with landowners to conduct the survey and to remedy the sites.
6. Encourage landowner to participate in cost-sharing and funding opportunities with state and federal agencies and council for future projects.

7.5 STATE, TOWN, AND RESIDENTIAL ROADS

Background

NPS sites on state, town, and residential roads occur primarily due to a lack of maintenance on existing roads or improper planning of new residential roads. Maintenance of town roads is a considerable part of any town's annual budget and too often road projects are not funded adequately enough to be effective. For example, a short

culvert may be less expensive than a larger culvert but may be inadequate to provide proper flowage and may cause erosion and fish-passage problems. Likewise, it may be cheaper to hire the less expensive non-certified ditching contractor but improper ditching may cause erosion, unstable shoulders, and ultimately road surface failure.

In a recent NRCS survey, soil scientists estimated that 133 tons of soil were lost per year from just 11 road-related NPS sites in the Narraguagus River Watershed (Garcelon, NRCS, Personal Communication, 2001). The figure not only represents soil loss and sedimentation, but nutrient loading and the transport of toxins into the waterways as well. It is also a reminder of the effectiveness of erosion control measures and best management practices. Good planning and careful management of land-use activities pays off in the long term and may result in lower maintenance costs, fewer work delays due to wet weather and washouts, fewer environmental consequences, and fewer permitting fines.

Specific Sites in the Watershed

There are approximately 48 NPS sites associated with state, town, or private roads. Approximately half of these sites occur on town roads. The problems include faulty culverts, poor ditching, road runoff, sand buildup, unstable shoulders, and erosion from bridge abutments. ➡

The towns of Cherryfield and Milbridge have far more roads than Deblois and Beddington, and therefore, have more NPS sites.

Environmental Consequences

Same as Logging Roads. See section 7.3.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Work with landowner and towns to find cost-sharing opportunities to repair sites.
2. Encourage the MDOT, residential landowners, and towns to use MDEP-certified contractors.
3. Conduct BMP training workshop specific for road building.
4. Encourage MDOT, residential landowners, and towns to follow MDEP and LURC permitting guidelines and standards by working with them on specific projects.
5. Encourage MDOT, residential landowners, and towns to use "Atlantic Salmon BMP Guidelines."
6. Encourage MDOT, residential landowners, and towns to conduct routine evaluation and maintenance of repaired NPS sites.



Don Kirshen, NOAA

7.6 SAND/SALT FACILITIES

Specific Sites in the Watershed

There are a total of six sand/salt storage facilities in the Narraguagus River Watershed.

Four facilities are town-owned and -operated and include Milbridge, Cherryfield, Deblois, and Beddington. The two other facilities are owned and operated by MDOT and are located on Route 182 in Cherryfield and Route 9 in Beddington (see Map 7.1).

All facilities have potential for environmental degradation due to the storage of materials in the open air. Salt from uncovered piles may potentially leach into the groundwater and into surface waters and agricultural fields. Additionally, sand may easily erode from the piles and enter local waterways causing increased sedimentation.

Summary of Area Sand/Salt Storage Facilities:

1. Milbridge
 - Located on School St. in Milbridge.
 - High priority site for town and council due to direct discharge into estuarine salmon habitat and the loss of vegetation.
 - Erosion and outwash was documented (Survey, 1999).
 - Salt is currently uncovered.
 - It is not considered priority by MDEP or ASC because salt is not considered a threat in the saltwater environment. As a result the town is unable to obtain grant funding.
 - Potential problem due to temporary storage of materials outside of shed
2. Cherryfield Town Facility
 - Located on North Street in Cherryfield.
 - Identified as a DEP Priority 1 Site due to location near salmon habitat and amount of discharge.
 - The salt and sand have been uncovered for decades and are washing directly into the river less than 50 feet away.
 - The town of Cherryfield currently recognizes the need for relocation and for a facility to cover the pile and is seeking funds to do so. Funding is pending.
3. Deblois Town Facility
 - Located on Route 193 in Deblois.
 - Medium priority site: covered by a shed but it is located within 100 yards of the main stem of the river and salt is often delivered and left exposed for sometime causing leaching
 - Potential problem due to temporary storage of materials outside of shed
4. Beddington Town Facility
 - Located on Route 193 in Beddington.
 - Low priority site: covered by shed and is not located close to waterbodies.
 - Potential problem due to temporary storage of materials outside of shed and proximity to river.
5. DOT Route 182 Cherryfield Facility
 - Located on Route 182 in Cherryfield

- High priority: situated on an aquifer, has an inadequate shed, is located near a tributary.
 - MDOT Level 2 Priority and is scheduled for repair/remediation in 2003.
6. DOT Route 9 Beddington Facility
- Located on north side of Route 9 in Beddington.
 - Medium Priority: located greater than 100 feet from river.
 - MDOT Level 3 Priority and is scheduled for remediation by 2005.

Environmental Consequences

- Eroded sand causes imbeddedness in salmon spawning gravel beds.
- Eroded sand causes siltation which can reduce clarity, increase water temperature, and reduce dissolved oxygen
- Erosion from sand piles causes loss of vegetation and possible bank destabilization.
- Increased levels of salt (sodium or calcium chloride) may cause loss of ionic balance in some fish.
- Increased salt causes loss of vegetation in



NRWC

neighboring areas subsequently increasing erosion.

- Salt may contain a toxic cyanide-based anti-caking agent.
- There is no current research being conducted on the effects of increased salinity on fish and other aquatic organisms but such research is currently being suggested by the USFW and UM.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

In general, the NPS problems associated with sand/salt piles can only be solved by creating appropriate facilities for the piles as well as ensuring that BMPs are upheld. There is a need for stronger training and enforcement of sand/salt storage guidelines and BMPs. New sources of funding for the sheds, especially in Milbridge where funding has been denied, might include traditional government funding sources. New sources include private funding sources and government funding sources for urban renewal or development.

Lastly, there is a need for increased water quality information. Baseline and storm event data related to salt discharge will support research and funding requests.

1. Work with towns to improve/upgrade sand/salt facilities. Find new locations and funding for the town of Milbridge and Cherryfield facilities.

2. Encourage the use of BMPs for towns that have sand/salt facilities but are not in compliance. Conduct/sponsor sand/salt BMP training.
3. Increase water quality monitoring of waterways associated with sand/salt facilities. Establish a volunteer coastal water monitoring program in Milbridge

7.7 PEAT HARVESTING

Background

Within the state of Maine, there are only two production peat bogs currently in operation. These two bogs are located in Washington and Hancock Counties: one in Centerville (Washington County, Pleasant River Watershed) and the other, Denbo Heath, which lies partially in the town of Deblois (Washington County) and partially in Township 16 (Hancock County). Denbo Heath is located within the Narraguagus Watershed and is owned and harvested by Worcester Peat Company (formally Downeast Peat).

With 540 harvestable acres, the Worcester Peat operation is currently the largest sphagnum peat operation in the Northeastern United States. The peat is harvested using the "milled peat method" in which the top 1-inch layer of peat is turned up and allowed to dry using a tractor-drawn miller and spoon harrower. The dried peat is collected into windrows and moved from field to carts and from carts to trucks where it is then transported to the plant in Deblois for processing. Peat harvested from the Denbo Heath may be packaged as a commercial gardening product or may be used at the Worcester Power Plant to produce electricity.

The draining of the Worcester Peat Bog (Denbo Heath) is managed by a series of ditches and sedimentation ponds. Within the bog there is a network of interior ditches that drain the bog surface and allow runoff. The interior ditches drain into a perimeter ditch that surrounds the bog and drains into several sedimentation ponds. All water from the ditches and sedimentation ponds drain into a holding pond at McCoy Brook in Deblois.

The sedimentation ponds are placed below the level of the bog to allow for adequate drainage and are designed to allow peat and suspended solids to settle out from drainage water. The ponds are cleaned out when accumulation of solids is less than or equal to 50% of the volume of the pond. Additionally, ditches are cleaned out and maintained to remove accumulated peat and ensure adequate flow of drainage water.

Environmental Consequences

(Reference for next four sections: Spencer-Famous, LURC, Personal Communication, 2002)
Peat may become a pollutant in three ways:

1. As a nonpoint source pollutant: Peat may become airborne at anytime during the harvesting operation and has the potential of traveling to waterways. Once in waterways, the peat, a plant product, generally degrades naturally. However, if large amounts of peat are allowed to become airborne at one time, the result could be excessive amounts of peat accumulating in fish-spawning habitat (clogged gravel beds). Additionally, if ditches are not maintained properly, runoff containing high amounts of peat may cause the same effect.

2. As a point source pollutant from ditches due to failure of containment dikes: In 1989 there were no sedimentation ponds and the perimeter ditch drained into the woods. During a heavy rain event, a significant amount of peat drained from the perimeter ditch on the north side of the bog and was discharged into the West Branch of the Narraguagus River. The drainage system was later redesigned to include sedimentation ponds and avoidance of future discharge.
3. As a point source pollutant from lack of containment at sedimentation pond: In 1996 containment dikes failed in ponds A-2, A-3, and B during a January heavy rain and snowmelt event. No evidence of peat deposits was observed but large amounts of contaminated water were discharged. This event indicates reoccurring dike weaknesses that were later repair (LURC Memorandum, Charles Corliss, January 31, 1996)

Sedimentation

Sedimentation in production bogs is affected by runoff patterns, mobility of particles, and the condition and design of the ditches and sedimentation ponds. Runoff patterns are determined by the age and type of bog, the type of peat, seasonality of operations and the local climate. Runoff tends to be higher during winter and spring, during the early years of bog development, and when the bog is saturated.

Peat particles have a tendency to be very mobile and the finer particles may not settle out in the sedimentation ponds but rather overflow into natural waterways during high precipitation events. Likewise, larger peat particles that contain trapped air may act the same. In order for peat to settle out from the drainage water or runoff, water flow in the ditches should not exceed 0.15 ft/sec.

The creation and maintenance of ditches and ponds certainly increases soil and peat disturbance thereby increasing sedimentation. Great care should be taken to ensure proper sloping, size, location, and timing of ditch and pond maintenance.

Potential Pollutants

The decomposition of peat releases a variety of minerals and nutrients into the environment. Increased amounts of N, K, Mg, Fe, Al, and DOC (dissolved organic carbon) have been observed in production bog effluent. In addition to increased nutrient levels, pH levels of 4 or less have been detected in some production bogs.

Water Quality of Contained Sedimentation Ponds

Water samples collected from the sedimentation ponds indicate significantly reduced water quality as compared to both upstream and downstream samples. Samples collected from the four sedimentation ponds had significantly lower pH, temperature, and dissolved oxygen, and significantly higher total suspended solids, specific conductivity, and iron.

These findings reveal the potential for a downstream water quality catastrophe in the event of containment failure in the sedimentation pond. Discharge or leaching of the sedimentation water, its toxins, and organic material would potentially destroy aquatic

organisms and their habitat in waterways downstream. The importance of proper impoundment maintenance cannot be overemphasized.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

Problems associated with peat harvesting are linked to the ditching and sedimentation pond plan:

1. Work with Worcester Peat to conduct surveys in drainage areas associated with the bog.
2. Work with Worcester Peat and MDEP to conduct water quality monitoring especially on the West Branch of the Narraguagus near the sedimentation pond.
3. Work with MDEP, LURC and Worcester Peat to develop BMPs. Guidelines specific to peat harvesting currently do not exist because there are only two operation sites in the state.
4. Work with landowner on cost-sharing projects that will help to ensure the integrity of ditching system and confinement dikes.

7.8 TIMBER HARVESTING PRACTICES

Background

Approximately 60% (92,000 acres) of the Narraguagus River Watershed is under forest management. International Paper (IP) owns approximately 82,900 acres and smaller companies own an additional 10,000 acres. The IP ownership is comprised of 41% softwood types, 27% mixed wood types, and 23% hardwood types. Approximately 1% is managed agricultural land (blueberries). The remaining 8% of the ownership includes natural water acres, wetlands, barrens, unforested acres (ledges, etc.), gravel pits, utility corridors, roads, and leased acres (primarily recreational camps).

Specific Sites in the Watershed

There are currently no documented NPS sites associated with timber harvesting in the Narraguagus River Watershed. The lack of documented sites may be due to several reasons:

- Timber harvesting activities may not be occurring in or near waterbodies.
- Timber harvesting activities may not have occurred concurrently with surveying efforts.
- Surveying efforts may not have focused on harvested areas.

Although there are no documented sites, timber harvesting is currently taking place in the watershed. The exact amount and location of timber harvesting activity is difficult to ascertain since landowners and harvesters are not required to submit specific information. Two estimates are available at this time:

1. The 1997 Atlantic Salmon Conservation Plan indicates that 11%, or approximately 14,000 acres, of the watershed was harvested between 1990 and 1994 (MASTF, 1997).
2. According to Maine Forest Service harvesting notifications, approximately 30,454 acres were harvested between 1998 and 2002 from the eight organized towns and eight townships in the watershed (Personal Communication, Paul Perry, MFS).

2002). It should be noted, however, that in the case of towns/townships that overlap two watersheds, it is unknown how much harvesting took place in the Narraguagus Watershed and how much took place in adjacent watersheds (i.e., Tunk, Union, Pleasant, Machias).

Riparian Forest Management

Thin buffers occur in the watershed as a result of heavy harvesting and spruce budworm salvage operations that took place 10-20 years ago. The lack of adequate buffer adjacent to waterbodies causes increased erosion, sedimentation, and pesticide drift. Protecting forested waterways during timber harvesting and other forest management practices depends on an effective Riparian Zone Management Plan. The MSPO has developed the "Method to Determine Optimal Riparian Buffer Widths for Atlantic Salmon Habitat Protection" (Kleinschmidt Associates, 1999) in order to assist land owners and conservation organizations in making better decisions for protecting critical Atlantic salmon habitat. IP has adopted a similar plan and it is summarized in the following table. All landowners should be encouraged to follow this plan as well as the state's minimum standards under the Shoreland Zoning Laws and Forest Practices Act.

Table 7.1. International Paper Riparian Zone Forest Management Plan.

	First-Order Streams	Second-Order Streams	Third-Order Streams	Fourth-Order (and Higher) Streams
Significance	Source of cold water, organic material. Usually not good fish habitat but important for downstream fish habitat. High water quality.	Same as First Order	Good fish habitat. Some recreational value. Good water quality.	Excellent fish habitat. Highest plant and animal diversity. High recreational value. Often only good to fair water quality.
Width of Protected Zone	100 feet on each side of stream.	100 feet on each side of stream.	330 feet on each side of stream.	660 feet on each side of stream.
Protection Objective	Only 30% forest removal permitted. Maintain shade, cool water temperature, organic material supply, stable banks and root systems.	Same as First Order	Same as First and Second-Order. Provide crown for mammal mobility, shade, and overhead cover fish. Leave snag/den trees.	Same as First, Second and Third-Order. Accommodate songbird habitat. Maintain high quality fish and wildlife habitat. Accommodate recreational uses.

Pesticides and Timber Management

Outside of the riparian zones, the pesticides, Garlon (Tricyclopyr) and Accord (Glyphosate) may be sprayed to suppress hardwood growth. Generally, these herbicides are sprayed once a year for about two years. Since the harvest frequency is about 35-40

years for pulpwood and 60 years for saw logs, the spray frequency is no more than twice in that period. Furthermore, selective harvests generally do not require sprays to accomplish softwood regrowth objectives. Sprays are generally only used on clearcuts or other special applications (Whiting, 2002). Other landowners have similar management practices that include some herbicide use.

Insecticides were used during the spruce budworm outbreaks in the late 1970's through the mid 1980's. Sevin, Dylox, and Orthene were used during the early part of the outbreak, but were replaced with a *Bacillus thuringiensis* spray (see Section 7.11) in the salmon river watersheds by the end of the outbreak (Whiting, 2002). Insecticides have not been used since the spruce budworm outbreak for timber management, including hemlock looper outbreaks in the 1990's and in 2001.

Environmental Consequences

From Stafford, et al, 1996:



- Studies at logging sites indicate that higher levels of fine sediment collect in gravel pools subsequently degrading fish and invertebrate habitat.
- Erosion and sedimentation increases in association with thin buffer, skid trails and haul roads in steep terrain and saturated soil.
- Reduction of canopy increases water temperature.
- Forest removal alters the nitrogen cycle resulting in higher nitrate concentrations in nearby waterways.
- Disturbed soil increases phosphorus release.
- Forest removal alters the ionic balance of the soil thereby altering the pH.
- Total salmonid biomass was significantly lower downstream from forestry-related activities.
- Logging/crossing tributaries disrupts fish habitat.
- Loss of salmonids and salamanders are associated with harvesting-related temperature increases.
- Pesticides used to suppress hardwoods and to protect young trees from insect and disease in the early years of rotation may drift and runoff into nearby waterways and/or seep into ground water.
- Loss of vegetation may cause changes in local hydrology such as increased soil-surface evaporation or increased surface runoff.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Focus surveying efforts on areas being harvested and time surveying to occur during or immediately after harvesting.

2. Increase Water Quality Monitoring to include timber harvesting sites before, during, and after harvesting in order to quantify/document the effects of harvesting.
3. Encourage landowners and community members to use SFI (see section 7.3) for reporting improper timber harvesting practices.
4. Find funding and technical assistance to encourage protection of tributaries and the use of portable skidder bridges. ➡
5. Encourage smaller landowners to adopt a Riparian Zone Management Plan.
6. Work with the Maine Forest Service and all landowners to encourage/implement/fund timber harvesting BMPs.
7. Conduct riparian plantings in thin buffer areas.



David Kirtledge, U Mass

7.9 SEPTIC SYSTEMS

Background

Nonpoint source pollution from sewage disposal systems is caused primarily by septic system failure and the subsequent discharge of untreated wastewater and household toxins into the watershed. Untreated wastewater may contain bacteria known as fecal coliform, which may result in shellfish bed closures, swimming restrictions, contaminated drinking water and disease-bearing pathogens hazardous to other warm blooded organisms.

Within the Narraguagus watershed, three types of sewage disposal systems exist: on-site subsurface wastewater disposal, on-site overboard discharge (OBD), and municipal wastewater treatment. While all three systems have the potential to contribute untreated sewage to the watershed, on-site overboard discharge systems pose the greatest threat to water quality. Overboard discharge systems are designed to allow treated wastewater to enter the river directly from individual sites. They are used on properties that do not have enough land to build a subsurface (tank and leach field) system. Their design requires the property owner to periodically place chlorine tablets into a treatment chamber so that bacteria are killed before entering the waterway. The OBD presents two water quality problems: 1) untreated wastewater enters the waterway when the property owner fails to use the chlorine tablets (evidence indicates that this occurs often) and 2) chlorine from the tablet enters the waterway and can potentially harm wildlife and humans.

Specific Sites in the Watershed

The only wastewater treatment facility in the watershed is located in Milbridge and serves 165 homes and businesses in the village. There are a total of 42 OBDs in the watershed: 3 residential OBDs in Milbridge village and 39 residential OBDs in Cherryfield village (see Map 7.2). The remaining properties in the watershed have on-site subsurface systems composed of septic tanks and leach fields.

There is direct evidence of septic system failure in the villages of Cherryfield and Milbridge. Water samples collected in the Narraguagus River during August 2001 indicated high concentrations of *E. coli*. Samples taken from the Cable Pool, above Cherryfield village contained 7.4 colonies per 100 ml while samples taken from the village contained 365.4 colonies per 100 ml. For reference, a mean of 49 colonies/100ml closes a shellfish bed and a mean of 100 colonies/100ml requires swimming restrictions. Shellfish beds from the head of tide in Cherryfield south to the Route 1A bridge in Milbridge have been historically closed for this reason.

Both the towns of Cherryfield and Milbridge recognize the problems and are actively pursuing solutions. The town of Milbridge has employed a shellfish engineer charged with monitoring sites and conducting surveys to locate failing systems. The town of Cherryfield has recently hired consulting engineers to develop wastewater disposal options. Options include the development of a municipal water treatment facility and the gradual replacement of individual OBDs with alternative systems under MDEP's small community block grant.

There has been little water quality monitoring for *E. coli* in Deblois, Beddington, and surrounding townships so the status of those waterways is currently unknown. The increased development on the lakes and ponds in that area, however, strongly indicates the need for increased monitoring.

Environmental Consequences

- Properly maintained OBD systems release chlorine into the watershed. Studies indicate that chlorine may have an adverse affect on salmon and other cold-water fishes. According to DEP Water Classification Program, the recommended limit for most fishes is < 0.003 mg/l of chlorine.
- Improperly maintained OBD systems and failed septic systems release untreated sewage containing fecal coliform bacteria.
- Properly and improperly maintained OBD systems release nutrients into the watershed.
- Properly and improperly maintained OBD systems release household hazardous chemicals into the watershed. The hazardous chemicals can be toxic to the plants and animals.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

Prevention and remediation of NPS problems related to wastewater disposal are dependent upon four primary actions: 1) replacement of existing failing systems, 2) monitoring existing and new water quality sites in the watershed, 3) regular surveying of

properties adjacent to water bodies, and 4) educating the public and town officials about prevention.

1. Establish volunteer coastal water quality monitoring program focusing on suspected faulty systems. Increase the amount of sampling and the number of sites sampled.
2. Establish lake water quality monitoring program. Little is currently known about sewage discharge from lake front properties.
3. Increase public awareness:
 - Produce a pamphlet on how to maintain a non-polluting septic system.
 - Produce pamphlet on alternatives to household chemicals.
 - Alert community to closures due to high coliform counts.
 - Conduct hazardous chemical pick up day.
4. Conduct more frequent OBD inspections. Pay plumbing inspector to inspect systems and/or divert state inspection fee back to town.
5. Replace or upgrade current faulty systems. Work with town government to obtain funding and research alternative systems.

7.10 PHOSPHORUS AND AGRICULTURAL FERTILIZERS

Background

Phosphorus is a naturally occurring plant nutrient that readily binds to soil particles. In an undisturbed environment, phosphorous is tightly bound by soil and organic material for eventual use by plants. Phosphorus enters the watershed when precipitation events or snowmelt washes exposed soil particles into a waterway. Increased phosphorus loading may cause an increase in algal and aquatic plant growth that may ultimately result in a decline in water quality.

Sources of phosphorus within the Narraguagus River Watershed include:

1. Erosion of exposed soils from unpaved roads and trails.
2. Exposed soils and erosion from construction, development, and logging sites.
3. Animal/Human Wastes
4. Agricultural (Blueberry) and Lawn Fertilizers
5. Detergents

All land disturbances and development increase the amount of naturally occurring phosphorus in the waterways. In addition, man-made phosphorus enters the watershed in the form of detergents and fertilizers. With the increase in phosphate-free detergents available on the market, it is expected that detergent phosphorus will gradually decline over time. However, the expansion of blueberry cultivation and management in the past two decades has led to increased phosphorus and nitrogen fertilizer use.

Fertilizers used in blueberry cultivation include mono- and diammonium phosphates, and aqueous solutions of ammonium polyphosphates. These compounds are applied in late spring either as a liquid or in pellet form and have the potential to enter water bodies during precipitation events. The likelihood of the fertilizer entering a waterway is reduced, however, if farmers avoid application during or immediately before a possible rain event, or if the fertilizer is applied to coarse textured soils typical of local blueberry

barrens, where infiltration rates are high. If the fertilizer is allowed to degrade slowly (without runoff from a rain event) it will move downward into the soil where it adheres to soil particles and is ultimately absorbed by the plants.

Most commercial growers participate in some form of leaf tissue sampling for nutrient analysis and fertilizer recommendations. Leaf tissue samples are taken during tip die-back, which occurs in mid-late July of the nonbearing year. The sample is tested for micro- and macronutrient levels and fertilizer recommendations are made to the grower. Growers who typically apply maintenance levels of phosphorus may continue to apply it despite recommendations to the contrary when their goal is one of trying to maintain base levels of the nutrient in the plants. In the acidic soils typical of local blueberry fields, most of the applied phosphorus is of limited availability to the plants and is normally not subject to leaching because of the formation of insoluble iron and aluminum phosphates in the soil.

Specific Sites in the Watershed

Phosphorus is regularly measured in water samples taken from a variety of sources in the watershed. To date there are phosphorus data from the following locations: Beddington Lake, Schoodic Lake, Spruce Mountain Lake, the Cable Pool on the main stem of the Narraguagus River, the West Branch of the Narraguagus River, and a few tributaries.

Average total phosphorus values and maximum and minimum values are given in Table 7.1. Most samples were collected as baseline samples and are not associated with a precipitation event. (For a more complete set of data, visit the MDEP PEARL website at <http://pearl.spatial.maine.edu/>) According to the MDEP, the average total phosphorus concentration for lakes in the state of Maine is 14 ppb.

Table 7.1. Phosphorus Sampling in the Narraguagus Watershed

WATER BODY	MAX TOTAL P (ppb)	MIN TOTAL P (ppb)	AVERAGE TOTAL P (ppb)	PHOSPHOROUS NUMBER (kg/ppb)
Beddington Lake	18	1	10	159.4
Schoodic Lake	51	1	11	10.5
Spruce Mountain Lake	26	1	8	7.4
Cable Pool (River)	24	11	15	-----
West Branch (River)	21	15	18	-----

Each lake is also modeled to estimate the amount of phosphorus it would take to raise the lake's phosphorus concentration by 1 ppb. This is known as the "Phosphorus Number" and is based on the lake's depth and flushing rate. The modeled Phosphorus Number for Beddington Lake is a relatively high value and, as such, is considered less sensitive to increased phosphorus input. It would take an addition of 159.4 kg of P in the lake to increase the concentration by 1 ppb. Schoodic and Spruce Mountain Lakes, however, have relatively low numbers (10.5 kg/ppb and 7.5 kg/ppb, respectively) because of their lower flushing rates, indicating that they are more sensitive to phosphorus loading (Personal Communication, Bouchard, Whiting, MDEP, 2001).

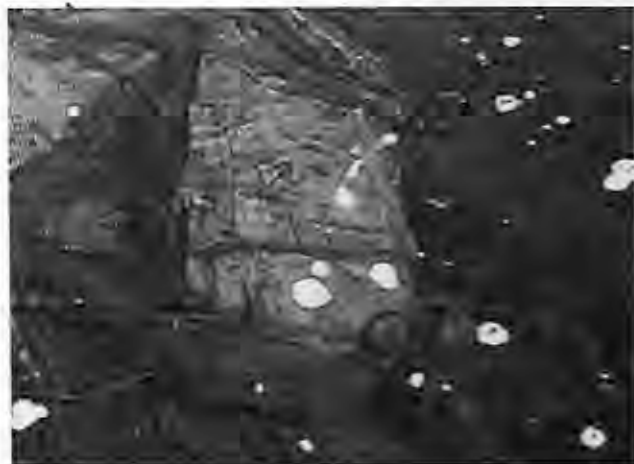
According to MDEP, the data from these sites indicate that lake phosphorus levels are moderate as compared to other lakes in the state. The TMDL Listing however, indicates that Spruce Mountain Lake was listed (1998) as threatened based on low dissolved oxygen and Beddington Lake has experienced at least one summer algal bloom. The listing of these lakes on the TMDL indicates the need for more investigation into the source of nutrient loading.

There is little information regarding phosphorus loading in rivers, and there is no modeled Phosphorus Number for rivers as there is for lakes. The LaMotte water chemistry kit contends that phosphate in excess of 30 ppb will contribute to increased plant growth in aquatic systems. Areas in the watershed having higher than usual values of phosphorus include Sinclair Brook at 29 ppb and the Cable Pool at 24 ppb. Both of these locations have the potential to experience isolated blooms of periphyton (algae that adheres to a substrate). There is some anecdotal evidence indicating the occurrence of such blooms in the watershed but more studies are needed.

Environmental Consequences

Increases in phosphorus, particularly in shallow lakes and slow moving water with low flushing rates, may result in:

- increased algal populations, in the form of algal blooms and periphyton, →
- increased aquatic weed growth,
- increased algal and plant decomposition, which subsequently depletes dissolved oxygen,
- a decline in water transparency, which reduces the photic zone, affects water temperature, and may alter habitat conditions,
- the eventual loss of cold-water fish and other sensitive animal species from lack of oxygen, and
- a possible shift from cold-water species to warm-water species.



MDEP

NPS Prevention and Remediation Strategy

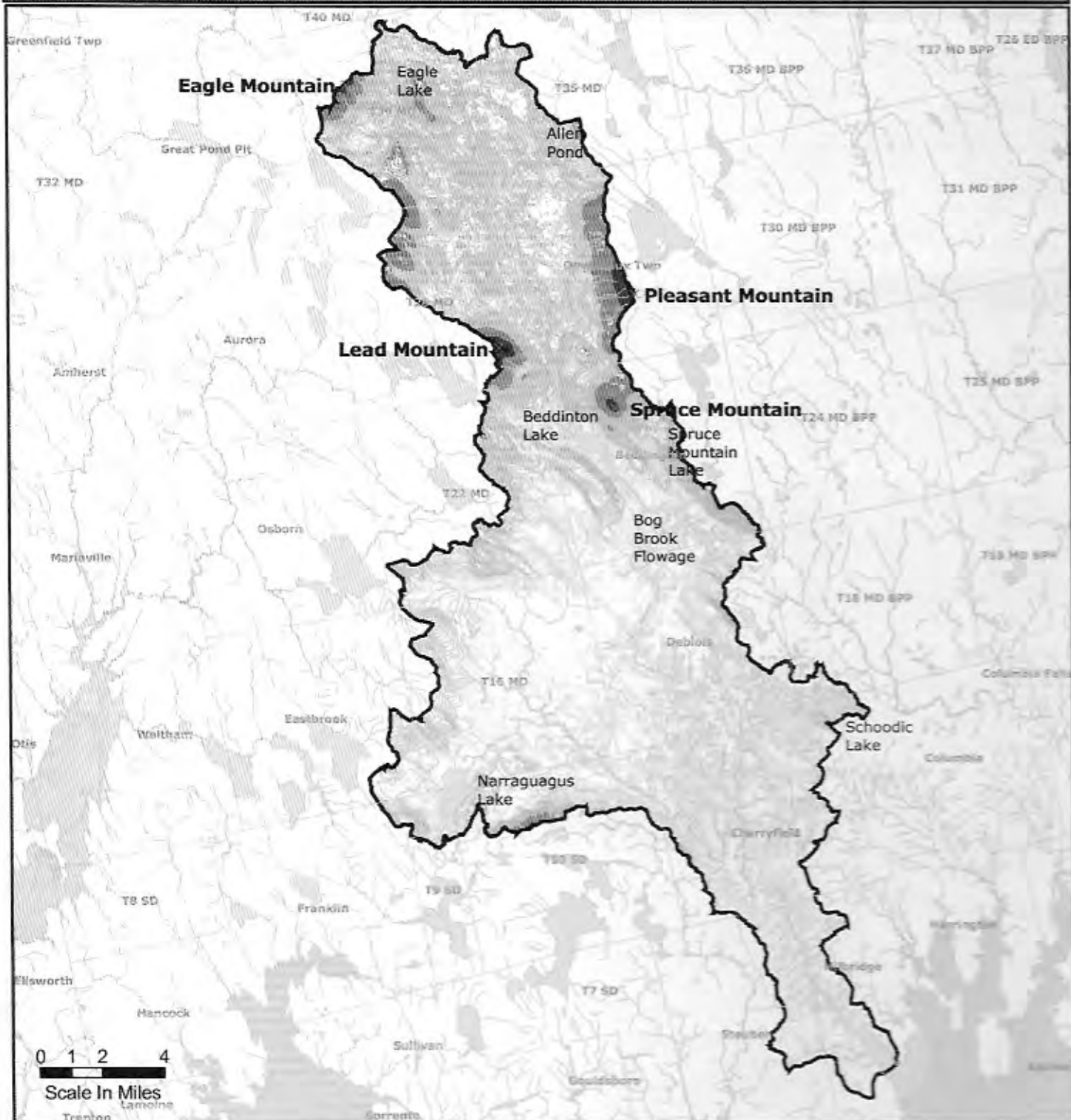
(See Sections 10 and 11 for more details)

1. Disturbed sites and exposed soil are potential sources of phosphorus. Work with landowners to repair sites and include revegetation and sufficient buffer strips to prevent overland flow at each site.
2. Best management practices for commercial agriculture fertilizer use are well published in the blueberry and cranberry growers' guides (UM Cooperative Extension). The Council/Project SHARE can work with landowners to encourage the use of BMPs. Provide technical assistance and workshops. Find cost-sharing programs to help landowners pay for BMPs.

APPENDIX

MAPS OF THE
NARRAGUAGUS
RIVER
WATERSHED

Map 2.1 Major Landmarks and Elevations



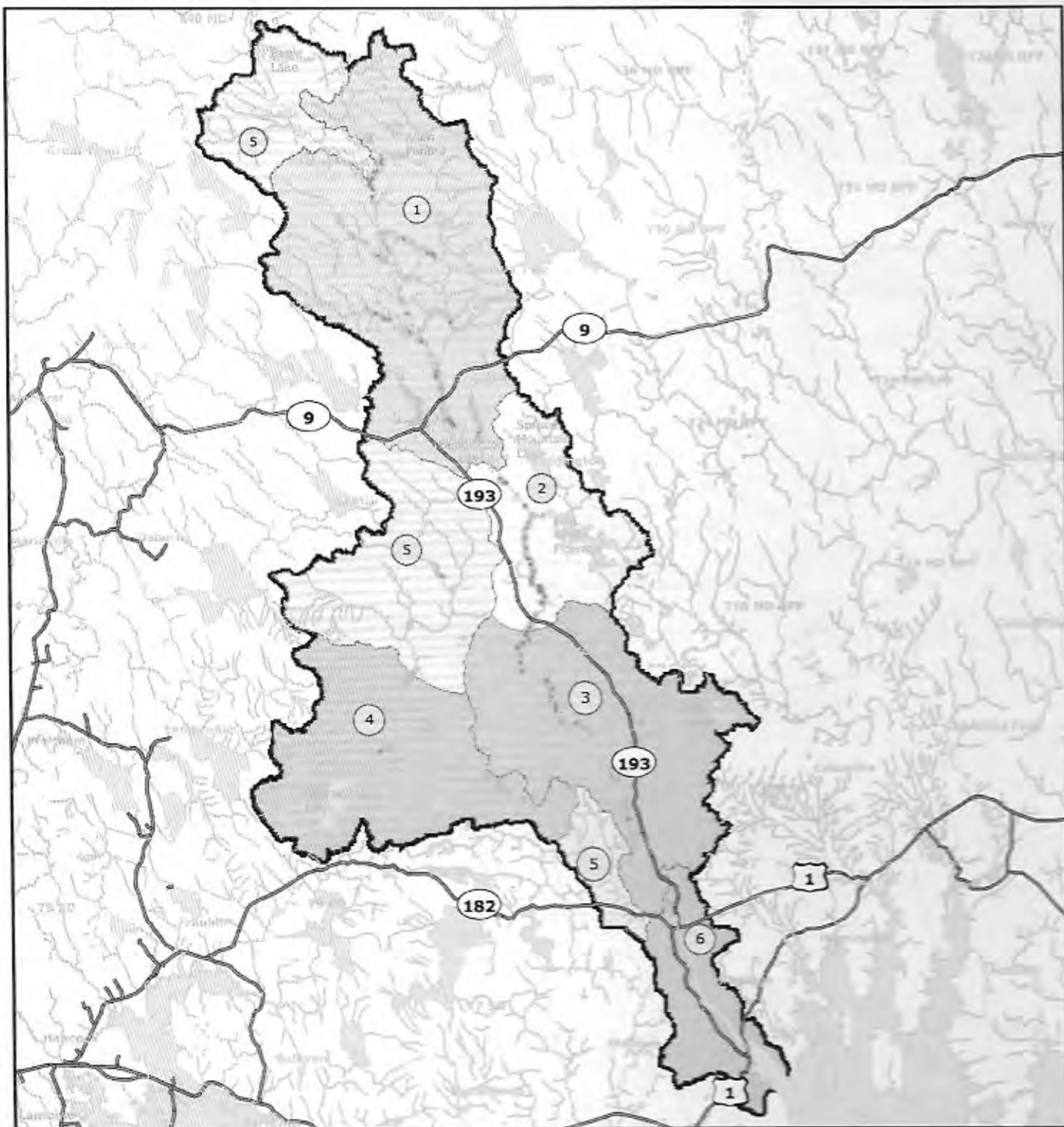
- | | | |
|---|--------------------|------------------|
| × | Mountain Peak | |
| — | Rivers & Streams | ELEVATION |
| — | Lakes & Ponds | 0 - 300 |
| — | Town Line | 301 - 600 |
| — | | 601 - 900 |
| — | | 901 - 1200 |
| — | | 1201 - 1500 |
| ⬮ | Watershed Boundary | |

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

Map provided by:
Torrey R. Sheafe for Project SHARE
Data provided by:
US Fish & Wildlife Service, Gulf of ME Project
Atlantic Salmon Commission
Maine Office of GIS
Revised November 2002



Map 2.2 Atlantic Salmon Priority Watersheds



Priority Subwatersheds (ASC 2002)

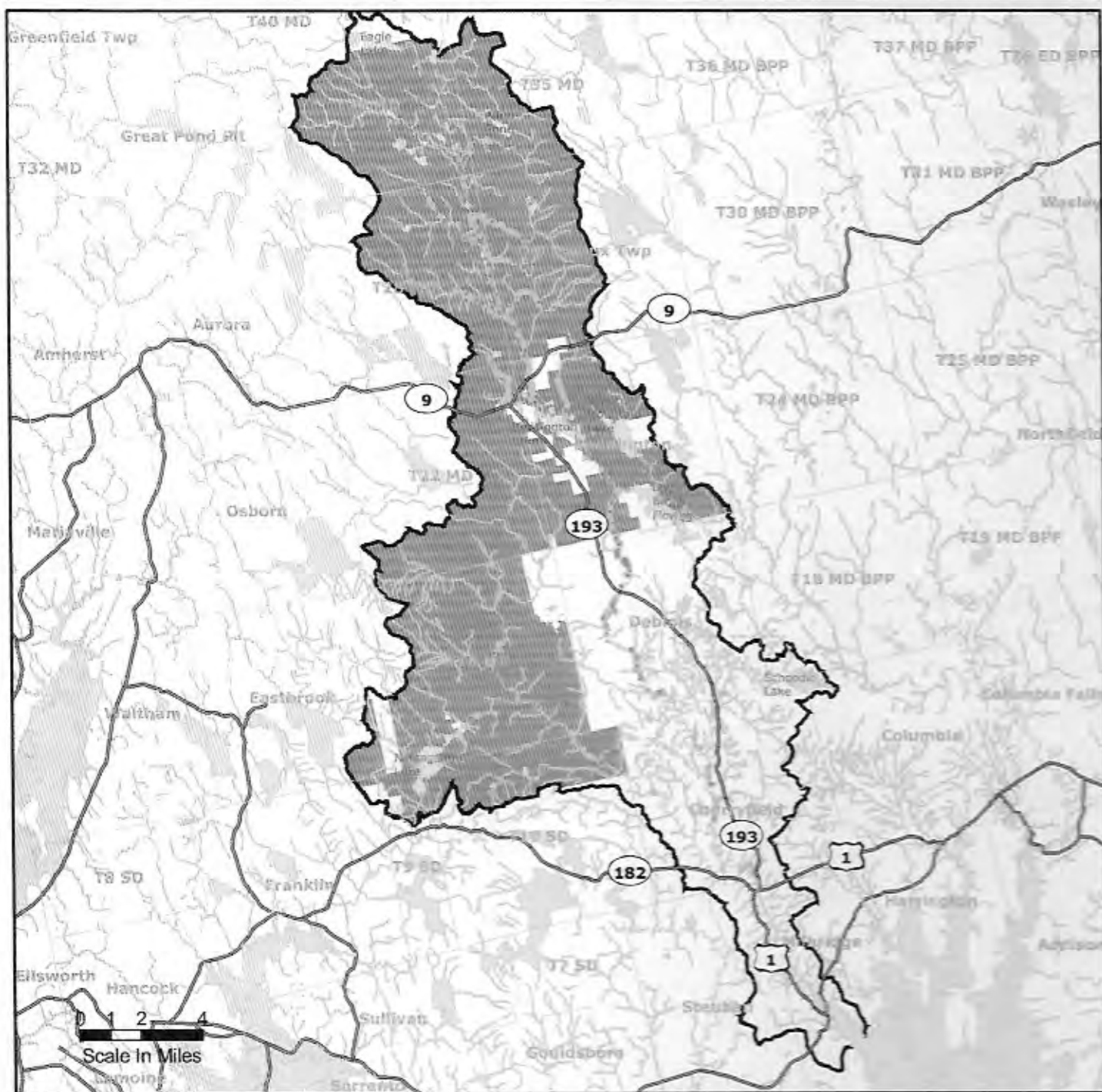
- | | | | |
|--|---|--|--------------------------|
| | 1 Deer Lake Outlet to Beddington Outlet | | Rivers & Streams |
| | 2 Beddington Outlet to Debris Falls | | Spawning Habitat |
| | 3 Debris Falls to Little Falls | | Juvenile Rearing Habitat |
| | 4 Rock Dam to Sprague Falls | | Lakes & Ponds |
| | 5 Other Freshwater | | Town Line |
| | 6 Estuary | | Watershed Boundary |

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Map 3.1 Lands Under Timber Management



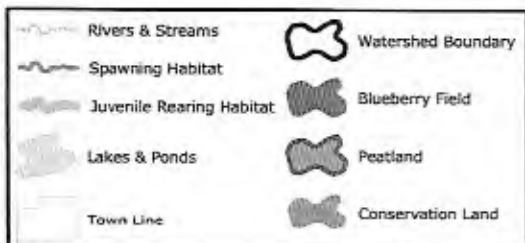
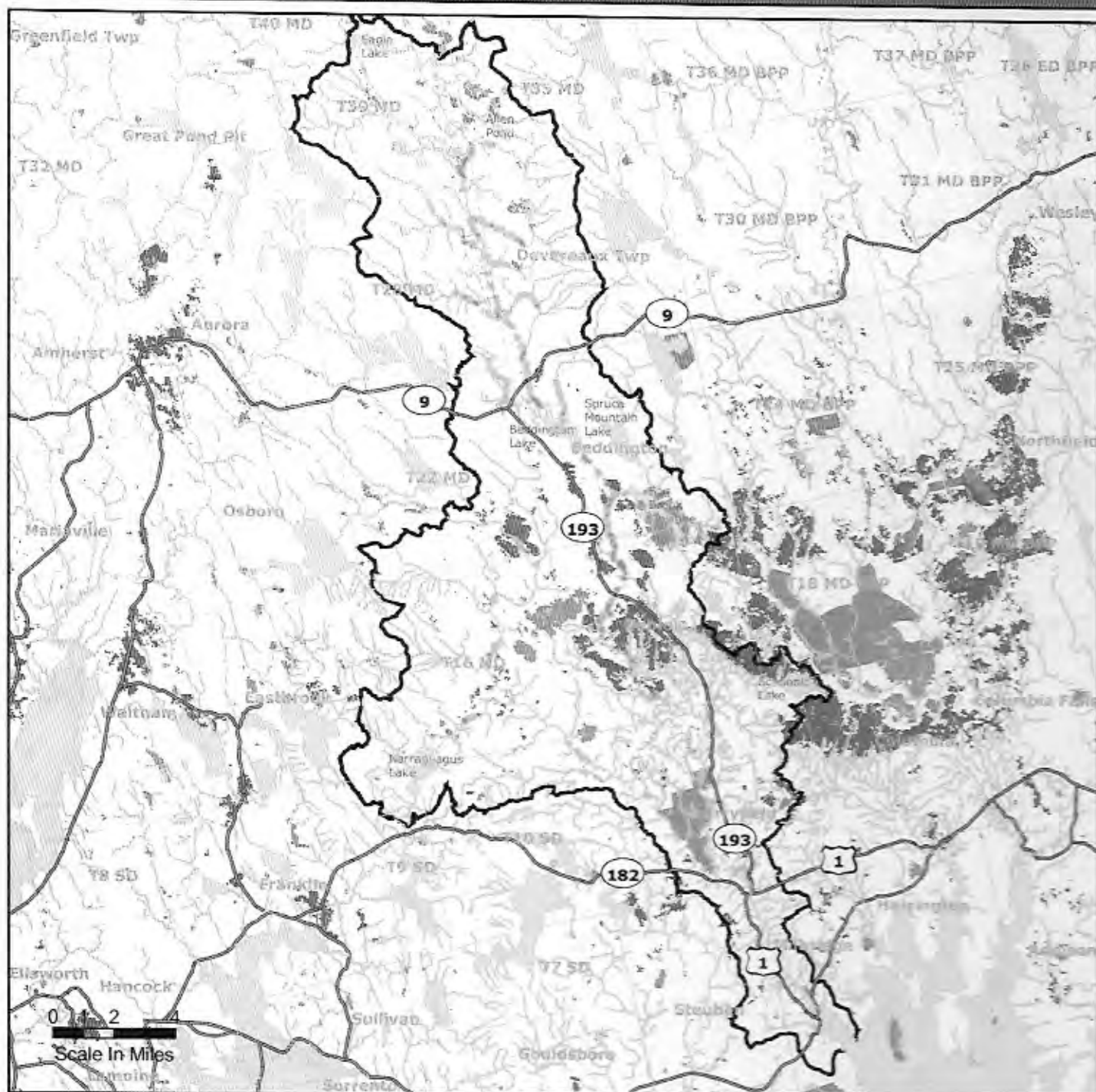
- | | |
|--|--|
|  Managed Forest Area |  Lakes & Ponds |
|  Rivers & Streams |  Town Line |
|  Spawning Habitat |  Watershed Boundary |
|  Juvenile Rearing Habitat | |

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Map 3.2 Agricultural, Peat & Conservation Lands

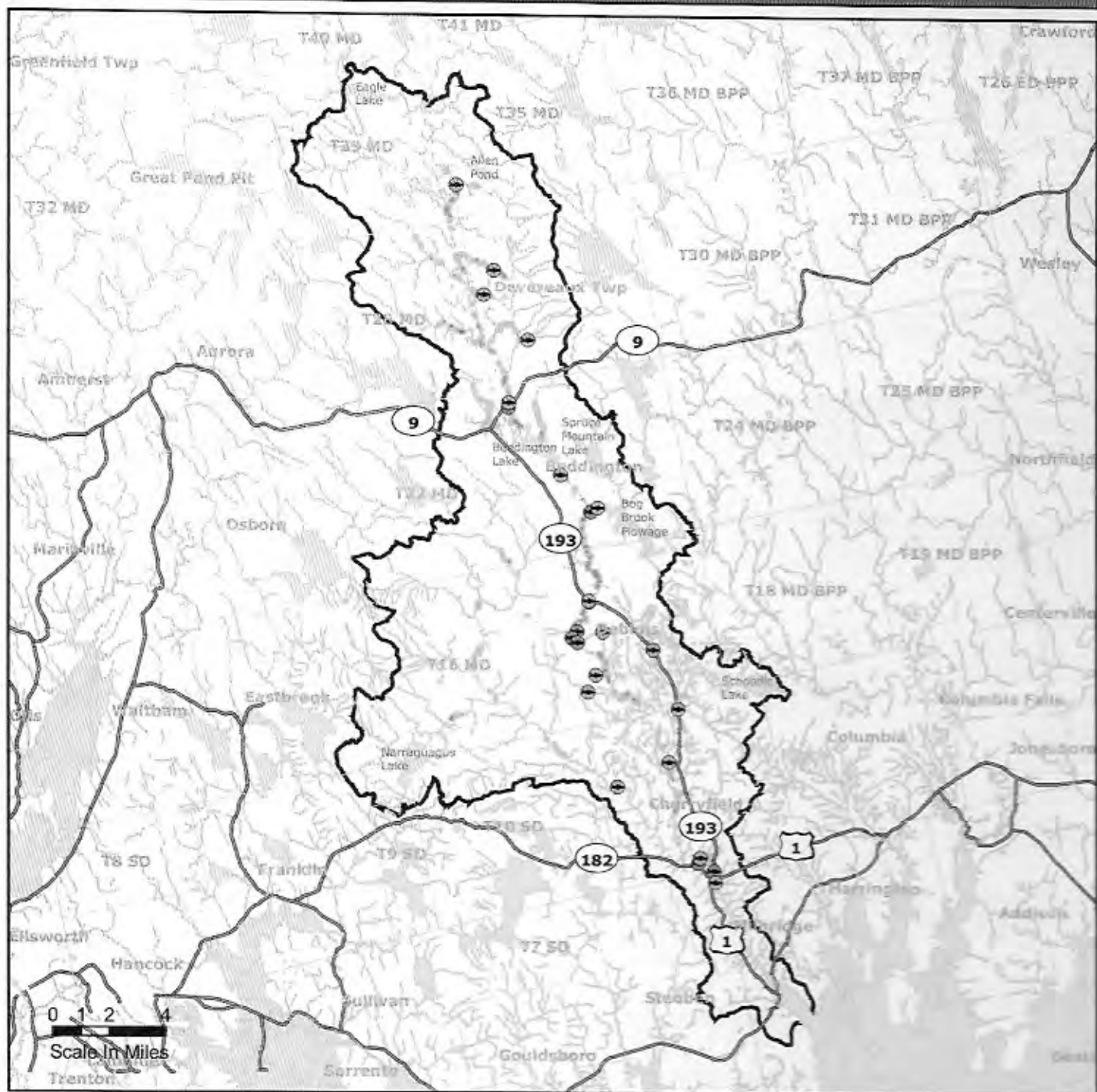


Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Map 4.1 DEP Biomonitoring & Water Quality Sampling Sites



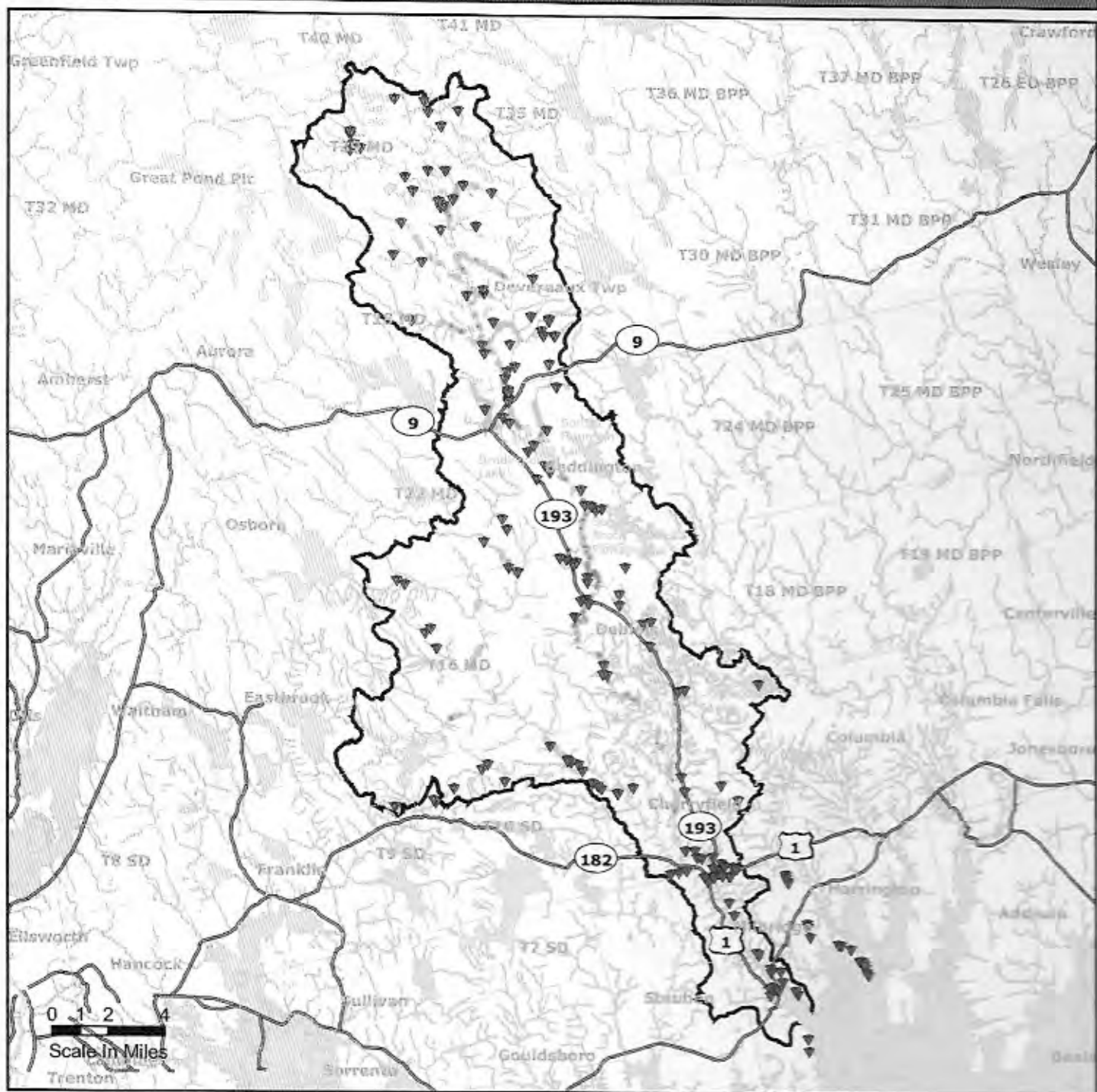
- DEP Water Quality Sampling Site
- DEP Biomonitoring Site
- Rivers & Streams
- Spawning Habitat
- Juvenile Rearing Habitat
- Lakes & Ponds
- Town Line
- Watershed Boundary

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Map 6.1 Documented Nonpoint Source Pollution Sites 1998-2002



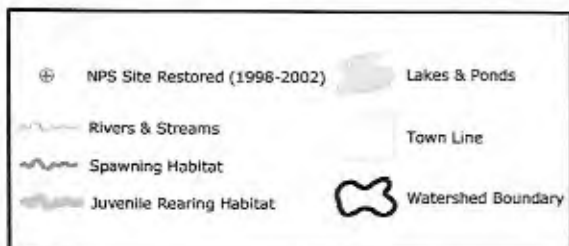
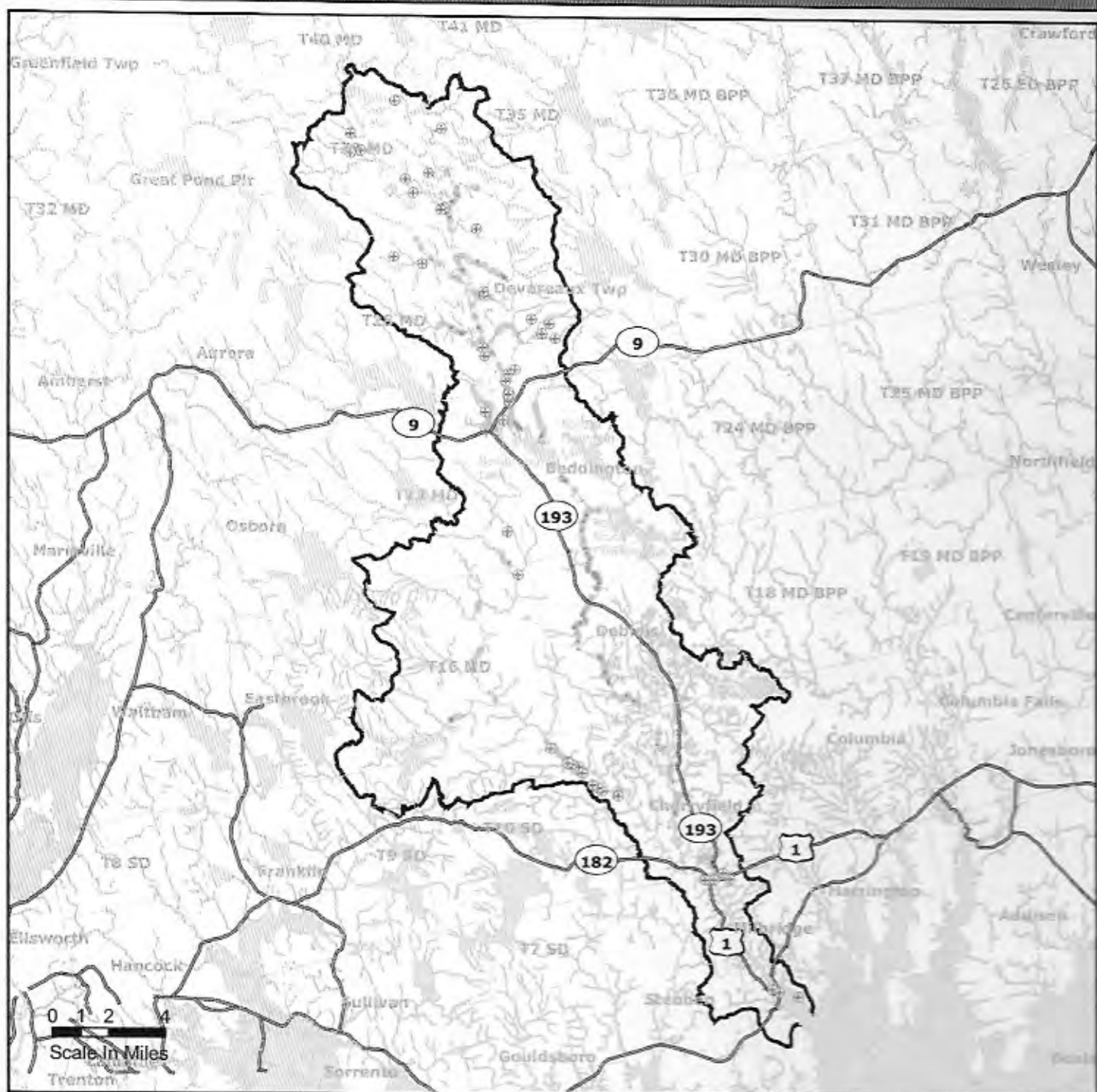
- ▼ NPS Site (1998-2002)
- Rivers & Streams
- Spawning Habitat
- Juvenile Rearing Habitat
- Lakes & Ponds
- Town Line
- Watershed Boundary

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

Map provided by:
Torrey R. Sheafe for Project SHARE
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Atlantic Salmon Commission
Maine Office of GIS
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Map 6.2 Restored Nonpoint Source Pollution Sites 1998-2002

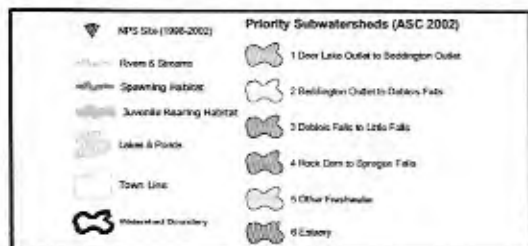
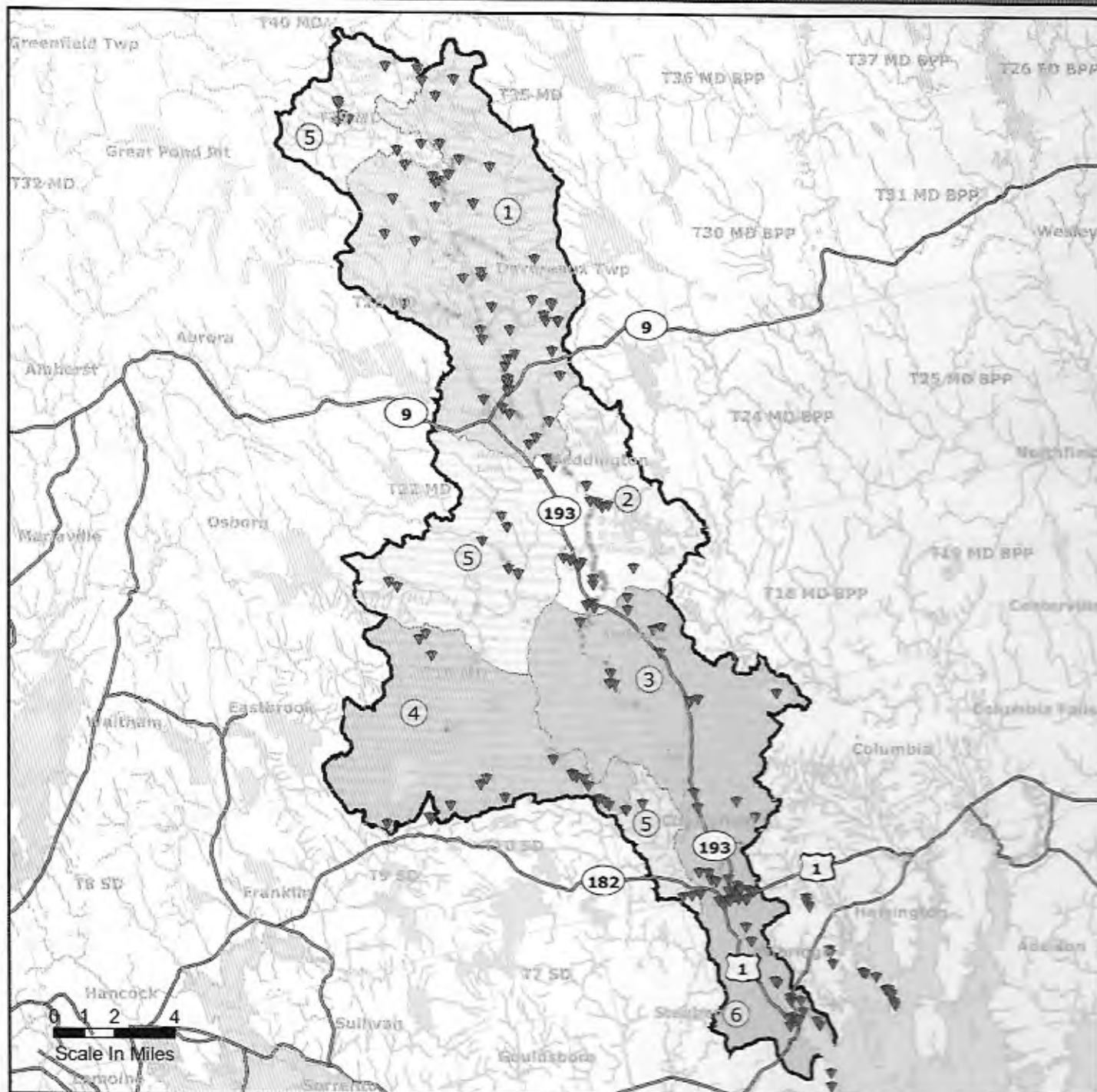


Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Map 6.3 Documented Nonpoint Source Pollution Sites & Priority Subwatersheds



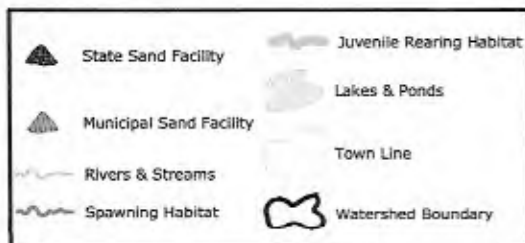
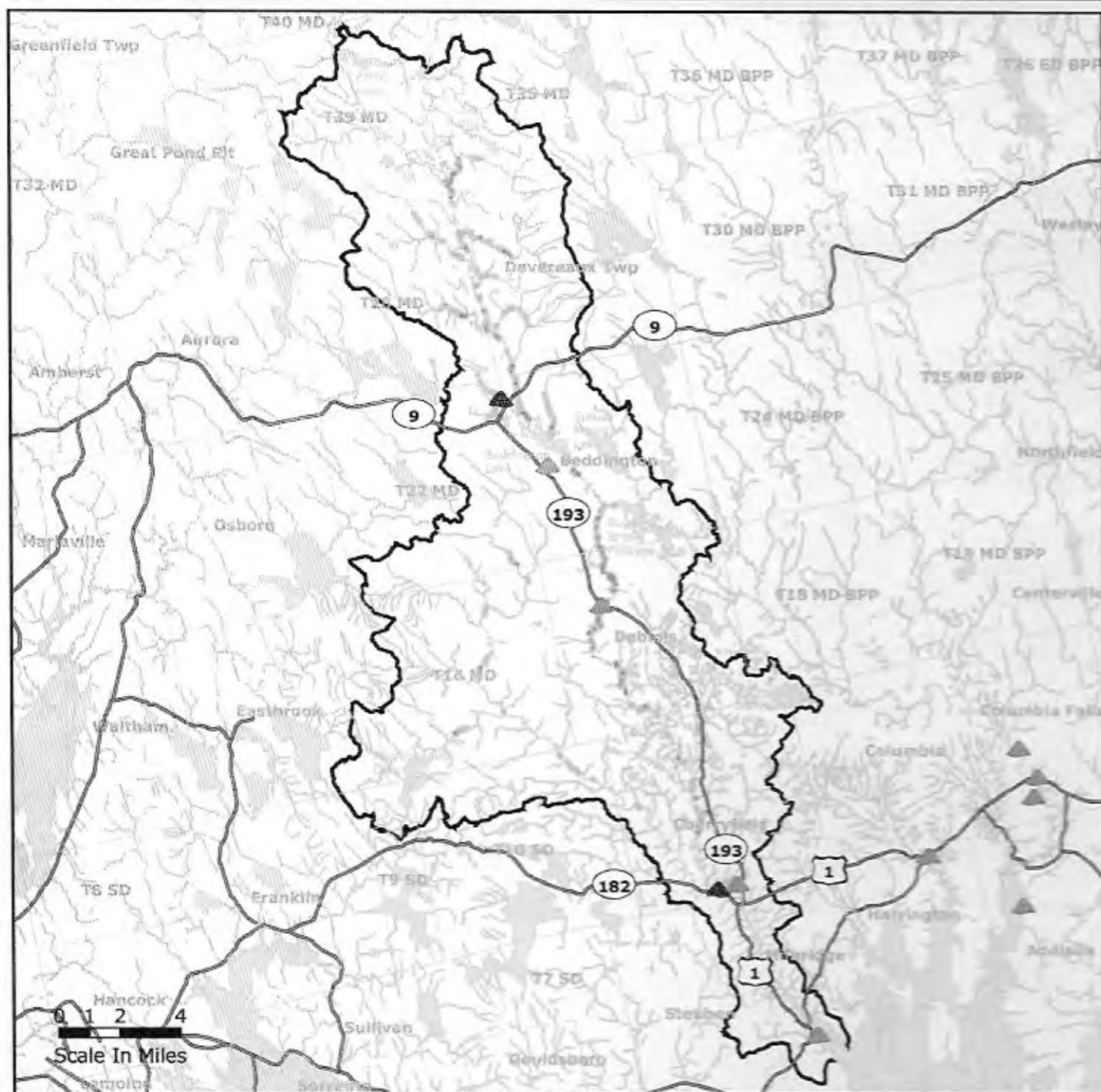
Projection: North American Datum 1983
 Coordinates: UTM, Zone 19
 Units: Meters

Map provided by:
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 Project SHARE
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Map 7.1 State & Municipal Sand/Salt Facilities



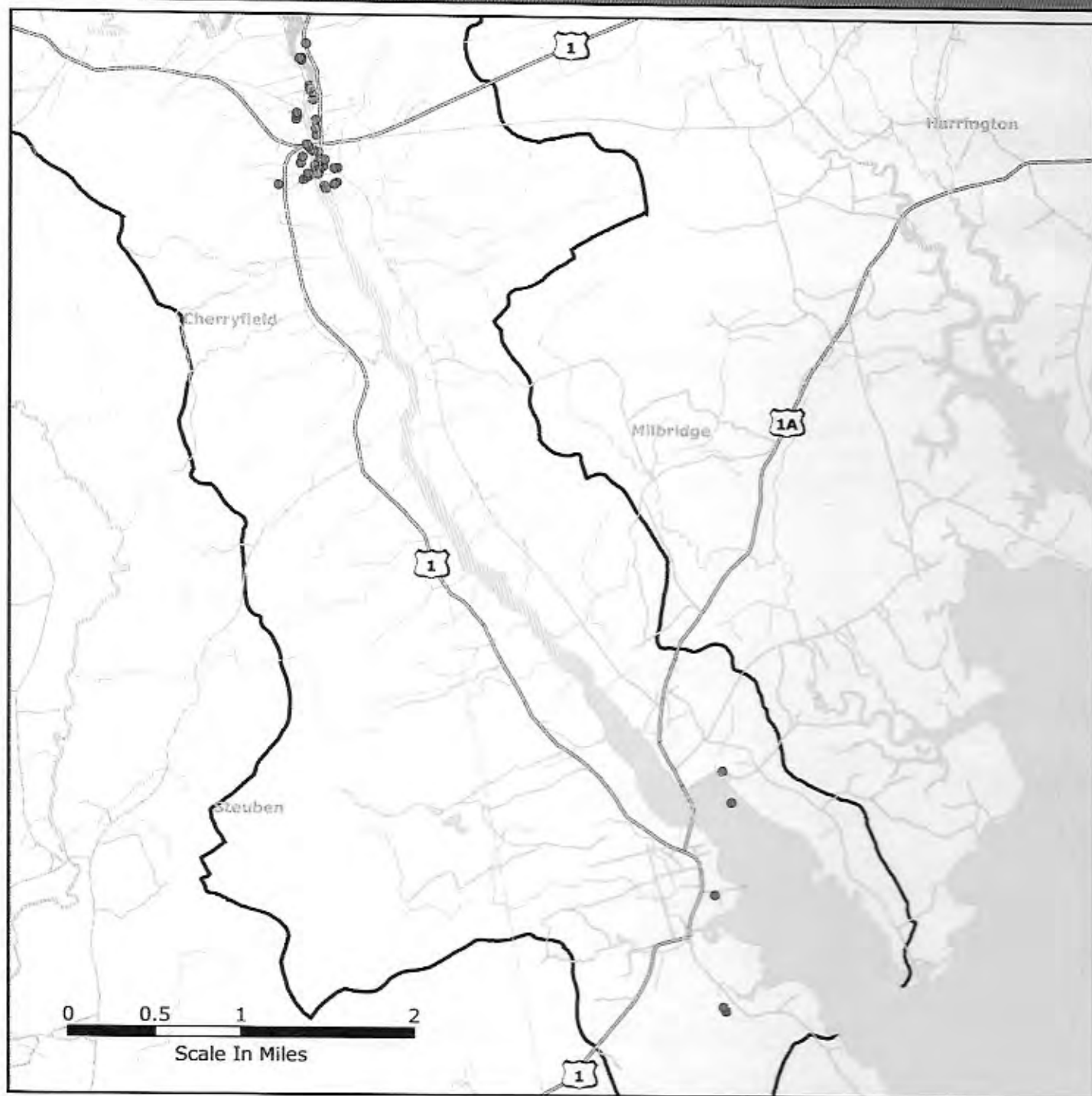
Projection: North American Datum 1983
 Coordinates: UTM, Zone 19
 Units: Meters

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 Project SHARE
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Map 7.2 Licensed Overboard Discharge Sites (2000)



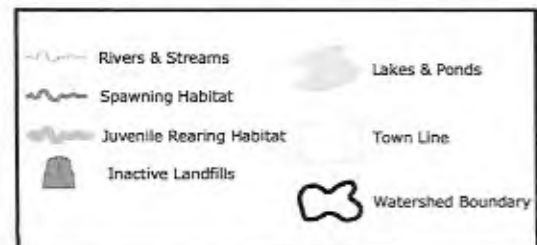
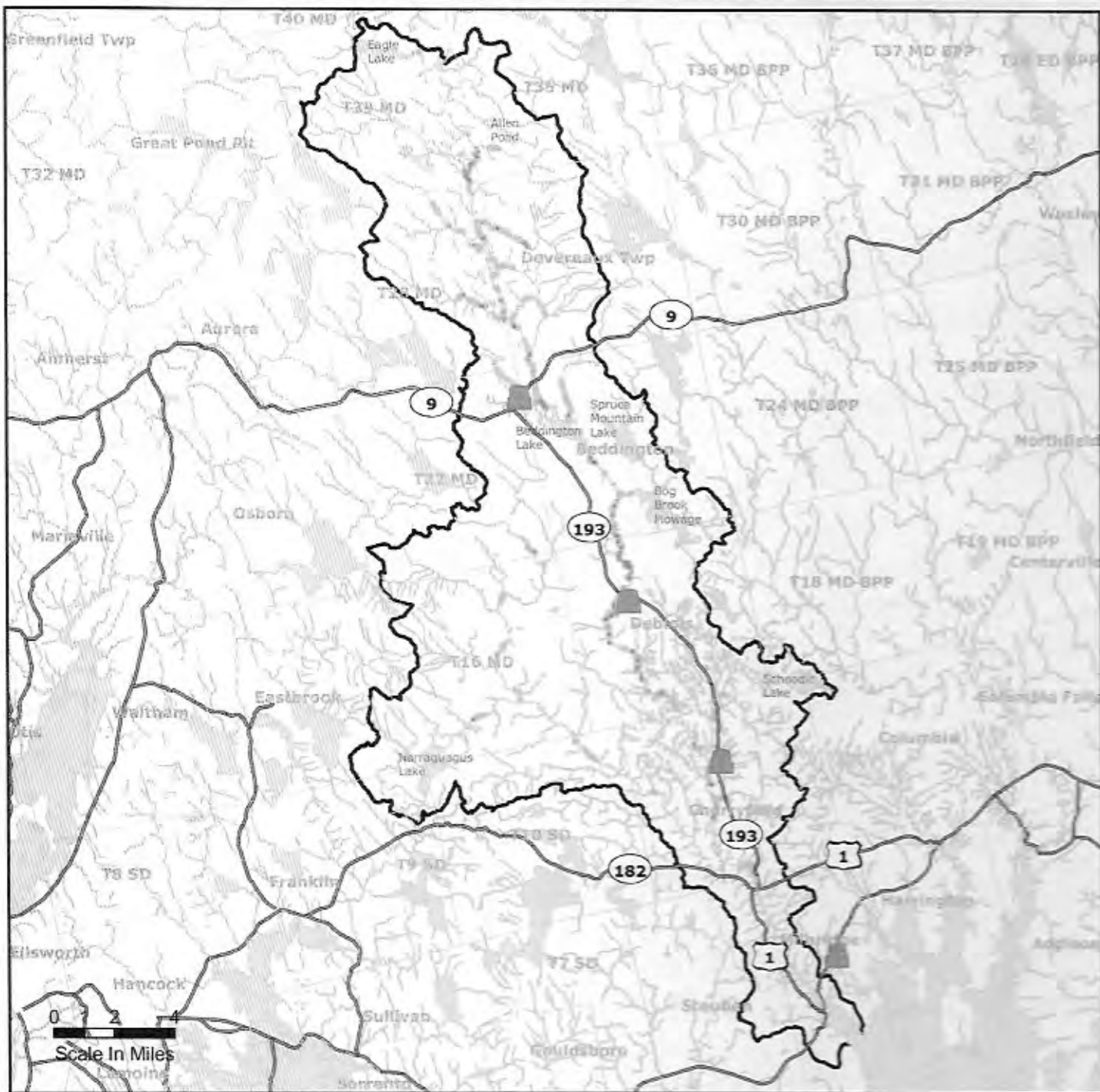
- Overboard Discharge
- Rivers & Streams
- ~ Spawning Habitat
- ▨ Juvenile Rearing Habitat
- ▨ Lakes & Ponds
- Town Line
- Watershed Boundary

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

Map provided by:
Torrey R. Sheafe for Project SHARE
Data provided by:
US Fish & Wildlife Service, Gulf of ME Project
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Department of Environmental Protection
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Map 7.3 Inactive Landfills (DEP 2002)



Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

Map provided by:
Torrey R. Sheafe for Project SHARE
Data provided by:
US Fish & Wildlife Service, Gulf of ME Project
Atlantic Salmon Commission
Maine Office of GIS
Department of Environmental Protection
Revised November 2002



3. Increase public awareness by holding a blueberry field day and discouraging the use of commercial gardening fertilizers (promote the use of compost).
4. Increase water quality monitoring. Establish lake monitoring groups, advocate for more MDEP lake sampling, and advocate for more river sampling.

7.11 AGRICULTURAL PESTICIDES

Background

Pesticides are used in the cultivation of blueberries in order to reduce the number of pests that can damage the crop. The term pesticide refers to several types of crop-protectant chemicals including herbicides, insecticides, and fungicides. Since the initiation of pesticide use in the blueberry industry, crop yields and crop quality have increased greatly.

Pesticides become nonpoint source pollution in at least three ways:

1. drift – when sprayed pesticides drift from the target application sites and become deposited in waterways,
2. runoff – when pesticides move overland with runoff into surface water bodies, and
3. leaching – when the pesticides leach into soil and groundwater, appearing subsequently in groundwater discharge.

Blueberry growers have a menu of over fifteen different pesticides from which to choose to maximize blueberry production and minimize pest damage. This broad array of chemicals allows growers greater flexibility in effectively and safely managing crop pests. Table 7.2 is a list of the most commonly used pesticides. Of the fifteen chemicals described below, only six are applied regularly in most years. These include: Orbit, Bravo, Phosmet, Velpar, Roundup, and Biobit.

Table 7.2. Commonly Used Pesticides in Blueberry Cultivation

PESTICIDE NAME Trade Name (Common Name)	TYPE OF PESTICIDE	TIME OF APPLICATION	TYPE OF APPLICATION
Orbit (Propiconazole)	Fungicide	Spring	Liquid: air/ground
Bravo (Chlorothalonil)	Fungicide	Spring	Liquid: air/ground
Imidan (Phosmet)	Insecticide	Spring/Summer	Liquid: air/ground
Biobit (<i>Bacillus thuringiensis</i>)	Biological Insecticide	Spring/Summer	Liquid: air/ground
Mycotrol (<i>Beauveria bassiana</i>)	Biological Insecticide	Spring/Summer	Liquid: air/ground
Sevin (Carbaryl)	Insecticide	Spring/Summer	Liquid: air/ground
Velpar (Hexazinone)	Herbicide	Spring	Liquid: ground
Karmex (Diuron)	Herbicide	Spring	Liquid: ground
Sinbar (Terbacil)	Herbicide	Spring	Liquid: ground
Pronone (Hexazinone)	Herbicide	Spring	Granular: ground
Roundup (Glyphosate)	Herbicide	Spring	Spot application
Poast (Sethoxydim)	Herbicide	Spring	Spot application
Select (Clethodim)	Herbicide	Spring	Spot application

Fusilade (Fluazifop-p butyl)	Herbicide	Spring	Spot application
------------------------------	-----------	--------	------------------

Description and Application Rates of Common Pesticides

(See Yarborough, Wild Blueberry Growers Guide, UM Cooperative Extension)

N.B. All rates given below are based upon the concentration of the pesticide product as it is formulated.

PROPICONAZOLE (ORBIT[®]) is a fungicide used to control mummy berry and is applied at a rate of 4 oz of product per acre during the cropping year with a legal maximum of 12 oz per acre per year. Orbit may be applied twice during the crop year depending on environmental conditions (frostier/wetter seasons may cause more fungal growth /crop damage and may require more fungicide to control fungal growth).

Propiconazole is a systemic fungicide that inhibits the biosynthesis of cell walls in fungi. Soil mobility of this chemical is very low, and it is degraded in soil by microorganisms to inactive products with a half-life of 40-70 days. Leaching is unlikely due to its soil immobility.

CHLOROTHALONIL (BRAVO[®]) is a fungicide used to control mummy berry and is applied at a rate of 2.5 pt or 2.7 lb of product per acre, depending on the formulation, during the cropping year. It is generally applied once in the spring.

This chemical is moderately persistent and moderately mobile in sandy soils with a half-life of 1 to 3 months. It degrades in soil and in water into two relatively nontoxic metabolites. Chlorothalonil was not found in any of 560 groundwater samples collected from 556 US sites.

PHOSMET (IMIDAN[®]) is an insecticide used to control spanworm, flea beetle, sawfly, and fruit fly and is applied at a rate of 1.5-3 pints per acre during the cropping and noncropping years.

Phosmet has low persistence in soil with a half-life of 4 to 20 days. It is rapidly degraded by hydrolysis, photolysis, and microorganisms into nontoxic products.

HEXAZINONE (VELPAR, PRONONE[®]) is a herbicide used to control annual and perennial weeds and grasses and is applied at a rate of 1-4 quarts, 0.5-2 pounds, or 10-20 pounds per acre, depending upon the formulation used, during the non-cropping year. An additional application of 1 lb of active ingredient per acre may be used in situations where hexazinone has not been applied within the past 8 years; e.g., to bring old blueberry land back into production, or opening up new blueberry acreage. This pesticide has a specific Best Management System for its use because of groundwater concerns.

Hexazinone is moderate to highly persistent in the soil with a half-life of 30 to 180 days. The chemical is degraded by microorganisms and photolysis. Hexazinone is very poorly adsorbed to soil particles, very soluble in water, and

degrades slowly, so it is likely to be mobile in most soils and has been found in groundwater.

Bacillus thuringiensis (BIOBIT[®]) is a biological agent used to control spanworm and is applied at a rate of 2.5 pint per acre during both the non-cropping and cropping years. The biological agent, *Bacillus thuringiensis* (B.t.), is a bacterium that causes spanworm larvae to stop feeding, eventually killing them. This agent is often used in place of Imidan[®] because it is bee-friendly.

B.t. is a naturally occurring pathogen that readily breaks down in the environment. Due to its short biological half-life and its specificity, B.t. is less likely than chemical pesticides to cause field resistance in target insects. B.t. is moderately persistent in soil. Its half-life in suitable conditions is about 4 months. Microbial pesticides such as B.t. are classified as immobile because they do not move, or leach, with groundwater. Because of their rapid biological breakdown and low toxicity, they pose no threat to groundwater.

Pesticide Studies in the Watershed

In 1997, the Maine Board of Pesticides Control began testing surface water for the presence of 33 pesticide chemicals and degradation products in the Narraguagus River Watershed (Chizmas, 2001). Samples were collected in 1997, 1999, 2000, and 2001 from various locations:

- Main stem of the Narraguagus River,
- Great Falls Branch,
- Schoodic Brook,
- Crotch Camp Brook,
- Lower Junior Grant Pond, and
- Longfellow Brook.

The only chemicals detected in the surface water samples were hexazinone (Velpar) and phosmet (Imidan). Hexazinone was found in quantities ranging from 0.10 ppb to 3.20 ppb and phosmet was found in quantities ranging from <0.05 ppb to 0.52 ppb. Evidence suggests that these levels are not in the acute or chronic toxicity range for most organisms. (See Environmental Consequences below)

In 2000 and 2001, studies using drift cards and filter paper were conducted to test for the presence of pesticide chemicals in atmospheric drift. The study tested for the fungicide, propiconazole (Orbit), and the insecticide, phosmet. Although there were detectable amounts of both pesticides on the filter paper and cards, neither of these pesticides was found in the water.

Two private wells located within the Narraguagus Watershed have been tested for pesticide active ingredients. One well was tested in 1992 and no active ingredients were detected. The second well was tested in 1999 and hexazinone was detected at 1.56 ppb.

The results of these studies indicate that:

- The ranges are well below the levels considered toxic for humans and wildlife. (See below)
- Most blueberry soils in the watershed are sandy and have an average infiltration rate of 6 inches per hour, so that precipitation and many agrochemicals leach rapidly and directly into the soil instead of running off the surface and directly into waterbodies. Evidence suggests that the chemicals make their way into the groundwater and travel via underground springs to come up in the surface water of rivers and streams.

Environmental Consequences

(Information below is taken from EXTOTOXNET, an internet pesticide information project, at <http://ace.orst.edu/info/extotoxnet>.)

PHOSMET (IMIDAN[®]) is an organophosphate insecticide and is highly toxic to humans through the skin and through inhalation. It is an inhibitor of the enzyme cholinesterase, which affects the nervous system in humans. It is highly toxic to some birds (LD50 is 18mg/kg in red-winged blackbirds) and can cause reproductive difficulties in birds whose feed contains phosmet residues. It is highly toxic to rainbow trout (LC50 of 56 ppb), aquatic invertebrates (LC50 of 2 to 6 ppb), and honeybees (LD50 of 0.0001 mg/bee).

HEXAZINONE (VELPAR[®]) is a triazine herbicide and, in humans, is slightly toxic via the oral route and practically nontoxic via the dermal route. Hexazinone is fairly rapidly processed and excreted by animal systems and evidence suggests that the chemical is unlikely to be carcinogenic, teratogenic, mutagenic or to cause reproductive effects in humans. Hexazinone is nontoxic to bees and birds (LD50 is 2258 mg/kg in quail) and slightly toxic to fish (LD50 is 240,000 to 320,000 ppb in salmonids). Chronic effects are unknown.

PROPICONAZOLE (ORBIT[®]) is a triazole fungicide and, in humans, may cause skin, eye, and lung irritation. At very high doses, it may produce an increased incidence of liver tumors. It is classified by the EPA as a Group C carcinogen. Propiconazole is nontoxic to soil bacteria, algae, plants, bees, and birds. It is moderately toxic to fish (LC50 is 20 mg/L in brown trout and 1.54 mg/l in rainbow trout).

CHLOROTHALONIL (BRAVO[®]) is a broad-spectrum organochlorine fungicide and, in humans, may cause skin and eye irritations. Although it is not stored in animal tissue, studies indicate changes in kidney function and possible carcinogenic effects in humans. This chemical is practically nontoxic to bees and birds (LD50 is 5000 mg/kg in mallard ducks) but is highly toxic to fish and aquatic invertebrates (LD50 is 0.25 mg/L in rainbow trout).

Bacillus thuringiensis (BIOBIT[®]) has not been reported as having harmful effects on fish. Rainbow trout and bluegills exposed for 96 hours to Bt technical material at concentrations of 560 and 1000 ppm did not show adverse effects.

Field observations of brook trout, common white suckers, and small mouth bass did not reveal adverse effects one month after aerial application of Bt. Application rates of Bt have not been toxic to beneficial or predator insects. Normal exposure rates do not cause harm to honeybees.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

- Encourage the use of effective riparian buffers. The goal of a riparian buffer is to help prevent runoff carrying pesticides and to block or trap the drift from agrochemical aerosol so that it does not make its way to water bodies or other sensitive areas. Riparian buffers should be designed so that they trap the air mass containing the agrochemical aerosol. The trees used in the buffer should be conifers that retain their lower limbs, densely planted, and have a high leaf (needle) surface area. In general, a minimum of two rows of jack pine or eastern white pine planted 6 feet on center is recommended to achieve this effect.
- Encourage use of a Drift Management Plan (DMP). A DMP is currently being developed by representatives from the blueberry industry and the Board of Pesticides Control. This plan will make recommendations on the best spray technology, riparian buffers, integrated pest management, etc.
- Encourage the use of Best Management Practices.
 - Mulching to cover bare soil
 - Use of windrows to keep soil in place, reduce wind damage to plants, and to keep snow cover.
 - Removal of weed seed heads to reduce the spread of weeds.
 - Use of flail mowing instead of burning in order to retain organic matter.
 - IPM monitoring for pests and diseases.
 - Use of living mulches such as stunted grasses to cover bare soil and increase soil fertility.
- Encourage the use of weather monitoring associated with spray timing. This can be achieved by using automated weather stations that are set up in the field but monitored by computer from the office. In addition, growers should use hand-held wind gauges on the ground to determine the most effective time to spray.
- Encourage experimentation with different cultural techniques and chemical alternatives. Currently, much of this work is conducted by the University of Maine Agricultural Experiment Station, but growers should be encouraged to conduct research into alternative methods on their own fields.
- Encourage the state and federal governments to limit the use of particularly toxic and highly mobile chemicals. For example, organophosphates, which include Imidan® (phosmet), are known to be neurotoxins and are currently being reviewed under the Food Quality Protection Act.
- Encourage the use of state and federal grants for Integrated Pest Management research and cost sharing.
- Encourage better educational programs for growers and the general public. Examples include growers' suppers, public field trips, and IPM workshops.

7.12 AGRICULTURAL WATER WITHDRAWAL

Background

Irrigation of blueberry fields has occurred since the 1960s and is known to increase yields by two to three-fold in dry years. The water used for irrigation comes from natural ponds, man-made irrigation ponds, tributaries, the West Branch, and the main stem of the river.

Water is withdrawn from water bodies by pump and is either transported through pipes to irrigation ponds or directly to the field, where it is applied using either "big gun" or small sprinkler systems. All water withdrawn from the watershed for blueberry cultivation is consumptive – the water is either absorbed by the blueberry plants or evaporates, with little returned directly to the waterbodies.

Irrigation Management

Bearing blueberry fields are watered for protection from frost during May and June and for irrigation during periods of low rainfall and high evapotranspiration. Fields are watered using two types of systems:

- Big guns, which apply $\frac{1}{2}$ inch of water in 45 minutes
- Small sprinklers, which apply $\frac{1}{2}$ inch of water in 6 hours

The target goal of irrigation is one inch of water per week when fields are not receiving one inch of rainfall per week. Irrigation usually begins in mid-late June in dry years. During periods of low evapotranspiration, such as when foggy or overcast, less than one inch of water per week may be applied. Fields are usually watered during the night or early morning in order to reduce excess evaporation losses. Fields are monitored for soil moisture in order to determine irrigation regimes.

The major blueberry landowner in the watershed is Wymans, and currently approximately 25% of their acreage (approximately 1,625 acres) is under irrigation. Their long-term plan is to have 67% of their acreage irrigated over the next twenty years. They will accomplish this by adding approximately 200 acres per year into irrigation.

In general, field irrigation is one of the higher costs in cultivating lowbush blueberries. Irrigation may be labor intensive, and the necessary equipment and maintenance is expensive. In addition, the permitting process may approach \$500,000/year for large irrigators with fields in LURC jurisdiction (see below).

Sources of Withdrawal

The two major landowners currently withdrawing surface water from the Narraguagus River Watershed are Cherryfield Foods Incorporated (CFI) and Jasper Wyman and Son (Wymans). The amount of water that can be withdrawn from any natural water body is regulated by two state agencies: MDEP (organized towns) and LURC (unorganized townships). Man-made irrigation ponds are not subject to any draw down regulations

by either agency, although regulated water releases are. Table 7.3 lists locations of water withdrawals, the landowner, the regulatory agency and the withdrawal limit responsible for each location.

Table 7.3. Sources of Agricultural Water Withdrawal

Location	Landowner	Regulatory Agency	Withdrawal Limit
Schoodic Lake	Wymans	MDEP	Voluntary*
Schoodic Lake	CFI	LURC	1 ft
West Branch, Big Hill	CFI	LURC	89 cfs**
Pork Brook	Wymans	LURC	0.4 cfs
East Pike Brook Pond	CFI	LURC	2 ft
West Pike Brook Pond	CFI	LURC	2 ft
Pineo Pond	Wymans	MDEP	Voluntary*
East Branch, Jr. Grant	Wymans	MDEP, USFWS	89 cfs**
Spectacle Pond	Wymans	MDEP	Voluntary*
Horseshoe Pond	CFI	LURC	2 ft
Man-Made Irrigation Ponds	Wymans	MDEP	None

* Subject to MDEP policy regarding dewatering (see below).

** As measured at the USGS Cherryfield Gauging Station.

Water Withdrawal Regulations/Policies

LURC

Each standing body of water (lakes, ponds) has a different allowable amount of draw down. This amount is based on 25% of the total depth and total volume at high water mark.

Withdrawal from streams and rivers is based on New England Low Flow Policy (USFW Compliance Limit), which limits withdrawal when flow in the Narraguagus River reaches the August Median Flow of 89 cfs, as measured at the USGS Cherryfield Gauging Station.

MDEP

The MDEP currently has no compliance limits regulating the amount of water withdrawn from lakes, ponds, rivers, and streams within MDEP jurisdiction. The Natural Resource Protection Act, however, does prohibit the "dewatering" of any body of water. Although this term is ambiguous and complaint driven, landowners will generally stop withdrawing water if a complaint is filed. Likewise, in cases where water withdrawal (pumping) from a river or stream requires activity within wetlands, the landowner must comply with the USFW Compliance Limit that limits withdrawal to the August Median Flow (89 cfs).

Water Use Management Plans

In response to the 1997 Atlantic Salmon Conservation Plan, the MSPO has developed Water Use Management Plans (WUMP) for the Narraguagus and Pleasant Rivers and Mopang Stream. The plans are designed to guide landowners in resolving the conflict between water withdrawal for irrigation and maintaining adequate flow for the salmon life cycle. The WUMP provides guidance information regarding salmon migration, spawning, incubation, and juvenile nursery functions as related to stream flow. Instream

Flow Incremental Methodology (IFIM) studies were conducted in conjunction with the plan to help quantify these relationships.

The WUMP recommends the use of water source hierarchies by state agencies and commercial growers, continued assessment of the impact of withdrawals during both high and low flow, research of wild blueberry plant water requirements, and research farm practices to further reduce water use (MSPO, 2001). As a result of the WUMP guidelines and recommendations, the blueberry companies are in the process of developing plans specific to their own available water resources, irrigation needs, and harvest goals.

Environmental Consequences

Excessive water withdrawal from waterways reduces water quality by:

1. reducing the amount of habitat available to aquatic organisms and
2. creating temperature increases which may be detrimental to fish and other wildlife.

These problems are exacerbated during periods of drought and the long-term effects are not clear. Immediate and short-term consequences include:

- Reduced water volume reduces available habitat for cold water fishes.
- Reduced water volume reduces the wetted perimeter habitat available for aquatic invertebrates.
- Study of Pork Brook conducted by MDIFW indicates that there was a decline in abundance of brook trout due to low flow in 2001 compared with 2000 (Personal Communication with Brokaw, 2001). The low flow was the result of the extremely dry conditions that prevailed in 2001. Water temperature in Pork Brook remains cold due to springs, so that even if water volume/flow is reduced, temperature remains fairly constant.
- The main stem of the river experiences more swings in temperature than its tributaries because the tributaries are fed by springs and are shaded.
- The tributaries contribute cold water to the main stem, helping to keep the temperature stable.
- Fish subjected to high temperature stop feeding and may ultimately die. Laboratory studies indicate that Atlantic salmon stop feeding at 22.5° C and die if exposed to 28°C for 3 hours or 31°C for eight minutes (Elliot, 1991).

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Work to expand and protect riparian zones and maintain riparian buffers.
Phase I: Survey and document riparian zones.
Phase II: Acquire funding to perform plantings
Phase III: Work with landowner to conduct plantings and maintain buffers
2. Encourage landowners to keep flail-mowed plant litter on the ground in order to reduce evaporation.
3. Work with landowners on cost-sharing programs for wind breaks, riparian buffers, etc.
4. Sponsor/conduct ongoing studies on blueberry plant moisture requirements.

5. Encourage landowners to follow WUMP guidelines:
 - a. draw down/flow limits,
 - b. reporting withdrawals,
 - c. alternatives analysis, and
 - d. needs analysis.
6. Encourage better communication with public. Conduct Blueberry Open Field Days.

7.13 BEAVER ACTIVITY

Background

Beaver (*Castor canadensis*) are native to North America and have coexisted and coevolved with the native salmonid fishes for centuries. Their life cycle is characterized by the following:

- they produce 3-5 kits per year per adult pair,
- they are attracted to free flowing water and will travel many miles to reach free-flowing water and food,
- they prefer to build dams in cold spring-fed streams which do not freeze and allow the beaver easy winter access in and out of the lodge,
- they prefer young shade-intolerant hardwoods (birch, poplar, maple),
- they build dams for protection and access to food, and
- their natural predators include man, bear, wolf, and coyote.

Status of Beaver Population Today

(Personal Communication, Schaeffer, MIF&W, 2001)

In general the beaver population has increased greatly over the past 10-20 years as compared to the previous 80 years. Two major reasons are suggested for this increase:

- 1) beaver trapping has decreased due to reduced popularity and low market prices for beaver pelts, and
- 2) the forest composition and structure has shifted from primarily softwood (conifers) to primarily hardwoods (birch, poplar, maple)—their preferred food.

The change in forest composition is related to the harvesting of conifers during the 1984-85 spruce budworm outbreak and the lack of adequate riparian buffers left after harvesting. The increase in hardwoods translates into an increase in beaver habitat/food that in turn causes an increase in the number of beaver and dams in the watershed.

Specific Sites in the Watershed

Within the Narraguagus Watershed, beaver activity is quite high. Although there are only 14 documented sites of beaver activity recorded to date, many non-documented sites are known to exist. Beaver activity in the watershed can be classified into at least 3 categories:

1. dam building in culverts,
2. free-standing dams in waterways, and
3. dams produced by burrowing into stream banks or lakeshores.

Regardless of whether the activity is occurring within a culvert or independent of a man made structure, beaver activity can cause a number of environmental problems such as erosion, sedimentation, loss of fish passage, and water temperature increases.

Environmental Consequences

Beaver activity produces several environmental benefits:

- creation of habitat for wetland-dependent species,
- creation of edge and interspersed habitat which generally increases overall diversity and productivity of landscape,
- creation of water storage sources within watershed by altering flow, and
- filtration of sediment from upstream.

Beaver dams are protected structures and, as such, should not be removed unless warranted and permitted by the MIF&W. In general, a beaver dam will alter the environment from lotic (free flowing) to lentic (still water). A change from a lotic to lentic environment will generally change water quality. Lentic environments will generally have a higher water temperature and reduced dissolved oxygen when compared to a lotic environment. This in turn will affect the aquatic invertebrates and the fish living in that area.

Beaver activity and the subsequent change in environment may cause:

- increased bank erosion,
- possible flooding,
- alteration of flow (loss of riffles and change from lotic to lentic),
- loss of shade and shore vegetation,
- increased water temperature,
- reduced fish passage,
- alteration of habitat, and
- shift from cold-water to warm-water species.

Beaver dams have long been suspected of temporarily reducing salmonid populations by reducing water quality (increased temperature, decreased DO) and prohibiting fish passage. A recent study conducted by the MIF&W (Personal Communication, Brokaw, MIF&W, 2001) compared the number of young trout encountered in response to beaver dam removal. A total of 49 beaver were removed in a 6-year period in a 2.25-mile stretch of the brook. The number of young of the year brook trout increased significantly in response to active beaver control. The study suggests that trout populations are affected by the presence/absence of beaver dams and that population numbers can increase with the removal of beaver dams.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Conduct intensive beaver dam survey to catalogue and prioritize beaver dams based on the proximity to priority salmon habitat.
2. Develop workgroup to breach or remove inactive dams.
3. Hire an animal control officer or trapper to either live trap and relocate beaver or trap and kill beaver.

4. Collect watershed-specific beaver dam information from other agencies and add to database.
5. Make survey of "active" beaver dams available to trappers in order to encourage beaver removal.
6. Encourage riparian protection and best management practices through use of conservation easements, education, land acquisition, better laws, and advocacy.
7. Collaborate with MIFW to install "beaver deceivers" in culverts. These devices use screen and PVC pipe to deter beaver dam construction while maintaining adequate flow through culvert.
8. Work with MIFW and ASC to properly breach active dams during spawning. Breaching of an active dam can be conducted to allow for fish passage while leaving enough habitat for the beaver to survive. Breaching should be conducted in accordance with state and federal recommendations and permitting guidelines:
 - Conduct breaching in October to allow for salmon passage.
 - Dam breaching should occur first where passage to high priority salmon habitat is restricted.
 - Since salmonids can "jump" over most dams, only the top half to one-third of the beaver dam should be removed.
 - Since salmonids generally restrict themselves to the channel (usually near the center) in any given stream or river, only the channel portion of the dam should be removed. Care should be taken to avoid disturbing the bottom sediment.

7.14 ACID DEPOSITION

Background

Atmospheric deposition of nitric and sulfuric acids (from the combustion of fossil fuels) is the most ubiquitous nonpoint source of acidity in the watershed. According to data collected at Bear Brook Watershed Manipulation Project (Norton, et al. 1999), local precipitation ranges in pH from 4.5 to 4.7. The pH of the precipitation ultimately entering the river, lakes, and tributaries is affected by surrounding soil chemistry, local vegetation, total annual precipitation, and the buffering capacity of the river itself.

The sources of acidity in the Narraguagus River Watershed include:

1. acid precipitation from fuel emissions and industrial air pollution primarily blown in from areas to the west,
2. acidic soil and exposed rock formations which possess little buffering capacity, and
3. erosion and sedimentation from local peat formations.

It is also suggested that extended amounts of acid precipitation have reduced the buffering capacity of forest soils in the Narraguagus River Watershed (Kahl, 1999).

Specific Sites in the Watershed

Water quality data has been collected in the Narraguagus River Watershed for at least thirty years by various agencies (MDEP, ASC, CES). MDEP data from 1969 through

1997 indicate that approximately 37% of the samples collected had pH values less than 6.0 (the lower range limit considered healthy for most organisms). The lowest recorded value was 4.21 in 1989 downstream from Denbo Heath.

While previous pH data is clearly very low, recent baseline data collected by the MDEP between 1999 and 2002 indicate higher values. The majority of baseline samples collected on the main stem of the Narraguagus River and its tributaries had pH values ranging from 6.0 to 7.3 during 1999-2002. Samples associated with precipitation events, however, indicate some acidification or acid pulses. Eight out of nine stormwater samples collected during 2002 had pH values between 5.17 and 5.86.

These spikes of low pH are associated with periods of high discharge, such as spring runoff or runoff from a storm event. There does not appear to be a problem during summer months when there is little precipitation. Additionally, the main stem and down river do not appear to be at risk from the problems of low pH. Areas most at risk are headwater streams and tributaries because they are not diluted or buffered. Examples are Baker, Rocky, Bog, Gould, Bobcat, Humpback, and Sinclair Brooks.

Environmental Consequences

(From Haines, 1981)

- The majority of organisms can withstand broad pH ranges but some species are less tolerant. Salmonids prefer pH range between 6.5 and 7.5 and have difficulty surviving pH values less than 5.0.
- At pH less than 6.5 there is potential for mercury to be incorporated into tissue and aluminum becomes free to react and damage gill tissue which effects ionic balance causing suffocation.
- There are indications that seasonal fluctuations in pH may cause physiological problems on a variety of aquatic organisms including minnows, amphibians, and salmon smolts.
- Loss of salmon populations in Norway and Canada have been linked to increased acidification. Low pH affects gills, enzyme systems, blood pH, respiration, hemoglobin-oxygen affinity, and overall growth.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Investigate the feasibility of increasing waterbody buffering capacity by adding lime (possibly in the form of clam shells) to specific tributaries in the watershed.
2. Increase water quality monitoring: all agencies and commercial growers can increase the number of sites and amount of samples; increase the number of automated loggers. ➡
3. Improve data coordination among agencies:



David Blumhauer

- Phase I: Poll all agencies/stakeholders to collect information, all existing data, workplans, reports, etc.
- Phase II: Create database/interactive website

7.15 LANDFILL MAINTENANCE

Background

During the 1980's, state legislation required that all municipal landfills be closed in accordance with state guidelines. Today solid waste is transferred from its source to either: 1) one of three state-regulated landfills or 2) to an incinerator, with the ash then transferred to one of the landfills. There are four known closed municipal landfills in the Narraguagus River Watershed. These landfills were closed in accordance with state guidelines in order to reduce or minimize impacts to ground and surface water. The potential threat of contamination from above ground seepage, toxic runoff, and through groundwater contamination is unknown at this time since no sampling data is available.

The four identified municipal landfills in the Narraguagus River Watershed were closed between 1985 and 1995 and are located in the towns of Milbridge, Cherryfield, Deblois and Township 22, the site for the town of Beddington (see Map 7.3). In the late 1980's several factors were used to determine the priority status of all landfills that were still operating as of January 1, 1983. Based on these factors, the MDEP scored the four area landfills as low priority. These factors included:

- size of landfill,
- threat to groundwater,
- threat to surface water,
- presence of open burning,
- control of disease vectors, and
- presence of hazardous waste.

In addition, several factors were used to determine the type of closure, follow-up protocol, and type of cap for each landfill. These factors are as follows:

- contents and the amount of industrial waste,
- proximity to private well,
- proximity to public well, and
- proximity to buildings.

Upon closure, all four sites in the watershed, received 18" of clay and 6" of topsoil. No post closure sampling was required. In addition, all sites require a vegetation cover of grasses/legumes to help prevent erosion. MDEP regulations require that the sites be mowed each year to eliminate woody vegetation since woody vegetation has a tendency to produce extensive root systems that may penetrate through the clay layer and create pathways for water infiltration. The infiltrating water would then pick up contaminants from the waste, transferring the contaminants to groundwater beneath the site. Grasses and legumes do not produce such extensive root systems.

MDEP landfill inspections involve observing and recording the physical appearance of the landfill including any sign of seepage. No sampling is performed unless seepage is

observed. If seepage is observed during inspection, MDEP will determine if testing is necessary based on landfill history, size, and location. Each municipality is responsible for the general maintenance and regular inspection of their own landfills.

Specific Sites in the Watershed

Below are the results of recent MDEP inspections of the four area landfills (Personal Communication, Wolfe, MDEP, 2002):

- Milbridge – closed 1986; inspected 2001; 2.5 acres; no post closure sampling required; town has stored unauthorized metal material on top of site. (This site is not within the Narraguagus River Watershed Boundaries but is located in a neighboring estuary.)
- Cherryfield – closed 1994; inspected 2001; 2.5 acres; no post-closure sampling required; site needs maintenance, tires stored on site, woody vegetation growing on site.
- Deblois – closed 1985; inspected 2001; 0.5 acres; no post-closure sampling required; site overgrown with woody vegetation.
- Beddington (Township 22) – closed 1989; inspection scheduled for 2002; 0.25 acres; no post-closure sampling required.

Environmental Consequences

- All four of the area landfills are in close proximity to major tributaries. In fact the Beddington, Deblois, and Cherryfield landfills are located in areas that are less than 500 feet from salmon habitat. Any seepage or leachate could drain directly into these waterways.
- Because inventories of the landfill were not performed prior to closure, the toxicity of the landfill contents is currently unknown. The lack of this knowledge presents obvious management challenges.
- Since the landfills were classified as low priority, there are no groundwater-monitoring wells. It is unknown if contaminants are leaching into the groundwater.
- The Deblois and Beddington landfills are located on sandy-gravelly soil that has a higher rate of leachability, thus more readily facilitating groundwater contamination.

NPS Prevention and Remediation Strategy

(See Sections 10 and 11 for more details)

1. Increase knowledge and awareness of known and suspected inactive landfills:
 - a. Focus surveying efforts on landfills.
 - b. Research, gather, and disseminate information on landfill guidelines and management plans.
 - c. Work with towns to encourage better inspection, monitoring, and maintenance.
 - d. Advocate for additional funding for monitoring of landfills based on proximity to and effect on salmon habitat.
2. Focus water quality monitoring efforts in waters associated with landfills.

Table 7.4. Potential Environmental Consequences of NPS Pollution

	Sedimentation	Loss of Riparian Vegetation	Loss of Aquatic Habitat	Alters Water Chemistry	Increase in Toxins	Nutrient Loading	Loss of Fish Passage	Thermal Stress
ATV USE	✓	✓	✓			✓	✓	✓
LOGGING ROADS	✓	✓	✓			✓	✓	✓
BLUEBERRY ACCESS ROADS	✓	✓	✓			✓	✓	✓
SAND/ SALT FACILITY	✓	✓		✓	✓	✓		✓
PEAT HARVESTING	✓		✓	✓	✓	✓		✓
TIMBER HARVESTING	✓	✓	✓			✓	✓	✓
FAULTY SEPTIC SYSTEMS						✓		
AGRICULT. FERTILIZERS				✓		✓		✓
AGRICULT. PESTICIDES		✓	✓	✓	✓			
WATER WITHDRAWAL			✓	✓			✓	✓
BEAVER ACTIVITY		✓				✓	✓	✓
ACID DEPOSITION		✓		✓	✓			
LANDFILL SEEPAGE					✓			

8. BEST MANAGEMENT PRACTICES

8.1 BEST MANAGEMENT PRACTICE RESOURCES

Water pollution caused by nonpoint sources can be prevented by encouraging actions by governments, organizations, businesses, industry, and individuals to prevent or reasonably minimize the discharge of NPS pollutants into waters. These actions are referred to as "Best Management Practice Guidelines" (BMPs). BMPs (defined at 38 M.R.S.A. 410-II) are practical and cost-effective siting, design, construction, or operational procedures which prevent or reduce pollution generated by nonpoint sources. BMP guidance manuals provide information on an assortment of pollution prevention or reduction methods. A BMP manual is like a toolbox containing a variety of tools for people to consider using to minimize water pollution.

Section 10 of this Plan describes the BMP strategies for repairing watershed NPS sites. See the end of this section for a listing of BMP Guidance Manuals that will be followed when repairing these sites. In addition, the reader should refer to the "Nonpoint Source Pollution Bibliography for the Narraguagus River Watershed" (Arter, 2001).

8.2 ATLANTIC SALMON BMP GUIDELINES

In addition to agency-specific BMPs, Project SHARE Restoration Working Group and NOAA Fisheries are currently developing "Atlantic Salmon BMP Guidelines" designed specifically to address road crossings in Atlantic salmon habitat. The group will develop user-friendly BMP guidelines for construction and maintenance associated with roads that are protective of Atlantic salmon habitat and promote habitat connectivity through fish passage. This document is expected to be completed in Fall 2003 and will become part of the "Endangered Species Act Recovery Plan".



The "Atlantic Salmon BMP Guidelines" will summarize existing BMPs and recommend the most "fish-friendly" best management practice to be used when crossing or working in Atlantic salmon habitat.

8.3 AGENCY BMPS RESOURCE LIST

LOGGING

- Maine Department of Conservation. 1992. Best Management Practices Field Handbook. Maine Forest Service, Augusta, ME. 36 pp.
- Maine Department of Environmental Protection. 2000. A Field Guide To Laws Pertaining to Timber Harvesting in Organized Areas of Maine. Augusta, ME: Division of Watershed Management. 35pp.
- Maine Land Use Regulation Commission. 2001. Erosion Control on Logging Jobs. Land Use Handbook Section 6. Maine Department of Conservation, Augusta, ME. 48 pp.

- Wiest, Richard L. 1998. A Landowners Guide to Building Forest Access Roads. NA-TP-06-98. USDA Forest Service, Northeastern Area State and Private Forestry. Radnor, PA. 45pp.

WATER WITHDRAWAL

- Maine State Planning Office. 2001. Downeast Salmon Rivers Water Use Management Plan. Augusta, Maine. 95 pp.

RIPARIAN BUFFER

- Hardesty, P. and C. Kuhns. 1998. The Buffer Handbook: A Guide to Creating Vegetated Buffers for Lakefront Properties. Maine Department of Environmental Protection, Augusta, Maine. 20 pp.
- USDA National Resource Conservation Service. 2000. Riparian Area Inventory and Assessment Guide. 31 pp.

AGRICULTURE

- Cranberry Technical Workgroup. 1997. Cranberry Beds Construction Planning Guide. Maine Department of Environmental Protection, Augusta, Maine. 22pp.
- University of Maine Cooperative Extension Service. 1989. Best Management Practices for Maine Agricultural Producers. Orono, Maine.
- University of Maine Cooperative Extension Service. 1995. Lowbush Blueberry Guide. Orono, Maine.
- University of Maine Cooperative Extension Service. 1997. Cranberry Agriculture in Maine: a Grower's Guide. Orono, Maine
- Maine Department of Agriculture. 1991. Strategy for Managing Nonpoint Source Pollution from Agricultural Sources and Best Management System. Augusta, Maine.

SAND/SALT

- Maine Department of Environmental Protection. 1995. Sand/Salt Storage Best Management Practices. Bureau of Land and Water Quality, Augusta, Maine.

EROSION

- Maine Department of Environmental Protection and the Cumberland County Soil and Water Conservation District. 1991. Maine Erosion and Sediment Control Handbook for Construction: Best Management Practices.
- Maine Department of Transportation. 2002. Fish Passage Policy and Design Guide. Augusta, Maine

PESTICIDES

- Board of Pesticides Control. 1996. Hexazinone State Management Plan for the Protection of Ground Water (Draft). Board of Pesticides Control, Dept. of Agriculture, Augusta, Maine.
- Gould, T.L. 1994. Maine Generic State Management Plan for Pesticides and Ground Water. Board of Pesticides Control, Dept. of Agriculture, Augusta, Maine.

9. PROJECT MANAGEMENT

9.1 WATERSHED NPS ACCOMPLISHMENTS TO DATE

Over the past three years, the NRW, Project SHARE, WCS&WCD, NRCS, MDEP, LURC, and the primary stakeholders have been effectively working to remediate the 175 NPS sites in the Narraguagus River Watershed. Although 175 sites have been documented between 1999 and 2001, approximately 30% of these sites have either been fully repaired or are in the process of completion.

In addition to the remediation of sites, these organizations have also initiated or participated in educational programs designed to enforce BMPs and prevent NPS pollution. Table 11.1 summarizes NPS accomplishments and activities in the watershed to date.

Table 9.1. NPS Accomplishments in the Narraguagus River Watershed.

DATE	ACCOMPLISHMENT
Summer 1999	LURC NPS Survey DEP 319 NPS Survey Riparian Buffer Survey
Summer 2000	LURC NPS Survey
April 2001	Public Lecture: Bjorn Vad, Salmon Restoration Specialist
May 2001	Public Notification of NPS Survey: Newspaper, letters, posters NPS Survey of Beddington, Deblois Press Release NWMP Grant Award in Newspapers Workgroup Meeting #2: NPS Issues Brainstorming Narraguagus River Clean Up and Tree Planting Stocking of Salmon Fry in Narraguagus and Tributaries Workgroup Meeting #3: NPS Goals and Objectives
June 2001	NPS Survey of Cherryfield and Lakes International Paper begins work on repairing 65 NPS sites Workgroup Meeting #4: Management Plan Project Planning Session Narraguagus River Canoe Trip Workgroup Meeting #5: NPS Issues Related to Logging Roads Cherryfield 4th of July NPS Information Booth
July 2001	Workgroup Meeting #6: Acid Deposition, Mark Whiting DEP Workgroup Meeting #7: Sand/Salt Facilities
Sept 2001	Workgroup Meeting #8: ATV, Brian Bronson, MDOC Little Narraguagus ATV Bridge Project NPS Presentation: Cherryfield Planning Board Workgroup Meeting #9: Septic Systems, Peter Duston, Cfield Plan. Board NPS Public Lecture Series #1: Mark Whiting, Narraguagus Water Quality Submit Narraguagus WMP Work Plan to DEP Submit Narraguagus WMP Bibliography to DEP
Oct 2001	Tour of NPS Sites with State and Federal Agency Representatives

	Workgroup Meeting #10: Agricultural Fertilizers
	Attendance at Salmon Conference in Orono
	Workgroup Meeting #11: Agricultural Water Withdrawal
	West Branch ATV Trail NPS Sites Project
	NPS Public Lecture Series #2: Logging Road BMPs, Tom Rukznis, IP
	ATV Trail Initiative & Partnership with AMC/NPS Rivers and Trails
	Attendance at Forestry Conference in Orono
	Council Successfully Advocates for New Cherryfield Sand/Salt Facility
Nov 2001	NPS Site Prioritization Workgroup Meeting
	Workgroup Meeting #12: Blueberry Access Roads
Dec 2001	NPS Public Lecture Series #3: Blueberry Pesticides, Kelley Wescott, CFI
	Sponsorship of NPS Prioritization Workshop
Jan 2002	Workgroup Meeting #13: Agricultural Pesticides, Julie Chizmas, MBPC
	NPS presentation: Town of Milbridge
	Workgroup Meeting #14: Peat Harvesting, Marcia Spencer-Famous, LURC
	NPS Prioritization Meeting
Feb 2002	Workgroup Meeting #15: Beaver Activity, Tom Schafer, MIF&W
	Workgroup Meeting #16: Landfill Seepage and Underground Storage Tanks
	Workgroup Meeting #17: NPS Sites Assessment
	NPS Public Lecture #4: NPS Pollution Associated with Aquaculture
Mar 2002	Workgroup Meeting #18: NPS Prevention Strategic Plan
April 2002	NRCS/DEP NPS Workshop #1 in Machias, Bill Laflame, DEP
	NRCS/DEP NPS Workshop #2 in Machias, Nate Pennell, WCS&WCD
	Narraguagus ATV Club Formation
	Attendance at DEP Water Conference, Augusta
May 2002	Attendance at DEP NPS Workshop in Boothbay
June 2002	Restoration Working Group initiates Atlantic Salmon BMP Guidelines
	Little Narraguagus Bridge Completed
	Attendance at the Fluvial Geomorphology Workshop
July 2002	Sinclair Barrens Bridge Completed
August 2002	Cherryfield Mill Site Completed
October 2002	CHAMP sites Completed
	Arched Culvert placed at Baker Brook
	MFS/WCS&WCD Skidder Bridge Training

9.2 MANAGEMENT OF NPS SITES

Figure 9.1 illustrates how the NRW will work closely with its partners to repair the remaining NPS sites following a planning process that will include:

1. identification and prioritization of the NPS sites,
2. development of site plans and BMPs,
3. locating appropriate funding,
4. implementation of repair or BMP, and
5. evaluation of effectiveness of the repair and maintenance.

In addition to site repair, the partners will:

1. continue or increase NPS surveying,
2. continue to update the GIS database and the documentation process, and
3. continue or increase water quality monitoring at the more sensitive sites.

9.4 PLAN OWNERSHIP

The Narraguagus River Watershed NPS Management Plan was initiated by the Narraguagus River Watershed Council in 2000 using Project SHARE as its fiscal partner. The NRWC is a grassroots organization of volunteers that have a common interest in the welfare of the Narraguagus River Watershed. Membership is open to all interested parties and dues are a nominal \$5. The Council office is located in the LURC Office at 7 Campbell Hill (Route 1) in Cherryfield.



The NWRC and Project SHARE, will take the lead on ensuring that the action items in this plan are initiated.

This plan is a product of the watershed stakeholders from industry, government, and the community and, as such, the responsible party for each action item may be the NRWC or any one these partnering stakeholders.

Since the NRWC is not a legally recognized 501 c3 (nonprofit) organization, it may use Project SHARE or other organizations (such as the DERC&D) as its fiscal agent for its NPS projects. In addition, Project SHARE has established its own history of successful NPS projects and relationships in the Narraguagus River Watershed. Together the two organizations will provide the leadership necessary to carry out the action items in this plan. Project SHARE and the NRWC will develop effective partnerships with large landowners, municipalities, community organizations, and state and federal government agencies. To date, Project SHARE and NRWC have partnered with the following:

NPS PARTNERS

Downeast Salmon Federation
Washington County Soil and Water Conservation District
USDA Natural Resource Conservation Service
Downeast Resource Conservation and Development Council
Maine Department of Environmental Protection
International Paper
Cherryfield Foods
Jasper Wyman and Son
Land Use Regulation Commission
National Marine Fisheries Service
Municipalities of Cherryfield, Milbridge, Deblois, and Beddington
Atlantic Salmon Commission
Maine Department of Conservation
Narraguagus ATV Club
Acadia ATV Club

9.5 LEADERSHIP ACTION ITEMS

In order to effectively enact the action items of the Plan, Project SHARE and NRW, will:

1. hire a Council Coordinator to build capacity, find funding, and manage NPS projects,
2. actively participate in the Project SHARE Restoration Committee (See below),
3. encourage and support the use of the NPS Restoration Prioritization Scheme, The Project SHARE NPS GIS Database, and the "Atlantic Salmon BMP Guidelines" (see Section 8),
4. actively seek input (financial and otherwise) from municipalities in order to strengthen NPS ownership of town projects,
5. continue to seek financial contribution (possibly in the form of cost-sharing) from large landowners for projects on their land, and
6. continue to seek funding from state and federal government agencies and private foundations for NPS programs and projects.

Project SHARE NPS Restoration Working Group

In December 2001, the NRW (DEP 319 NWMP Funding) and Project SHARE sponsored an NPS Prioritization Workshop that was attended by over 30 state and federal officials and local stakeholders. The workshop was extremely effective and brought focus to the issue of how to prioritize NPS sites based on salmon habitat. As a result of the workshop, a Restoration Working Group was formed. This working group is comprised of NPS professionals and state and federal officials and meets quarterly to develop a prioritization scheme for land managers. To date, the Working Group has been effective in initiating the development of the:

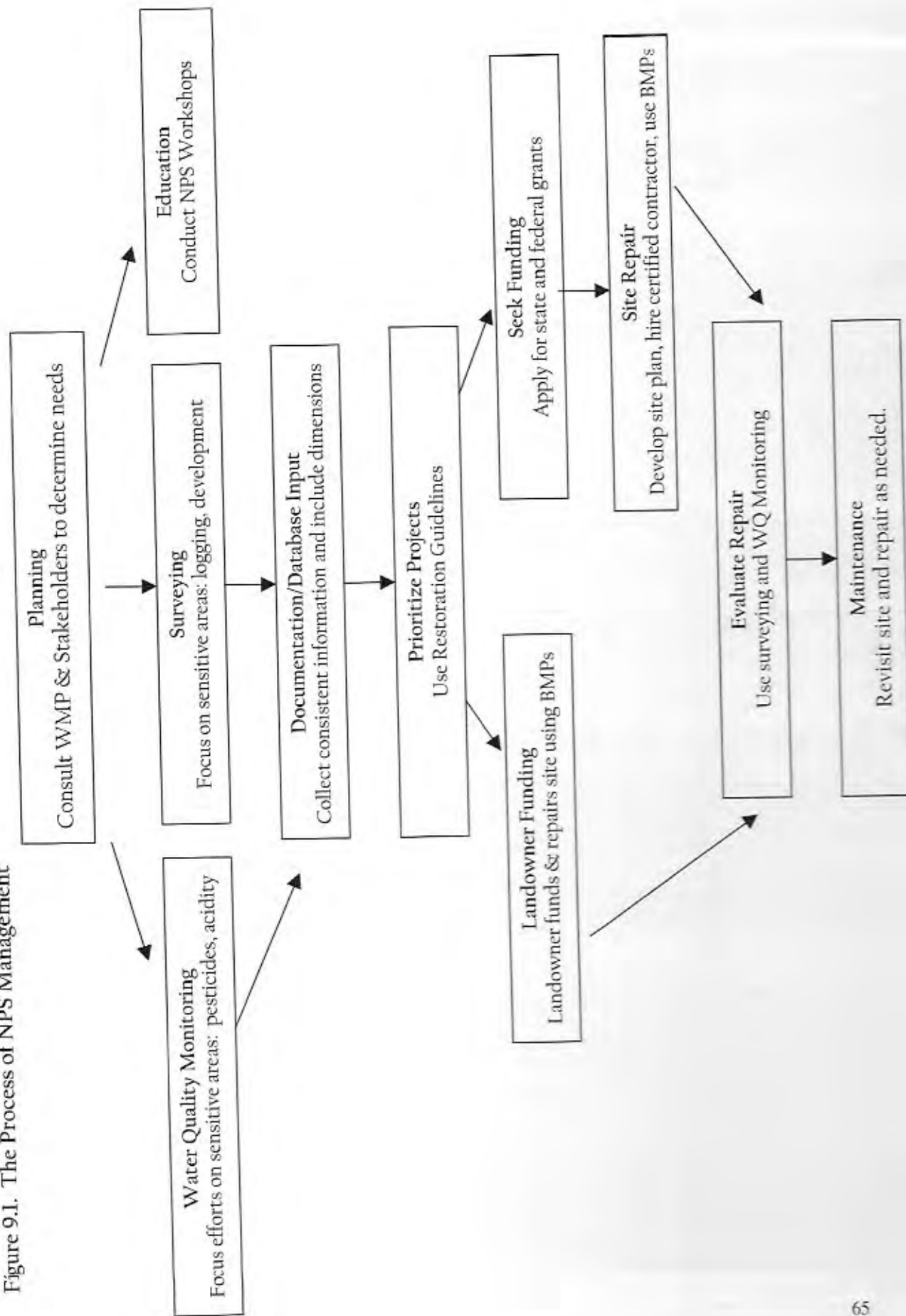
1. NPS Restoration Prioritization Scheme,
2. Atlantic Salmon Subwatershed Priority Map,
3. Project SHARE NPS GIS Database,
4. MDEP NPS Site Evaluation, and
5. "Atlantic Salmon BMP Guidelines"

9.6 POSSIBLE NPS & RESTORATION FUNDING SOURCES

The following agencies are either currently funding the remediation of sites or are potential funders:

International Paper
Cherryfield Foods
National Fish and Wildlife Foundation
Maine Department of Environmental Protection
Maine Atlantic Salmon Commission
Maine Department of Transportation
USDA National Resource Conservation Service - Farm Bill
Maine Department of Conservation
US Fish and Wildlife
Jasper Wyman and Son
NOAA Fisheries

Figure 9.1. The Process of NPS Management



10. IMPLEMENTATION STRATEGY

10.1 REMEDIATION OF CURRENT NPS SITES

Objective #1 of the Narraguagus River Watershed Management Plan (see Section 5.2) is to "Eliminate or reduce existing nonpoint sources of pollution." Table 10.1 is designed to meet this objective. It summarizes the remediation and implementation strategy that will be used (or is being used) to repair the 175 NPS sites in the Narraguagus River Watershed. As stated earlier approximately 50% of the sites are either repaired or in the process of being repaired using the appropriate BMPs for each critical area. The table groups the sites according to who is repairing the site or how the site-repair is funded rather than by land use (see Figure 9.1).

Table 10.1. Implementation Strategy for NPS Sites in the Narraguagus Watershed.

SITE DESCRIPTION	NPS PROBLEM	ACTION	RESPONS. PARTY	TIME FRAME	COST/FUNDING SOURCE	TECH. ASSIST.	PRIORITY
Logging Roads	Approximately 65 sites have faulty culverts, poor ditching, unstable shoulders, and road runoff.	Replace culverts, reshape ditch, stabilize shoulders, reshape road, seed and mulch bare soil	Landowner	2001-2004	\$10,000 Landowner (Some state & federal cost sharing)	Medium	High Subwatershed #1
Little Narraguagus ATV Bridge #1	Old bridge deteriorated, unstable, erosion near abutments.	Build new bridge, stabilize shoulders and abutments, rip-rip, seed and mulch bare soil	Project SHARE/NRWC	2001-2002 Completed	\$3,000 ASC	Medium	High
West Branch ATV Trail	Approximately 12 sites with runoff, erosion, and unstable shoulders	Reshape trail, stabilize shoulders, establish ditch, seed and mulch bare soil	Project SHARE/NRWC	2001-2003	\$1,500 ASC \$2,000 NOAA	Low	Medium
Route 182 Church Parking Lot in Cherryfield	Steep eroding slope	Regrade slope, install earthen diversion at top, cover with top soil and vegetate, reshape and vegetate ditch at base of slope	WCS& WCD	2001-2002	\$6,000 DEP 319	Medium	Medium



Dan Kirchner, NOAA

New Little Narraguagus ATV Bridge

River Road Church Parking Lot in Cherryfield	Runoff and erosion from parking lot into river	Stabilize driveway, install water bar, divert runoff, widen road ditch, redirect uphill ditch to allow water to runoff into existing culvert	WCS& WCD	2001-2002	\$6,000 DEP 319	Medium	Medium
Ice Dam /Cable Pool in Cherryfield	Erosion of sand from parking area and shoreline erosion above dam.	Install rock rip-rap, stabilize bank, install earthen diversion to divert surface runoff, seed and mulch bare soil.	WCS& WCD	2001-2002	\$5,500 DEP 319	Medium	High
Sinclair Barrens ATV Bridge and Trails	Approximately 10 sites: fording river in priority salmon habitat, many sites with runoff, erosion, and unstable shoulders	Build suspension bridge to cross river, reshape trail bed, stabilize shoulders, build new road for landowner, rip-rap and vegetate.	Project SHARE/ NRWC	2001-2002 Completed	\$70,000 ASC NFWF MDOC IP \$5,400 Trout Unlimit.	High	High Subwater-shed #1
Cherryfield Sand/Salt Facility	Erosion of sand and salt directly into river	Build new facility at different location, reclaim old site by removing contaminated soil, stabilize, and revegetate site	Project SHARE/ Town of Cherryfield	2002-2004	\$79,000 MDOT \$3,500 NFWF \$75,000 NMFS	High	High
Old Sawmill Pond in Cherryfield Village	Sedimentation form stream due to loss of earthen dam	Redirect stream to original location, stabilize banks, install sediment basin	Project SHARE/N RWC	2001-2002 Completed	\$15,000 NFWF Landowner Incentive Program	High	Medium
Little Narraguagus ATV Bridge #2	ATV's fording River	Build new bridge, stabilize shoulders and abutments, seed and mulch bare soil	Project SHARE/ NRWC	2001-2002 Completed	\$500 ASC	Medium	High
Railroad Tracks	Approximately 5 sites along the railroad tracks with faulty culverts, unstable shoulders, pesticide drift, or thin buffer	Work with MDOT to replace culverts, stabilize shoulders, establish buffer, minimize pesticide drift	MDOT	2002-2004	\$3,000 MDOT	Low	Medium
State Roads	Approximately 5 sites with faulty culverts, poor ditching.	Work with state to replace culverts, reshape ditch, stabilize shoulders, reshape road, seed and	MDOT	2002-2004	\$5,000 MDOT	Medium	High

	unstable culverts, road runoff	mulch bare soil						
Lawrence Brook Bridge	Bridge opening too narrow, erosion.	Bridge Replacement	MDOT	2003-2005	\$30,000-\$50,000	High	High	
Milbridge/Cherryfield Town Roads	Approximately 12 sites with faulty culverts, poor ditching, unstable culverts, road runoff	Work with town to replace culverts, reshape ditch, stabilize shoulders, reshape road, seed and mulch bare soil	NRWC/Project SHARE/Town of Milbridge	2002-2004	\$10,000 DEP 319 MDOT	Medium	Medium	Medium
Blueberry Field Access Roads	Approximately 18 sites with faulty culverts, poor ditching, unstable culverts, road runoff or thin buffers	Work with landowner to replace culverts, reshape ditch, stabilize shoulders, reshape road, seed and mulch bare soil, plant more trees to increase buffer capacity	Landowner/NRWC/Project SHARE/NRCS	2002-2004	\$10,000 USDA/NRCS Landowner Cost-Share	Medium	Medium	Medium
Miscellaneous ATV Trails	Approximately 12 sites scattered throughout the watershed with runoff, erosion, and unstable shoulders	Work with ATV Club to Reshape trail, stabilize shoulders, establish ditch, seed and mulch bare soil	Project SHARE/ATV Club/NRWC MDOC	2002-2004	\$10,000 MDOC NOAA	Medium	Medium	Medium
Private Driveways, Camp Roads, Shorefront	Approximately 12 sites with road runoff, beach erosion, unvegetated soil	Work with landowner to regrade road, install diversions and ditches, stabilize bank with riprap or vegetation	Landowner/NRWC/Project SHARE	2003-2005	\$8,000 DEP 319 Landowners	Low	Low	Medium

II. PREVENTION STRATEGY

Objective #2 of the Narraguagus River Watershed Management Plan (see Section 5.2) states that the NRWC and its partners will work to "prevent future sources of NPS Pollution." The objective contains several components designed to help the stakeholders achieve NPS Prevention. These components include:

- better planning and use of existing plans and BMPs.
- continue/increase water quality monitoring and NPS surveying.
- increase public awareness, training, and advocacy with regard to watershed issues.

Table 11.1 is a listing of action items for each specific land use or NPS issue discussed during the eighteen-month NRWMP planning process (see Section 7). Although the list is extensive, it is designed to act as a menu of possible action items that the stakeholders can choose from in order to meet their objectives. In addition, many of the action items are currently in progress or have been completed within the past year.

Table 11.1. Narraguagus River Watershed NPS Prevention Strategy.

OBJECTIVE	ACTION ITEM	RESPONSIBLE PARTY	PRIORITY	TIME FRAME
LOGGING Educate /advocate for better road building and harvesting practices	Sponsor timber harvesting and road building BMP training sessions	NRCS/DEP/ LURC/MFS	High	2004
	Work with land trust organizations to develop proper road-building and timber-harvesting management guidelines for inclusion in conservation easements. Guidelines should plan for short-term and in-perpetuity management.	NRWC/QRLT/ DLT/Nature Conservancy/ Landowners	Medium	2005
	Encourage landowners and contractors to participate in Sustainable Forestry Initiative, Maine Tree Farmers System, and Small Woodland Owners Association of Maine. Distribute information. Sponsor training/workshop.	NRWC/SFI/ Project SHARE/ IP/SWOAM	Low	Ongoing 2005- 2006
	Share database of state-certified road-building and timber-harvesting contractors with local landowners. Use database to share information, conduct training sessions, and distribute to landowners.	NRWC/DSF/ LURC/MFS	Low	Ongoing
Develop a technical assistance program for landowners.	Encourage timber harvesters to use the "Portable Skidder Bridge Program" available from MFS, NRCS, and IP.	NRWC/MFS/IP/ NRCS	High	Ongoing

ACID DEPOSITION				
Increase water quality monitoring	Work with and encourage companies to conduct monitoring on company lands.	NRWC/ Landowners	Low	Ongoing
Improve data coordination among agencies	Implement more automated data loggers. Develop a data coordination program. Phase I: Data collection, organization, and coordination between agencies/landowner Phase II: Create database website so that agencies, volunteers, stakeholders have access to information. Advocate for hiring a WQ data coordinator/manager	DEP/ASC/NMFS NRWC/DEP/ NMFS/ASC	High Medium	2003 2004
Reduce acidity in priority salmon habitat areas	Investigate the possibility of acid rain mitigation such as liming. Develop an experimental project in which lime is added to a specific tributary and studied over time.	NRWC/DEP/ ASC/NMFS UM / NMFS/ASC	High Medium	2003 2005
SAND/SALT FACILITIES				
Improve or Replace Storage Facilities	Find new location and funding such as community development block grants or private funding for Milbridge sand/salt shed	Town of Milbridge/ NRWC/MDOT	Medium	2006
Education	Conduct BMP training for sand/salt operators, especially storage and application standards.	DEP/SHARE/ MDOT	High	2004
Increase Monitoring	Conduct inventory of area S/S facilities including size of facility, evidence of leaching and erosion, size and effectiveness of buffer, and proximity to waterway. Use information to make better management decisions. Advocate for use of calcium chloride on all roads especially those affecting priority salmon habitat.	NRWC/Towns	High	2003- 2004
		NRWC/DEP/ ASC/NMFS/ Towns/MDOT	Low	2003- 2004
SEPTIC SYSTEMS				
Increase monitoring of sites	Focus sampling in areas of known or suspected wastewater contamination. Sponsor a volunteer shore stewards monitoring program and lake's monitoring program	Towns /Lake Assoc./Shore Stewards/DEP/ DMR	High	2003- 2004
Education	Let the public know about closings due to fecal coliform	Towns /Lake Assoc./Shore Stewards/DEP/ DMR	High	Ongoing
	Produce/obtain and distribute a "How to" pamphlet on maintaining a non-polluting ODB system and household hazardous materials	DEP/DMR/ Towns/NRWC	Low	2004

	Conduct community hazardous waste pick up program	DEP/NRWC/ Towns	Medium	2004
Reduce NPS pollution from human waste	Conduct more frequent OBD inspections: (Pay plumbing inspector to inspect systems and/or divert state inspection fee back to town) Research alternatives to OBD systems and replace OBDs with a town group system or individual modern systems. Partner with town governments to obtain funding to upgrade systems, such as from the block grant program.	DEP/DMR/ Towns/NRWC	High	2004
		DEP/DMR/ Towns/NRWC	Medium	2005- 2006
		DEP/DMR/ Towns/NRWC	Medium	2005- 2006
ATV USE				
Promote education of ATV users	Sponsor the creation of an ATV Club. Sponsor ATV Stewardship Workshop. Create educational kiosks and place throughout the watershed. Advocate for funding for greater law enforcement and trail maintenance.	NRWC/ATV Club/MDOC	High	2002
		NRWC/ATV Club	High	2005- 2006
Promote the formation of an organized trail system	Partner with landowners and the Maine Department of Conservation to create organized system of authorized trails. Work with ATV clubs and MDOC to create and distribute ATV maps.	IP/NRWC/CFI/ Wyman's/MDOC /DOT	High	2002- 2003
Promote proper maintenance of ATV trails	Establish agreement with DOC/ATV Club for maintenance of trails. Sponsor volunteer projects for maintenance. Create ATV Stewardship Initiative: Information Brochure Stewardship Form Training for ATV Stewardship "Sensitive Habitat" and "No Spin" Signage.	NRWC/DOC/ATV V Club	High	2002
		Project SHARE NRWC ATV Clubs MDOC AMC River & Trails	High	2002- 2003
PHOSPHOROUS				
Increase Water Quality Monitoring	Create a Shore Stewards Coastal Monitoring program and Lake Monitoring Program. Encourage DEP to conduct more sampling (core samples of lake sediments?)	Towns/DMR/NRWC/DEP/Lake Associations Lake Assoc./NRWC/DEP	Medium	2003- 2004
Increase Public and Grower Awareness	Sponsor formation of Lake Associations at Beddington, Schoodic, Spruce Mountain Lakes	NRWC/Towns/DEP	Low Medium	2003- 2004 2003- 2004

	Sponsor a public blueberry field day/tour in with cooperation with the blueberry companies	NRWC/ Companies/ NRCS/S&WCD	Low	2004
Encourage BMPs	Encourage growers to become part of the Integrated Crop Management Program	UMO/SCD/ NRCS	Medium	Ongoing
	Provide technical assistance/training program to growers for employing BMPs	UMO/SCD/ NRCS	Medium	2004- Ongoing
WATER WITHDRAWAL				
Encourage BMPs	Work to expand and protect riparian zones and maintain riparian buffers. Phase I: Survey and document riparian zones. Phase II: Acquire funding to perform plantings Phase III: Work with landowner to conduct plantings and maintain buffers	NRWC/ Landowners/ NRCS/SCD/MFS /NFWF	High	2004- 2005
	Encourage landowners to keep flail-mowed plant litter on the ground in order to reduce evaporation. Sponsor/conduct ongoing studies on blueberry plant moisture requirements.	NRWC/ Landowners	Medium	Ongoing
Encourage use of WUMP	Encourage landowners to follow WUMP guidelines, drawdown limits, and reporting withdrawals.	NWRC /Landowners	High	Ongoing
Encourage better communication with public	Conduct open field days on BB company fields	NRWC/BB Landowners	Low	2004
BLUEBERRY FIELD ACCESS ROADS				
Encourage use of BMPs	Sponsor road-building BMP training workshops	NRWC/NRCS/ LURC/MFS	High	2004- 2005
Encourage landowners to follow DEP/LURC BMPs	Continue NPS surveying to document erosion, siltation, faulty culverts, bank destabilization. Encourage landowners to participate in cost-sharing and funding opportunities with state/federal agencies	NRWC/BB Growers	High	Ongoing
STATE AND TOWN ROADS				
Encourage use of BMPs	Encourage the MDOT, residential landowners, and towns to use MDEP-certified contractors.	NRWC/SHARE	High	Ongoing
	Work with landowner and towns to find cost-sharing opportunities to repair sites.	NRWC/SHARE	High	Ongoing
	Conduct BMP training workshop specific for road building.	NRWC/NRCS/ LURC/MDEP	Medium	2004- 2005
	Encourage MDOT, residential landowners, and towns to follow MDEP and LURC permitting guidelines and standards by working with them on specific projects.	NRWC/NRCS/ LURC/MDEP	Medium	2004- 2005

	Encourage MDOT, residential landowners, and towns to use "Atlantic Salmon BMP Guidelines."	NRWC/ SHARE	High	Ongoing
PESTICIDES				
Increase knowledge and awareness	Encourage better educational programs for growers and the general public. Examples, growers' supper and various IPM workshops.	UM/BB Growers		2004-2005
Improve water quality	Encourage the use of effective riparian buffers between spray areas and waterways. Participate in cost-sharing programs for tree plantings, etc.	NRWC/UM/BB Growers/NRCS		Ongoing
	Encourage use of the Drift Management Plan (DMP) that makes recommendations on best-spray technology, riparian buffers, and integrated pest management. Focus on water quality monitoring efforts on spray areas	NRWC, BB Growers, BPC		2003- Ongoing
	Encourage use of weather monitoring (on ground gauges and/or automated weather stations) in order to determine most effective time to spray.	BB Growers/BPC		Ongoing
PEAT HARVESTING				
Encourage the use of BMPs	Assist company in conducting water quality monitoring above and below sedimentation ponds both on the West Branch and main stem of river. Survey and monitor ditches and drainage areas for failure or effectiveness.	Landowner/CES/ LURC/DEP/ NRWC		2003-2004
	Participate in cost sharing projects to ensure integrity of ditching systems and confinement dikes.	Landowner/ LURC/DEP/		2003-2004
TIMBER HARVESTING				
Increase Education and Awareness	Increase Water Quality Monitoring to include timber harvesting sites before, during, and after harvesting in order to quantify/document the effects of harvesting.	SHARE MDEP NRWC	Medium	2003-2006
	Focus surveying on recently or currently harvested areas.	SHARE NRWC	High	2003-2005
	Encourage landowners and community members to use SFI (see Section 7.3) for reporting improper timber harvesting practices.	NRWC	Medium	Ongoing
Encourage the use of BMPs	Find funding and technical assistance to encourage protection of tributaries by using portable skidder bridge program	SHARE/ MFS NRWC	High	2003-2006
	Encourage smaller landowners to adopt a Riparian Zone Management Plan.	SHARE	Low	2004
	Conduct riparian plantings in thin buffer areas.	SHARE NRWC	High	2003-2005
BEAVER ACTIVITY				
Increase Education and Awareness	Conduct intensive beaver dam survey to catalogue and prioritize beaver dams. Collect watershed-specific beaver dam information from other agencies and add to	NRWC		2003- ongoing

	database.				
Reduce beaver dams/beaver population in watershed	Hire an animal control officer or trapper to either live trap and relocate the beaver or legally trap and kill the beaver.	Landowner/ NRWC/MIFW/ USFW/ASC			2003- 2005
	Make survey/map of beaver dams available to trappers in order to encourage beaver removal.	Project SHARE/NRWC			
	Work with MIFW and ASC to properly breach active and inactive dams to allow for fish passage while leaving enough habitat for the beaver to survive (in accordance with state and federal recommendations and permitting guidelines)	NRWC/ASC/ MIFW/ Landowner			
Improve water quality	Encourage riparian protection and best management practices to promote old growth forest through use of conservation easements, education, land acquisition, better laws and advocacy.	NRWC/DSF/ QRLT/NRCS/SCD			Ongoing
	Collaborate with MIFW to install "beaver deceivers" in culverts. These devices use screen and PVC pipe to deter beaver dam construction while maintaining adequate flow through culvert.	MIFW/NRCS/ NRWC			Ongoing
	Focus water quality monitoring above and below beaver dams in order to determine affects	DEP/LURC/ NRWC/UMM			2004
LANDFILL MAINTENANCE					
Increase knowledge and awareness of known/suspected inactive landfills	Research, gather, and disseminate information on landfill guidelines and management plans.	Towns/NRWC/ DEP			2004- Ongoing
	Focus surveying and water quality monitoring efforts on landfills.	Towns/NRWC/ DEP			2004- Ongoing
	Work with towns to encourage better inspection and monitoring.	Towns/NRWC/ DEP			2004- Ongoing
	Advocate for reclassification of landfills based on proximity to and effect on salmon habitat.	Towns/NRWC/ DEP			2004- Ongoing

12. EVALUATION PLAN

The stakeholders will use the following to determine the effectiveness of the Plan. The Plan will be considered effective if surveying, water quality monitoring, site repair, database maintenance, public outreach and participation, and funding are continued. It is recommended that stakeholders revisit and evaluate plan success annually.



The NRW and Project SHARE will gather the stakeholders annually to review the success of the Plan and all of their NPS efforts. The partners will evaluate work completed and plan the next year's programs and projects.

Surveying

- Continue NPS surveys in order to complete the watershed.
- Focus new surveys on septic systems, landfills, and other areas not previously studied.

GIS Database

- Continue to add digital photographs, documentation, and land use data to existing database.
- Use database to evaluate progress.
- Use database to create planning maps and documents.

Site Remediation

- Continue to find funding for site repair.
- Continue to repair the sites in the current database.
- Repair new sites added to database.

Water Quality Monitoring

- Conduct WQM before and after repair of a site in order to determine effectiveness.
- Focus WQM on septic systems, landfills, and other areas not previously studied.
- Use WQM data to justify funding, planning, and reclassification.

Evaluation of Repair

- Revisit repaired sites, photograph, and document condition.
- Maintain repairs as needed.

Public Outreach and Participation

- Encourage public participation in site repair.
- Continue public lectures, and outreach activities.

Funding for Sites

- Continue to work with stakeholders to find new sources of funding.

Management

- Reconvene the original workgroup, review the plan progress and prepare a report on status of achievement.
- Track all achievements, such as press releases, outreach activities, number of sites repaired, number of volunteers, amount of funding received, number of sites documented, etc.

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APPENDIX

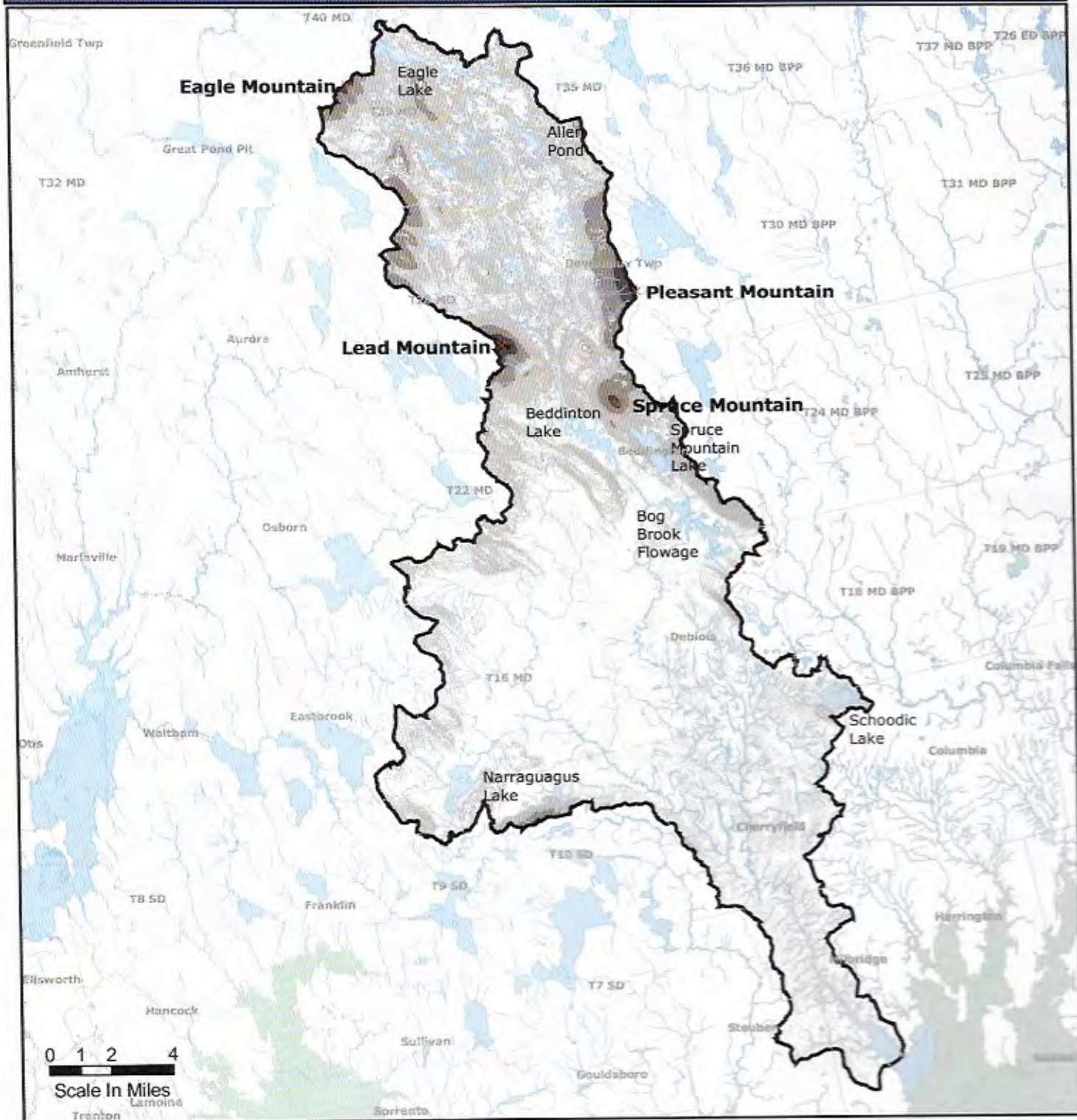
MAPS OF THE

NARRAGUAGUS

RIVER

WATERSHED

Map 2.1 Major Landmarks and Elevations



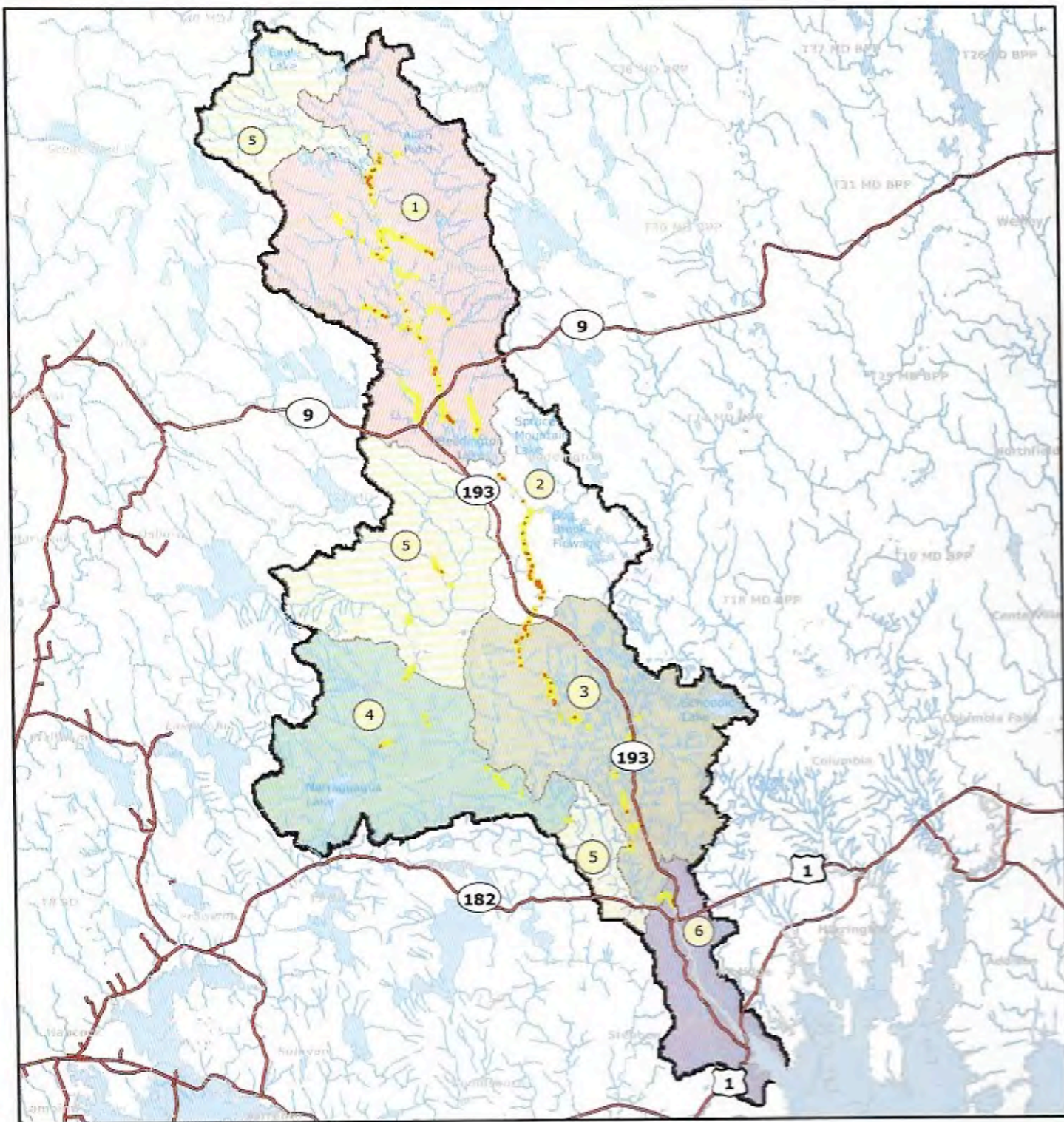
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|---|--------------------|--|
| × | Mountain Peak | |
| — | Rivers & Streams | |
| — | Lakes & Ponds | |
| — | Town Line | |
| — | Watershed Boundary | |
- | ELEVATION | |
|-------------|--|
| 0 - 300 | |
| 301 - 600 | |
| 601 - 900 | |
| 901 - 1200 | |
| 1201 - 1500 | |

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Data provided by:
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Atlantic Salmon Commission
Maine Office of GIS
Revised November 2002



Map 2.2 Atlantic Salmon Priority Watersheds



Priority Subwatersheds (ASC 2002)

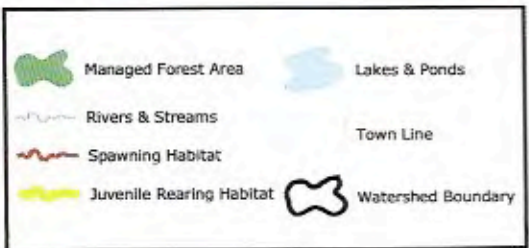
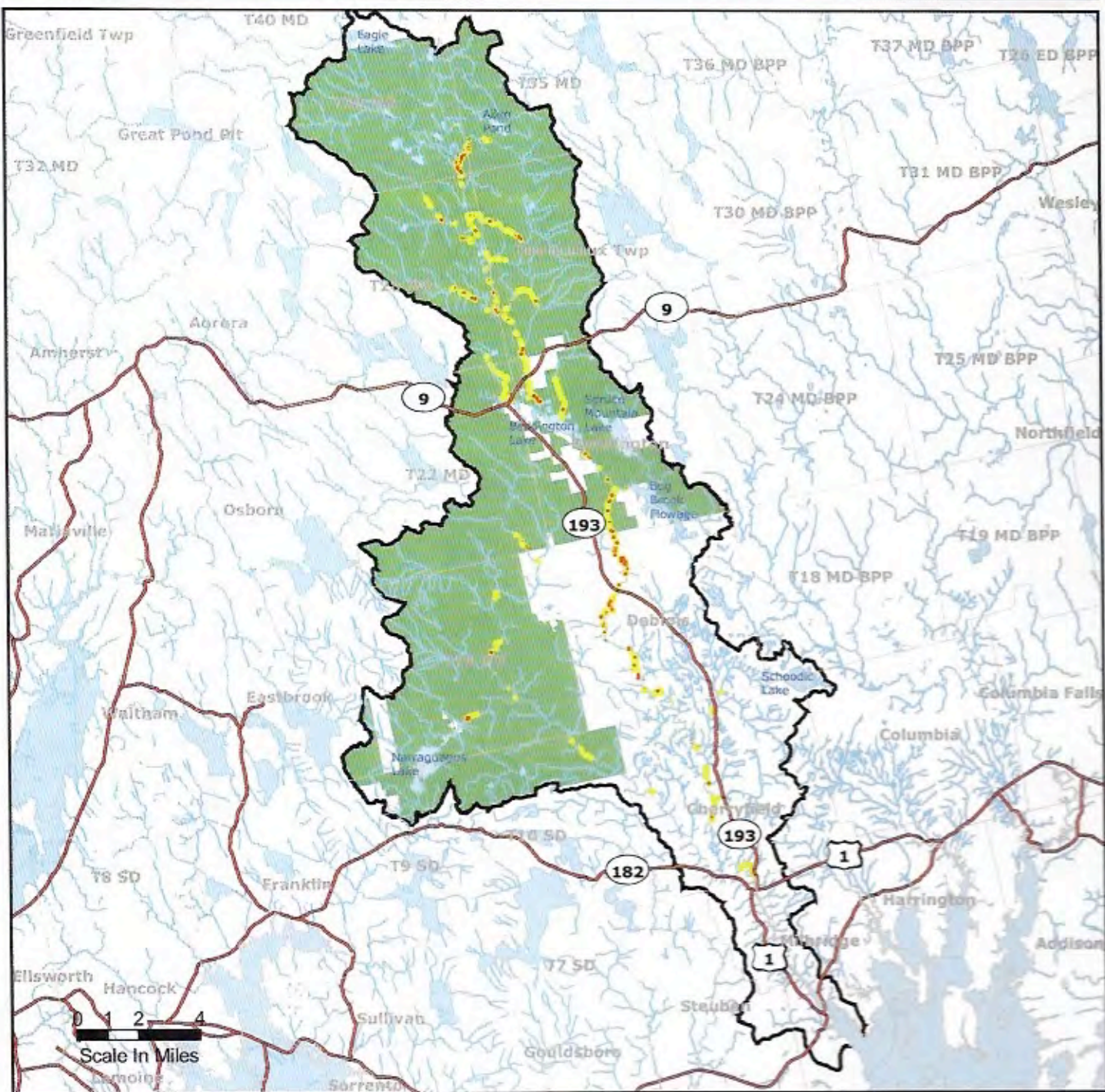
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|---|--------------------------|
| 1 Deer Lake Outlet to Beddington Outlet | Rivers & Streams |
| 2 Beddington Outlet to Debris Falls | Spawning Habitat |
| 3 Debris Falls to Little Falls | Juvenile Rearing Habitat |
| 4 Rock Dam to Spring Lake | Lakes & Ponds |
| 5 Other Freshwater | Town Line |
| 6 Estuary | Watershed boundary |

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Map 3.1 Lands Under Timber Management

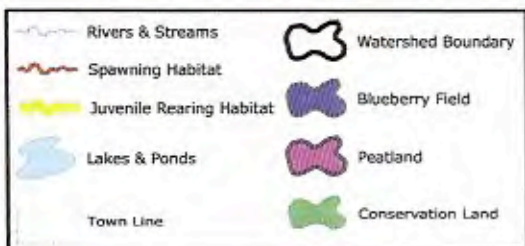
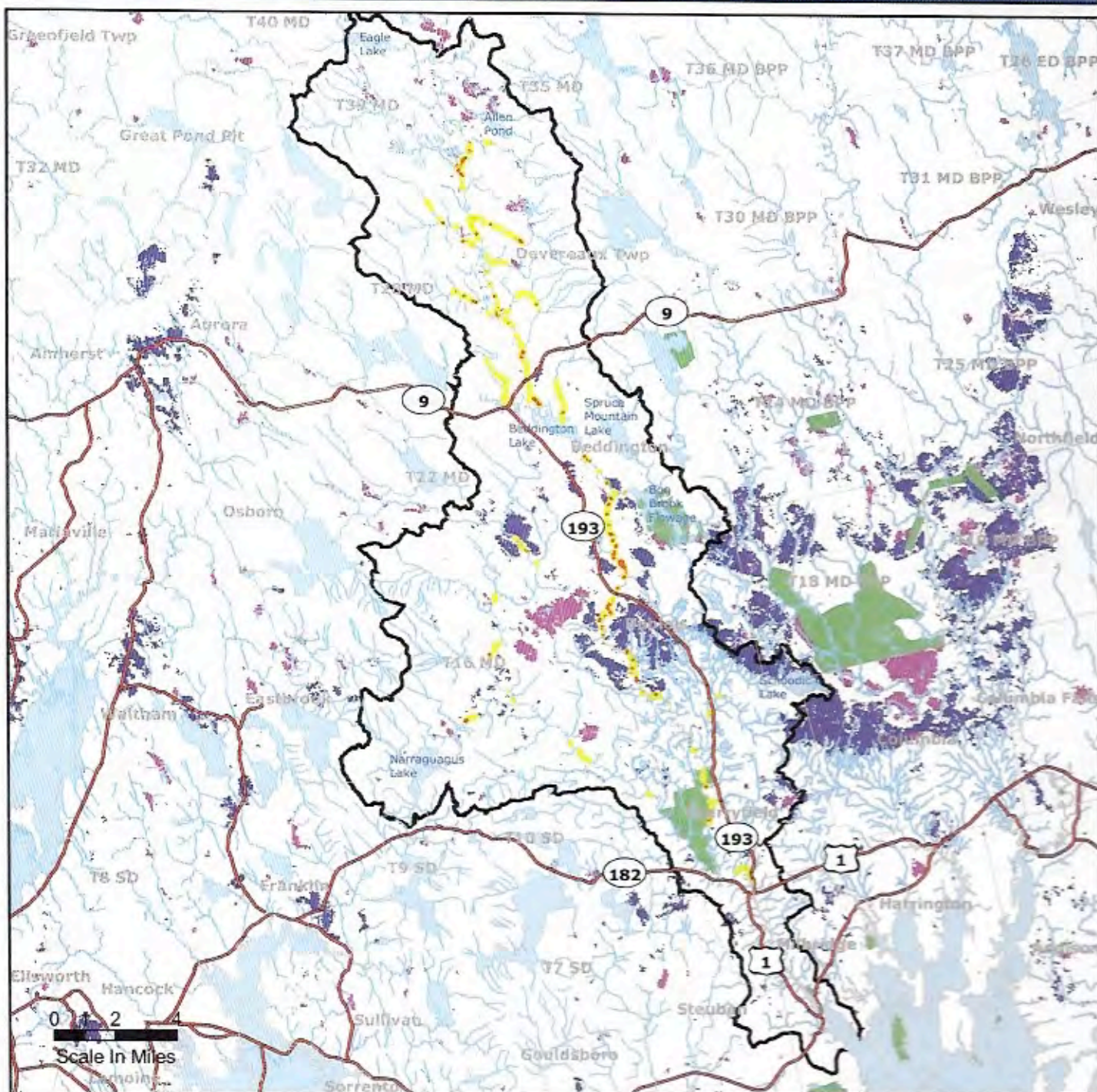


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Map 3.2 Agricultural, Peat & Conservation Lands

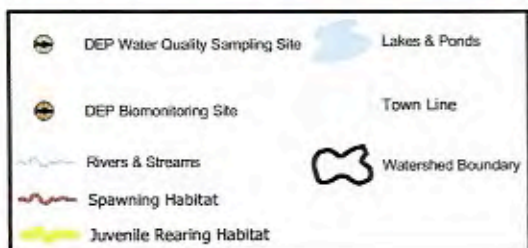
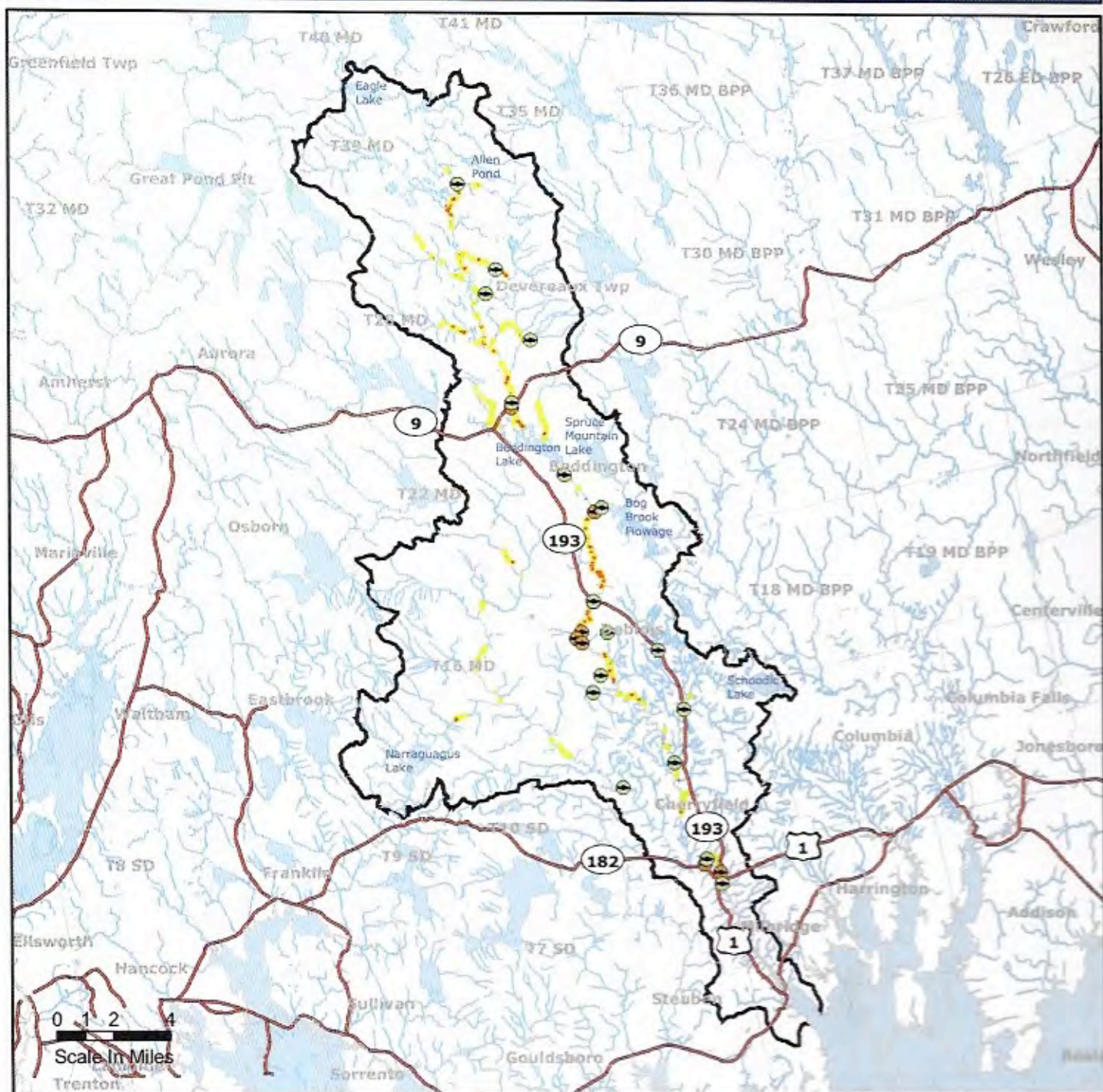


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Map 4.1 DEP Biomonitoring & Water Quality Sampling Sites



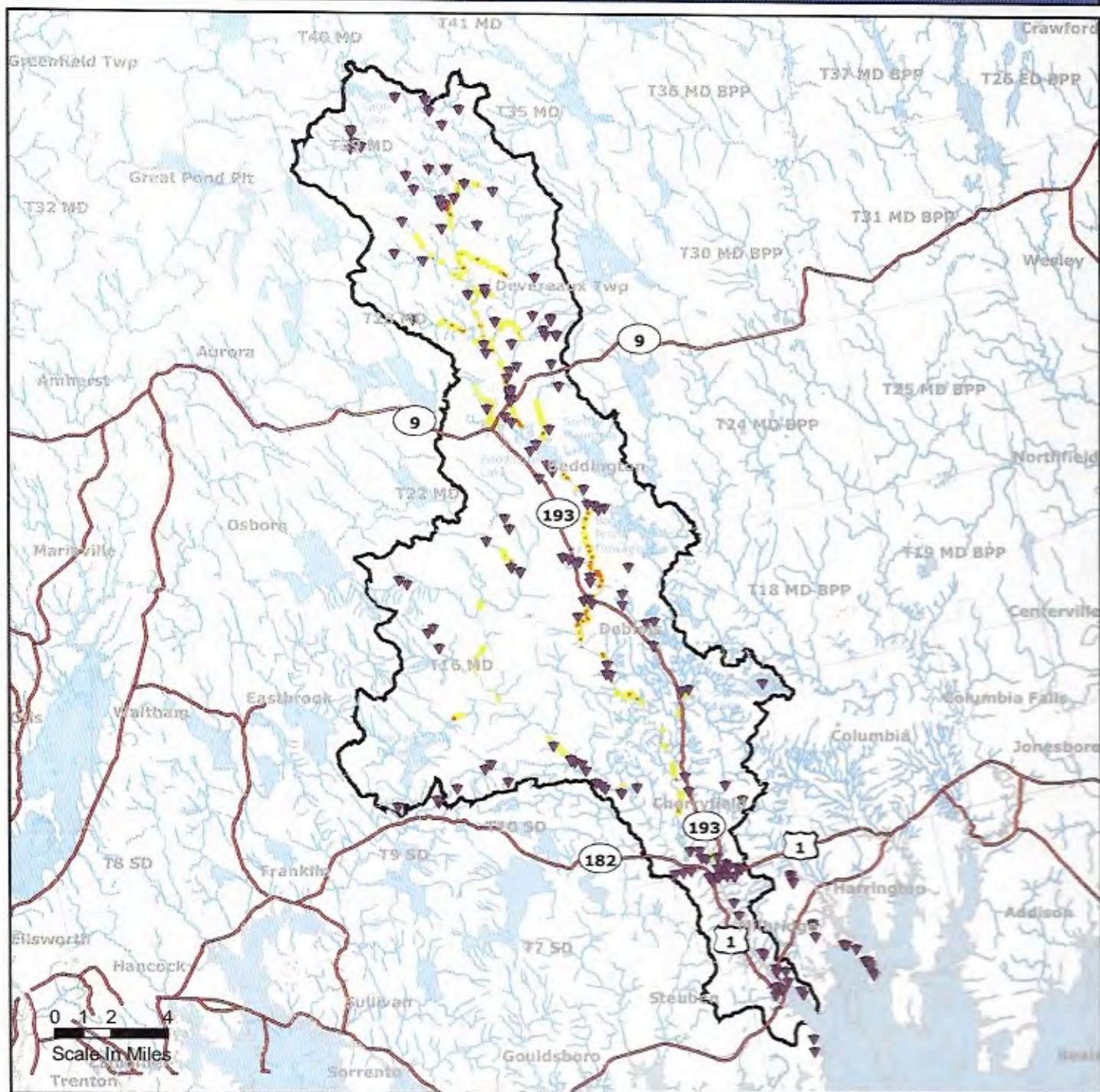
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 Revised November 2002



Map 6.1 Documented Nonpoint Source Pollution Sites 1998-2002



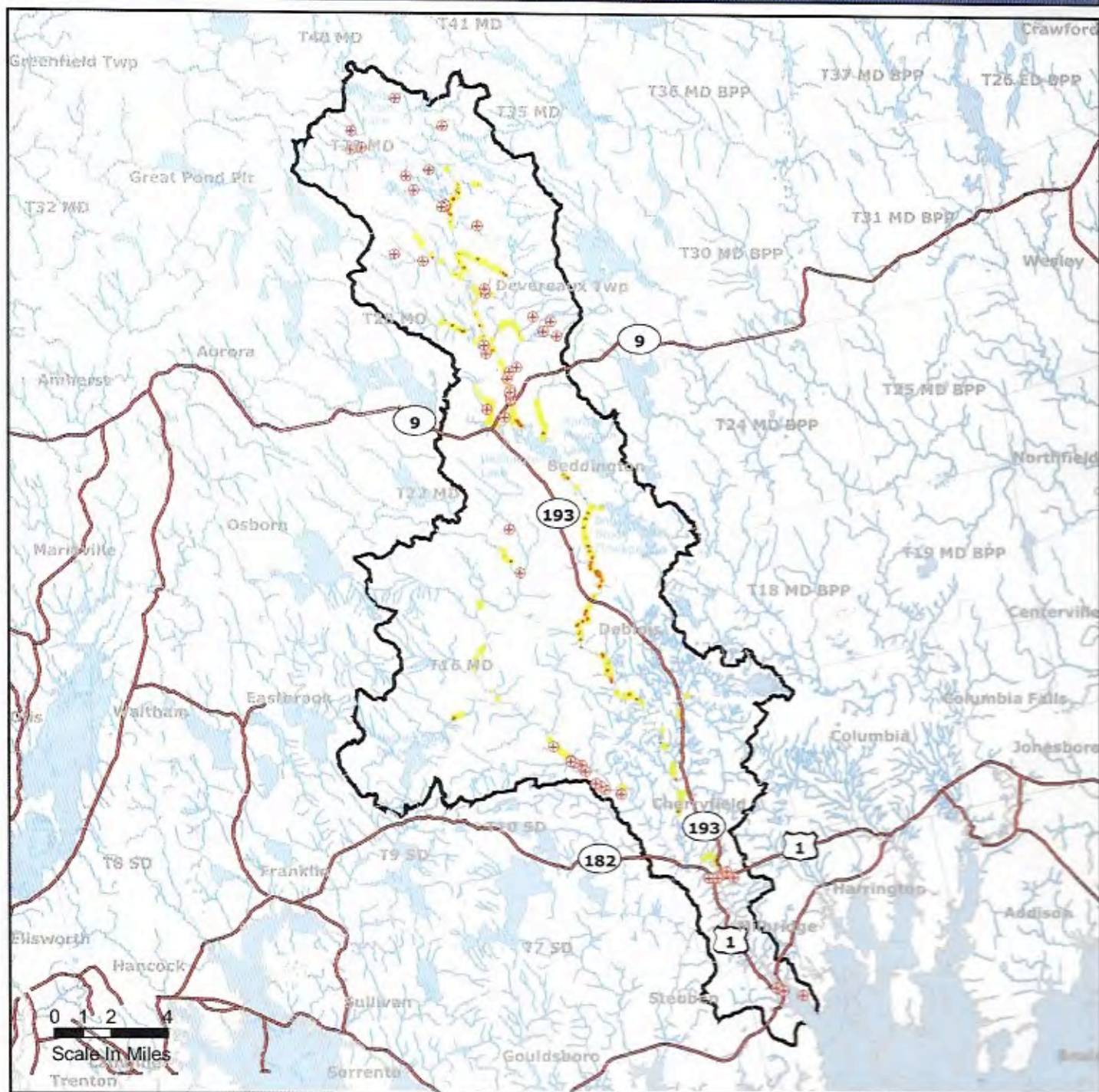
- NPS Site (1998-2002)
- Rivers & Streams
- Spawning Habitat
- Juvenile Rearing Habitat
- Lakes & Ponds
- Town Line
- Watershed Boundary

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Project SHARE
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Map 6.2 Restored Nonpoint Source Pollution Sites 1998-2002

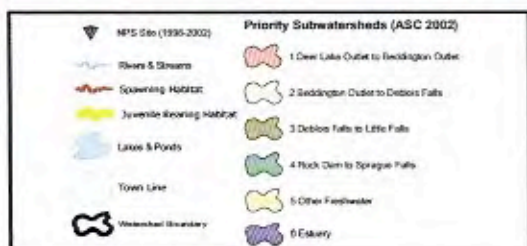
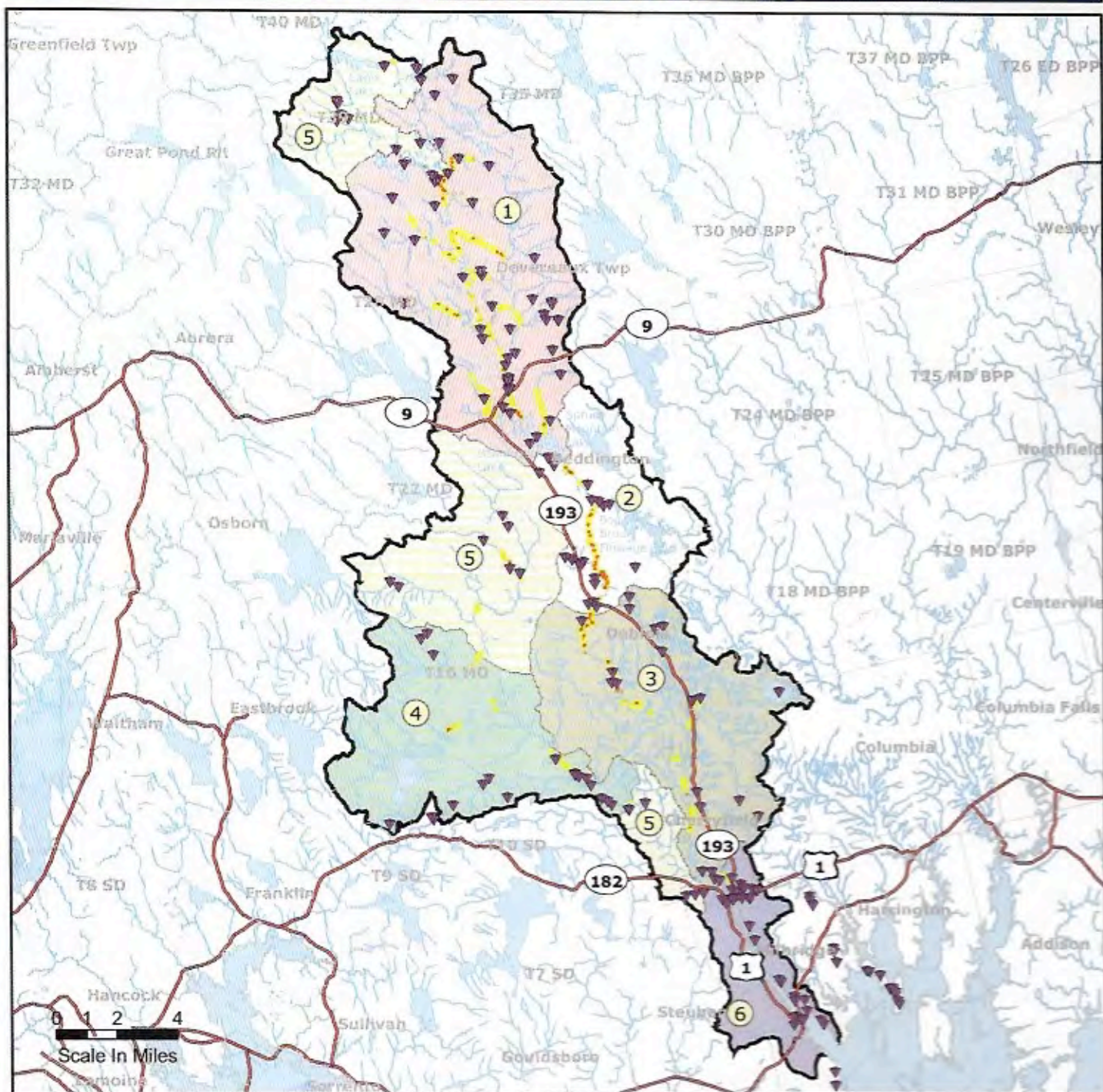


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Data provided by:
US Fish & Wildlife Service, Gulf of ME Project
Atlantic Salmon Commission
Maine Office of GIS
Project SHARE
Revised November 2002



Map 6.3 Documented Nonpoint Source Pollution Sites & Priority Subwatersheds



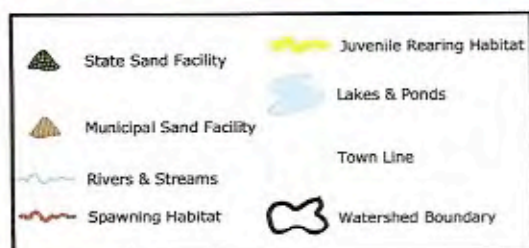
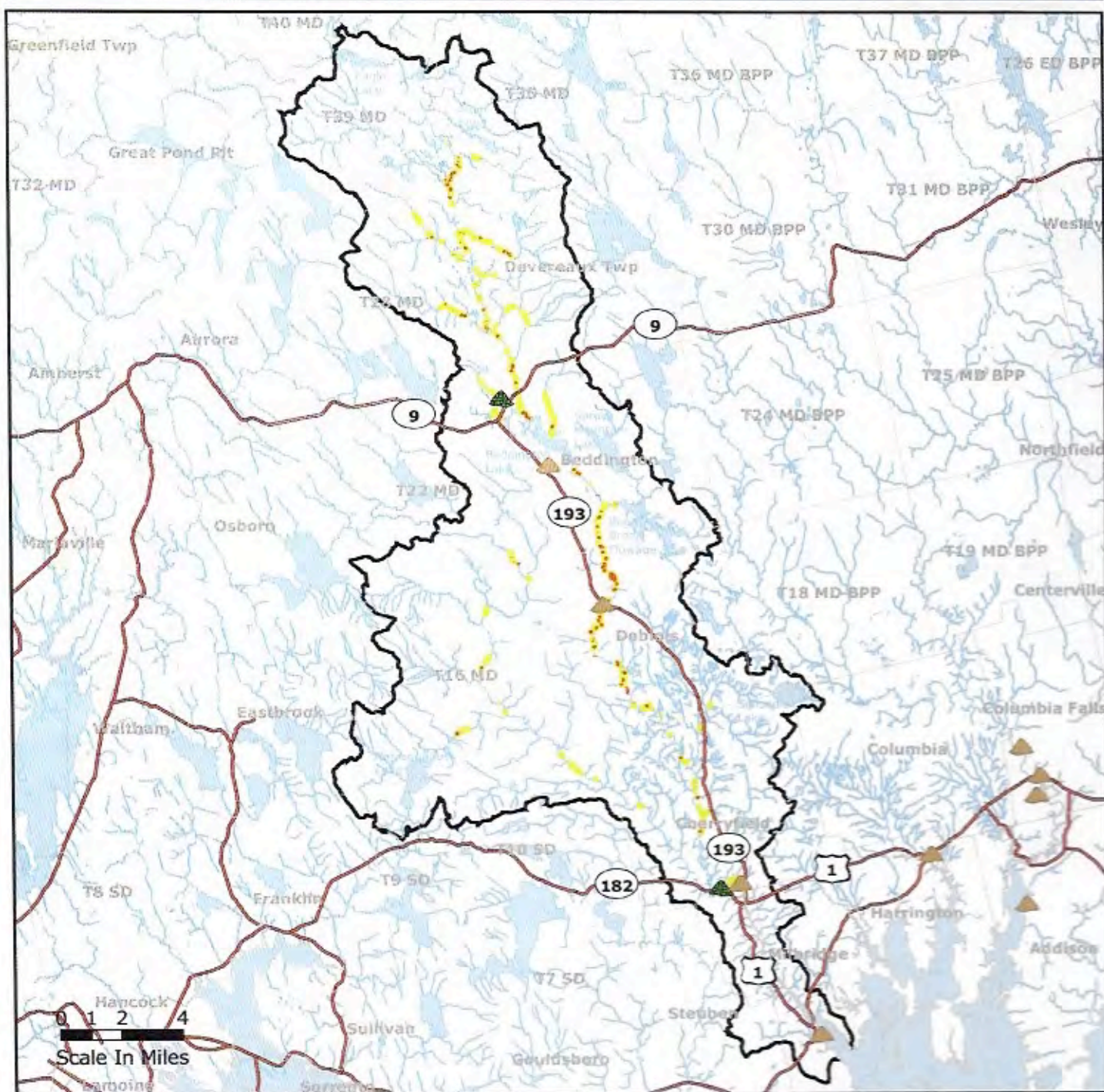
Projection: North American Datum 1983
 Coordinates: UTM, Zone 19
 Units: Meters

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 Torrey R. Sheafe for Project SHARE

Data provided by:
 US Fish & Wildlife Service, Gulf of ME Project
 Atlantic Salmon Commission
 Maine Office of GIS
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Map 7.1 State & Municipal Sand/Salt Facilities



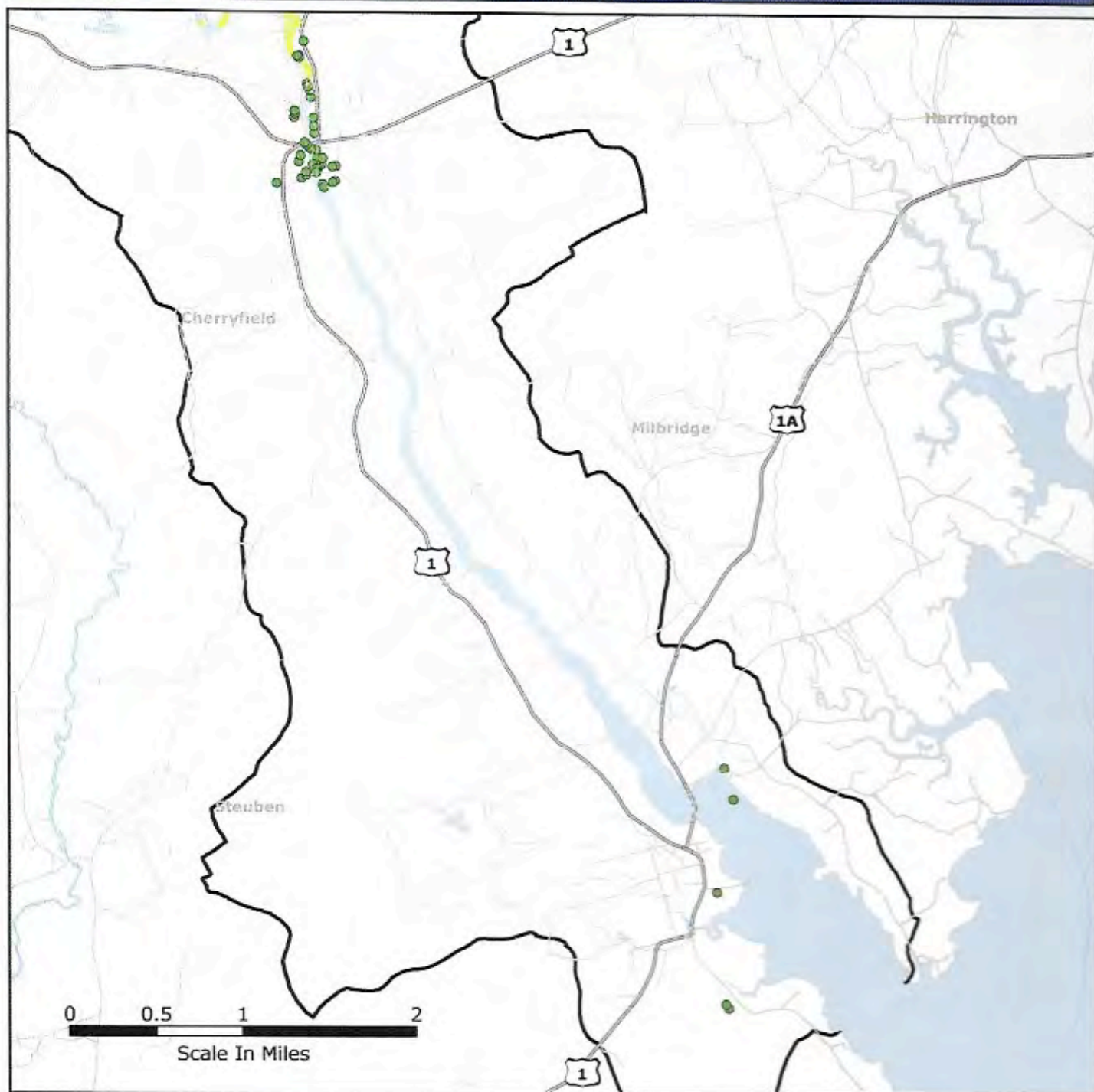
Projection: North American Datum 1983
 Coordinates: UTM, Zone 19
 Units: Meters

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Map 7.2 Licensed Overboard Discharge Sites (2000)



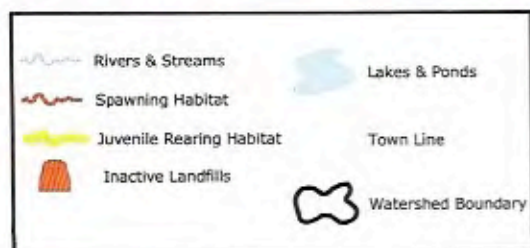
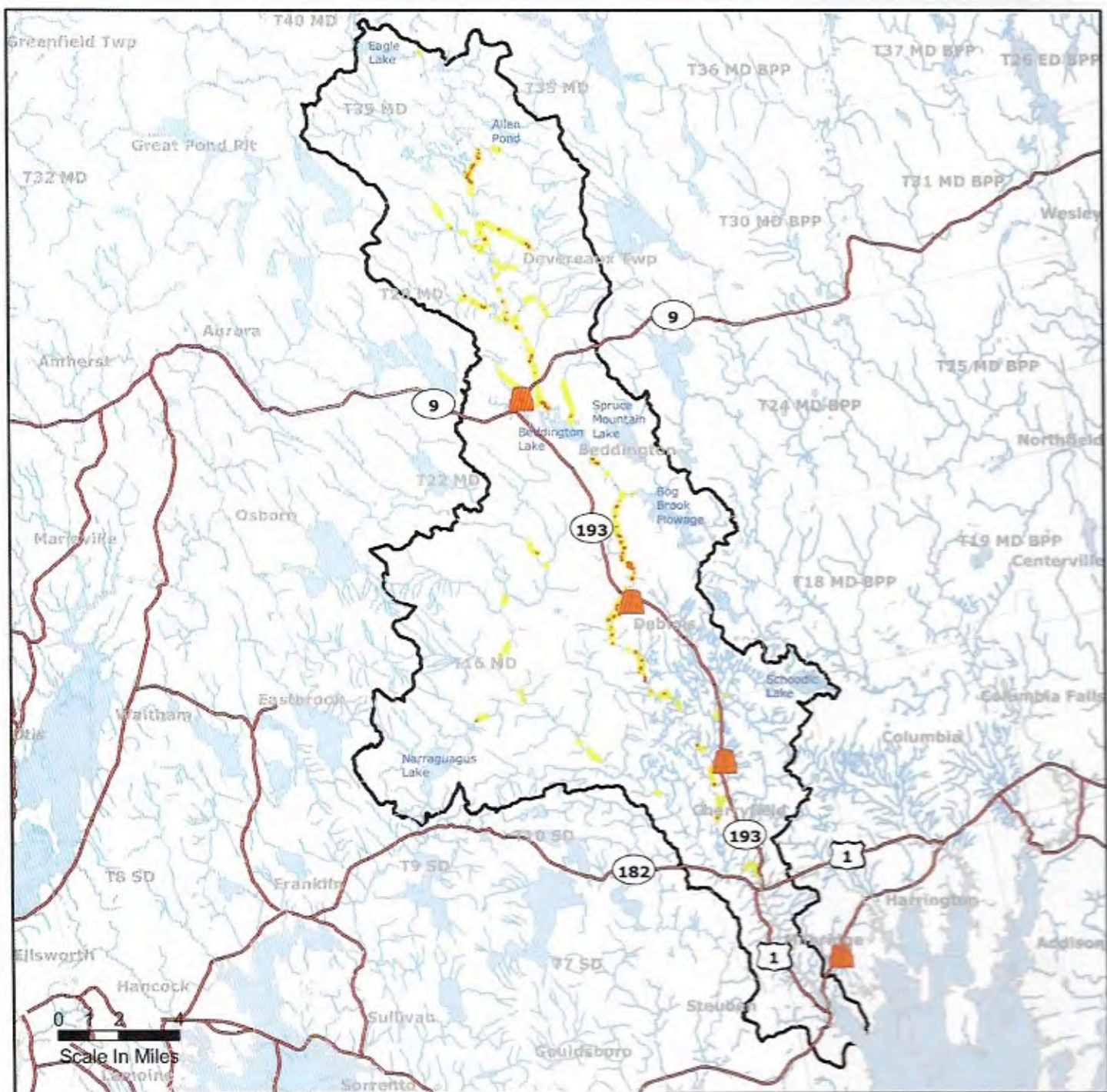
- Overboard Discharge
- Rivers & Streams
- ~ Spawning Habitat
- Juvenile Rearing Habitat
- Lakes & Ponds
- Town Line
- Watershed Boundary

Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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Torrey R. Sheafe for Project SHARE
Data provided by:
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Maine Office of GIS
Department of Environmental Protection
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Map 7.3 Inactive Landfills (DEP 2002)



Projection: North American Datum 1983
Coordinates: UTM, Zone 19
Units: Meters

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