New Hampshire Nonpoint Source Management Plan

New Hampshire Department of Environmental Services
October 1999

Cover photo: North Branch, Contoocook River
Credit: Angela Archer

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Acronyms

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References

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NONPOINT SOURCE MANAGEMENT PLAN

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Executive Summary

The *Nonpoint Source Management Plan* was initially prepared by the New Hampshire Department of Environmental Services (DES) in 1989. This document updates and replaces the *1989 Plan*. It describes the status of nonpoint source (NPS) problems in New Hampshire and lists specific actions for the next five years relative to statewide programs and nonpoint source types to improve water quality by preventing and controlling nonpoint source pollution. The five year action plan will be coordinated by the DES Nonpoint Source Program and will require the cooperation of many other programs and agencies.

Statewide management of NPS problems relies on a mix of regulatory and voluntary programs. The cornerstone of the DES nonpoint source effort is the watershed program. The watershed program organizes planning, assessment, and implementation tasks for both point and nonpoint source control programs by river basin.

Based on an analysis of existing water quality data and a number of public meetings held throughout the state, watersheds have been classified as " needing restoration," "presently meeting water quality goals," and "under federal management (in the White Mountain National Forest)." DES will focus staff time on those watersheds in need of restoration. Technical and financial assistance will be available to support locally oriented watershed organizations and agencies for remediation and pollution prevention actions. In the larger watersheds it is anticipated that DES will assign a watershed coordinator to facilitate watershed planning and restoration. Watershed planning, which may lead to establishment of designated uses and, ultimately, to watershed-specific standards, will be conducted at the appropriate watershed scale, based primarily on local interest.

The watershed program relies on both state actions and local leadership. Local leadership can take many forms: a watershed association, regional planning commission, conservation district, municipality, business group, water supplier. The organization should be recognized locally and respected among the various watershed interests so as to be able to work with and through them to effect solutions to problems or derail problems before they occur. Deciding local watershed priorities is the responsibility of the lead organization. DES can assist the local watershed organization in defining its goals and setting priorities to address water quality problems. Some watershed organizations will choose to develop a watershed management plan to direct their actions, while others will adopt a more informal, targeted approach to problem solving.

Other important statewide efforts are recognized and incorporated into this *Plan* by reference, including the *Comprehensive State Groundwater Protection Program Work*

Plan, 1994-1999 and *New Hampshire Coastal Nonpoint Pollution Control Program*, September 1996, as amended. Important statewide resource based programs, including Drinking Water Source Protection, the New Hampshire Resource Protection Program, and the Brownfields Program are also described and included in the *Plan.*

In addition to the statewide programs, DES and cooperating agencies must manage certain NPS types on a statewide basis to provide a minimum level of protection necessary to achieve water quality goals. Fourteen NPS types were examined and ranked based on the magnitude of the problem relative to public health and receiving waters, professional judgement, existing regulatory and educational programs, and public perception. The NPS types ranked in order of priority are:

Stormwater Runoff
Hydromodification
Subsurface Systems
Junk, Salvage, and Reclamation Yards
Construction
Marinas and Recreational Boating
Road Maintenance
Unlined Landfills
Land Disposal of Sludge, or Biosolids
Land Disposal of Septage
Agriculture (Hobby and Commercial)
Timber Harvesting
Resource Extraction
Storage Tanks (Above and Below Ground)
Golf Courses and Landscaping

The *Plan* is organized into two sections: *Section 1--Watershed Management*, and *Section 2, Statewide NPS Management*. A third section includes Appendix materials, such as maps and tables. The chapters within Sections 1 and 2 include recommended actions for NPS control and prevention programs. The actions are organized below into a five year action plan,Table ES 1.

Filled areas in the Table identify when the activity will take place. Dotted lines indicate lesser levels of intensity relative to filled areas. Key Player abbreviations are clarified in Section 2 under the specific discussion of each action. The number following each objective indicates the section, chapter, and numbered objective of this Plan where the objective is found, e.g., 2.3.1 refers to the first objective in Section 2, Chapter 3 addressing Urban Runoff.

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
Assist local watershed management organizations. 1.1.1						DES
Restore Category I watersheds. 1.1.2						DES, local, state, regional, and federal partners
Optimize support for local watershed management w/in DES. 1.1.3						DES
Complete nonpoint source investigations in the coastal watershed. 1.1.4						DES
Initiate Merrimack watershed investigations. 1.1.4						DES
Initiate Connecticut watershed investigations. 1.1.4						DES
Develop new groundwater protection work plan. 1.2.1						DES, partners
Implement drinking water source protection initiatives. 1.3.1						DES
Give priority to resource protection area projects. 1.5.1						DES
Expand eligibility of SRF to include brownfield projects. 1.6.1						DES
Encourage use of other funding sources. 1.6.2						DES
Develop MOAs with federal resource agencies. 1.7.1						DES, NPS, F&WS, FS
Encourage planning board adoption of stormwater						OSP, DES, RPCs, CDs,

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
regulations. 2.3.1						NHMA
Encourage regulations requiring maintenance of stormwater controls. 2.3.2				_____	_____	OSP, DES, RPCs
Promote use of structural and nonstructural stormwater controls. 2.3.3						OSP, DES
Encourage problem solving in existing urban areas. 2.3.4				---------	---------	DES, TTC, RPCs, OSP, CDs, EPA
Explore use of SRF or other funding sources. 2.3.5						DES, OSP, EPA
Amend regulations for 2-year storm control. 2.3.6						DES
Update stormwater manuals; provide training. 2.3.7						NRCS, DES, CDs, RPCs, UNH
Target vulnerable watersheds for NPS assistance. 2.4.1						DES
Identify shoreline restoration sites. 2.4.2						
Promote protection of naturally vegetated buffers along waterbodies and wetlands. 2.4.3						DES, UNH CE, LACs, NRCS, USF&WS NGOs
Compile data on cumulative impacts and make recommendations for addressing them in regulatory and nonregulatory contexts. 2.4.4	---------	---------		---------	---------	DES, SC

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
Develop program to monitor changes. 2.4.5						DES, NHACC
Promote smart growth and land conservation. 2.4.6						OSP, DES, RPCs, UNH CE
Support public funding for land conservation. 2.4.7						Local govt, NGOs, DES, DRED, DCA, F&GD
Distribute O&M information to rural homeowners. 2.5.1		----------		---------	---------	DES, GSD&I, local govt, realtors
Support financial incentives for installation of disposal systems in areas of concentration. 2.5.2				_____	_____	DES
Explore funding sources for help to private parties. 2.5.3						DES, legislators
Work with local govts. to allow for alternative treatment systems. 2.5.4				_____	_____	DES, health officers
Cost share household hazardous waste day collections. 2.5.5						DES
Consider expanding DES regulatory review. 2.5.6						DES, legisltors
Monitor the effectiveness of state-of-the-art subsurface systems, as well as older systems. 2.5.7						DES
Promulgate rules for junkyard regulation. 2.6.1	---------					DES

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
Maintain ongoing assessment. 2.6.2	---------			---------	--------	DES, NHATRA, ADA
Encourage local e & s regulations. 2.7.1						OSP, DES, RPCs
Target local decision makers for education about erosion control. 2.7.2					_____	DES, OSP, RPCs, CDs, NHACD, UNH T2 C, UNH
Maintain local outreach on SPA. 2.7.3						DES
Facilitate training for DOT staff, w/ cooperative monitoring of highway projects. 2.7.4						
Provide educational programs to teach marina BMPs. 2.8.1		_____				DES, NHMTA, NH DoS
Expand boat inspection program. 2.8.2						DES, DoS
Create program for outreach on nuisance species. 2.8.3						DES, F&GD, NHLA
Seek financial support for additional pumpouts. 2.8.4			---------	---------	---------	DES
Promote use of vent pipes, fuel vent line whistles. 2.8.5						DES, NHMTA
Promote use of environmental contracts. 2.8.6						DES, NHMTA
Require out of state permits. 2.8.7						DES, NHLA, legislators

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
Track water quality to determine BMP efficacy. 2.8.8						DES
Reduce habitat impacts from recreational boating. 2.8.9	_____	_____				DES, LPC, LACs, VLAP, VRAP, DoS, NGOs
Study chloride impacts. 2.9.1	---------					DES, USGS, USFS, DOT
Provide local option for protecting salt-sensitive areas. 2.9.2						DES, DOT, local govt
Provide training for road agents. 2.9.3						UNHTTC
Focus education on salt piles/storage. 2.9.4						UNHTTC, DES
Ensure closure of all remaining landfills by 2010. 2.10.1						DES, legislature
Maintain state support for HHW collections. 2.10.2						DES
Assist landfill closures financially. 2.10.3						DES
Keep current on research findings and public concerns. 2.11.1						DES
Establish a network for linking sources and users of biosolids. 2.11.2						DES
Educate the general public. 2.11.3						DES
Work w/ municipalities to ensure all have septage disposal arrangements. 2.12.1						DES

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
Seek alternative solutions. 2.12.2						DES, NHASH, WWTFs, NH WPCA
Explore SRFs for capacity building. 2.12.3						DES
Link haulers with farmers. 2.12.4						DES, NRCS, NHASH
Support HHW clean up days. 2.12.5						DES
Educate homeowners about the importance of system O&M, keeping septage free from toxics. 2.12.6		_____		_____	_____	DES-see chpt. 10, GSDI
Keep current on research and respond appropriately. 2.12.7						DES
Promote manure recycling options. 2.13.1	_____			_____	_____	DES, NRCS, CDs, UNH CE, NHDAMF
Promote IPM implementation. 2.13.2			---------	---------	---------	UNH CE, NRCS, NHDAMF
Require nutrient management plans. 2.13.3						NRCS, CDs
Educate landowners about buffers. 2.13.4						NRCS, UNH CE, CDs, DES
Promote sustainable agriculture locally. 2.13.5					---------	RPCs, DES, NRCS, UNH CE, CDs, NHDAMF
Explore options for municipal manure recycling. 2.13.6						DES, GRP, NRCS, CDs,

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
						NHDAMF
Educate landowners about pesticide use and abuse. 2.13.7						UNH CE, CDs, DES
Conduct field evaluation of logging operations. 2.14.1						DRED
Conduct interdepartmental field training sessions. 2.14.2						DRED, DES, NRCS, UNH CE
Improve DRED/DES handling of complaints and questions. 2.14.3		_____				DES, DRED
Improve timber harvesting notification system. 2.14.4						DRED, DES, DRA
Provide information and education to town officials re. opportunities for improved timber harvesting. 2.14.5				_____	_____	DRED, DES, UNH CE, THC, NHMA
Promote landowner understanding of forestry services. 2.14.6	---------			---------		UNH CE, DRED, TOA
Improve local capacity. 2.15.1				_____	_____	RPCs, OSP, DES
Encourage PBs to establish a system for determining gravel pit compliance. 2.15.2				_____	_____	RPCs, OSP, DES
Develop GIS database of sites. 2.15.3				_____	_____	DES, DRA, RPCs
Create and distribute informational brochure. 2.15.4						DES, RPCs

Table ES-1
Five Year Action Plan

Objective	2000	2001	2002	2003	2004	Key Players
Increase the number of on-site UST compliance inspections. 2.16.1						DES
Investigate use of the State Revolving Loan Fund for UST compliance. 2.16.2						DES
Continue state waste oil financial support municipalities. 2.16.3						DES
Expand preventive outreach to home owners. 2.16.4						DES, tank installers
Promote homeowner understanding of backyard practices and their impacts. 2.17.1						UNH CE, DES
Ensure capacity for pesticide investigations. 2.17.2						NHDAMF
Explore reduced licensing requirements for landscapers. 2.17.3						NHDAMF, NHLdA
Continue to promote sustainable golf course management practices. 2.17.4						UNH CE, DES, golf course mngrs

Acronyms in 5-year action Plan

ADA	Auto Dealers Association
CD	Conservation District
CE	UNH Cooperative Extension
DCA	Department of Cultural Affairs
DES	NH Department of Environmental Services
DoS	NH Department of Safety
DOT	NH Department of Transportation
DRED	NH Department of Resources and Economic Development
EPA	US Environmental Protection Agency
F&GD	NH Fish & Game Department
F&WS	US Fish & Wildlife Service (Dept. Of Interior)
FS	US Forest Service (Dept. Of Agriculture)
GRP	Governor's Recycling Program (OSP)
GSD&I	Granite State Designers and Installers
LAC	Local Advisory Committee (entity of State Rivers Program)
LPC	Loon Preservation Committee (of the Audubon Society of NH)
NGO	Nongovernmental Organization
NHASH	NH Association of Septage Haulers
NHATRA	NH Auto and Truck Recycling Association
NHDAMF	NH Department of Agriculture, Markets, and Food
NHLA	NH Lakes Association
NHLdA	NH Landscapers Association
NHMA	NH Municipal Association
NHMTA	NH Marine Trades Association
NHWPCA	NH Water Pollution Control Association
NPS	National Park Service (Dept. Of Interior)
NRCS	Natural Resources Conservation Service
OSP	NH Office of State Planning
RPC	Regional Planning Commission
SC	Steering Committee (habitat subcommittee for this *Plan*)
THC	Timber Harvesting Council
TOA	Timberland Owners Association
TTC	Technology Transfer Center at University of NH
UNH	University of New Hampshire
USGS	US Geological Survey
VLAP	Volunteer Lake Assessment Program (in DES)
VRAP	Volunteer River Assessment Program (in DES)
WWTF	Waste Water Treatment Facility

Introduction

The *Nonpoint Source Management Plan* describes specific actions desired to attain short and long term goals for water quality. The overarching goal, within fifteen years, is to improve land management practices such that water quality standards are met throughout the state. At the current time, clean water goals expressed through water quality standards (RSA 485-A:8 and Env-Ws 430) are uniform throughout the state, with slight differences in surface water supply watersheds. According to the most recent biennial water quality report (*State of New Hampshire 1998 Section 305(b) Water Quality Report*) 84.1% of stream miles and 96% of lake and pond acreage fully support all uses as currently expressed in water quality standards. Although many sources of impairment are unknown, it is estimated that 92% of impairments are caused by nonpoint sources. Biennial water quality reports will serve to measure long term progress toward the goal of meeting water quality standards throughout the state.

Current water quality standards are based primarily on chemical and physical characteristics of water bodies. In 1995 DES initiated a biomonitoring program to develop a better understanding of the biological health of our waters. Over the long term (15-20 years), it is anticipated that biological criteria will be incorporated into state water quality standards. Given that nonpoint sources are dispersed and intermittent, the addition of biomonitoring data to the chemical and physical parameters currently measured should provide a much better indication of the extent and severity of NPS pollution in the state. As biocriteria are established, they will serve as additional measures of the effectiveness of NPS control programs.

A component of the overarching goal to meet current water quality standards is to facilitate and support development of site specific water quality standards which protect locally important water uses. This effort will require extensive commitment from people interested in their watersheds and substantial technical support from DES. The process for water quality standards revision is established in the Clean Water Act; DES is committed to supporting the process. Success will be measured by adoption of site specific water quality standards to protect locally designated water uses.

Short and long- term goals, 5-year objectives, specific actions, and progress measures are described in each chapter of the *Plan*. The Executive Summary includes a table summarizing all of the recommended actions in the *Plan* and schedules for completion. The short term goals and associated actions are intended to cover a five year period. DES will track progress annually and provide an update of the *Plan* at the end of the five year period.

The Nine Key Elements

In May 1996, the U.S. Environmental Protection Agency released *Nonpoint Source Program and Grants Guidance for Fiscal year 1997 and Future Years*, which among other policies, established **nine key elements** of effective state nonpoint source programs. The federal *Clean Water Action Plan*, released in February 1998, made receipt of new federal appropriations to states under Section 319 of the Clean Water Act contingent upon states incorporating the nine key elements into state nonpoint source management plans by 2000.

A description of the nine key elements, and how they are incorporated into this *Plan*, is given below.

Key Element #1: The State Program contains explicit short- and long-term goals, objectives and strategies to protect surface and ground water.

The overarching goal of the *Plan* is to achieve and maintain designated uses of all water bodies in the state within 15 years. A component of this goal is to facilitate development of locally designated uses and associated water quality standards to protect such uses. This goal is described above. Short and long-term goals, 5-year objectives, and strategies are given in each chapter of the *Plan*. Refer to Table ES-1 for a five year implementation schedule.

Key Element #2: The State strengthens its working partnerships and linkages to appropriate State, interstate, Tribal, regional, and local entities (including conservation districts), private sector groups, citizens groups, and Federal agencies.

The *Plan* was developed with a large number of stakeholders (see Acknowledgments) whose input both strengthens the actions described and creates a greater likelihood of successful implementation. Stakeholder roles are described throughout the *Plan* and summarized in Table ES-1.

Key Element #3: The State uses a balanced approach that emphasizes both State-wide nonpoint source programs and on-the-ground management of individual watersheds where waters are impaired or threatened.

Section 1 describes the framework for local watershed management and restoration in priority watersheds, as well as the available technical and financial assistance programs. Section 2 provides the statewide context for addressing various nonpoint source issues.

Key Element #4: The State program (a) abates known water quality impairments from nonpoint source pollution and (b) prevents significant threats to water quality from present and future nonpoint source activities.

DES will continue to conduct watershed investigations to identify and abate sources of water quality impairment described in Section 1. The Total Maximum Daily Load (TMDL) program is linked to the *Plan* in that nonpoint sources identified in TMDLs that are due in April 2000 will be addressed as priority issues in Category I watersheds. Pollution prevention remains a key component of the program in both local watershed planning and recommended actions for the nonpoint source types addressed in Section 2.

Key Element #5: The State program identifies waters and their watersheds impaired by nonpoint source pollution and identifies important unimpaired waters that are threatened or otherwise at risk. Further, the State establishes a process to progressively address these identified waters by conducting more detailed watershed assessments and developing watershed implementation plans, and then by implementing the plans.

This key element is embodied in the *Unified Watershed Assessment* (UWA) and nonpoint source investigations described and incorporated in Section 1. The UWA uses water quality information from biennial water quality reports and the Total Maximum Daily Load program to prioritize restoration watersheds. Nonpoint source investigations include intensive surveillance of watersheds to identify and address pollutant sources.

Key Element #6: The State reviews, upgrades, and implements all program components required by section 319(b) of the Clean Water Act, and establishes flexible, targeted, and iterative approaches to achieve and maintain beneficial uses of water as expeditiously as practicable. The State programs include:

- A mix of water quality-based and/or technology-based programs designed to achieve and maintain beneficial uses of water; and

- A mix of regulatory, non-regulatory, financial and technical assistance as needed to achieve and maintain beneficial uses of water as expeditiously as practicable.

The Executive Summary lists all of the recommended actions and a five year schedule for implementation. The short term actions are intended to make progress toward a 15 year goal of meeting water quality standards in all water bodies. They are based on a mix of regulatory and non-regulatory programs, and in some instances include

financial support or technical assistance. Details are provided in Section 2. Progress toward the long term goal will be measured in biennial water quality and TMDL reports. The *Plan* will be updated every five years to reflect progress made and new challenges and issues which need to be addressed.

Key Element #7: The State identifies Federal lands and activities which are not managed consistently with State nonpoint source program objectives. Where appropriate, the State seeks EPA assistance to help resolve issues.

Federal lands are managed consistently with State nonpoint source program objectives. Federal activities which relate to State nonpoint source program objectives are described in Appendix B. Most of these activities are regularly reviewed by DES to ensure consistency with environmental goals and state regulatory programs. Appendix B identifies the DES programs which provide regular review of federal activities. A recommended action of the *Plan* is to work more closely with those agencies with which we do not have a close working relationship at present, including the U.S. Forest Service and the U.S. Fish and Wildlife Service.

Key Element #8: The State manages and implements its nonpoint source program efficiently and effectively, including necessary financial management.

Federal funds implementing the nonpoint source program are obligated and expended in a timely manner. Financial records are maintained in accordance with generally accepted accounting principles.

Key Element #9: The State periodically reviews and evaluates its nonpoint source management program using environmental and functional measures of success, and revises its nonpoint source assessment and its management program at least every five years.

Table ES-1 will be used to track significant milestones in the nonpoint source program. The 305(b) report and TMDL program will be used for long term measurement of program effectiveness. The *Plan* will be updated every five years.

Nonpoint Source Management Plan

Section 1

NONPOINT SOURCE MANAGEMENT PLAN

STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
6 HAZEN DRIVE
CONCORD, NH 03301

October 1999

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NPS Watershed Management

Introduction

Nonpoint source pollution is everyone's business because we all create it. The Department of Environmental Services manages several programs whose goals are to prevent or control nonpoint source pollution from land use activities. DES is just one of many players working to keep New Hampshire's water clean. Local initiatives, managed by nongovernmental organizations, several state and federal agencies, and local governments, addressing water resource issues of importance to the greater watershed community are necessary to keep improving water quality. The Department's watershed management program described below is designed to address priority water quality problems, to facilitate development of local initiatives, and to provide assistance once local initiatives are under way. Assistance provided includes both financial and staff assistance.

Many elements of watershed management are incorporated in Section 2 of this *Plan*, where goals, objectives, and action plans are described for each type of NPS pollution in New Hampshire. Local watershed management initiatives can rely on the strategies in Section 2 as building blocks for comprehensive watershed management, and to determine gaps which may need to be addressed locally.

Addressing Priority Water Quality Problems

To make best use of available resources in addressing water quality problems, DES must determine which watersheds are most impacted by NPS pollution. At the same time, recognizing that pollution prevention is more cost effective than mitigation, DES must also assist in watershed management programs that focus on prevention of water resource degradation.

DES has developed a process to address priority water quality problems under the auspices of the federal Clean Water Action Plan (CWAP), which was released by federal agencies on February 14, 1998 at the direction of the President. The CWAP charts a course toward fulfilling the original goal of the Clean Water Act--"fishable and swimmable" waters for

all Americans. Among the many specific actions called for by the CWAP is one for states to develop "Unified Watershed Assessments" that identify watersheds that do not meet clean water and other natural resource goals, such as habitat protection and maintenance of species populations, and watersheds where preventive action is needed to sustain water quality and aquatic resources.

There are four categories in the Unified Watershed Assessment:

Category I — Watersheds in Need of Restoration. These watersheds do not now meet, or face imminent threat of not meeting, clean water and other natural resource goals.

Category II — Watersheds Meeting Goals, Including Those Needing Action to Sustain Water Quality. These watersheds meet clean water and other natural resource goals and standards and support healthy aquatic systems. All such watersheds need the continuing implementation of basic clean water and natural resource programs to maintain water quality and conserve natural resources.

Category III — Watersheds with Pristine or Sensitive Aquatic System Conditions on Lands Administered by Federal, State, and Tribal Governments. States and tribes work cooperatively with federal land managers to identify watersheds with exceptionally pristine water quality, drinking water sources, or other sensitive aquatic system conditions, which are located on lands administered by federal, state, or tribal governments.

Category IV — Watersheds with Insufficient Data to Make an Assessment. These watersheds lack data, critical data elements, or the data density needed to make a reasonable assessment.

Based on an analysis of existing water quality data and a number of public meetings, categories were assigned to all of the watersheds in New Hampshire, and the Unified Watershed Assessment was published in September 1998. The UWA establishes priority watersheds for restoration activities. DES has adopted the philosophy that pollution prevention activities are necessary in all watersheds to preclude the need for future restoration. Therefore, all watersheds that are not Category I or Category III (federal lands in the White Mountain National Forest), are designated Category II. There are no Category IV watersheds. Watersheds are listed by category in Table 1.1, and are shown on Map A.

Table 1.1
Unified Watershed Assessment
Watersheds by Category

Category	**Watershed**	**Hydrologic Unit Code** (as determined by USGS)	**Reason**
I	Piscataqua/Salmon Falls	01060003	numerous water quality standards violations, shellfish bed restoration
	Merrimack	01070002	numerous water quality standards violations
	Haverhill Tributaries (Connecticut River)	01080104-010	Imminent threat from agricultural operations
	Oliverian Brook (Connecticut River)	01080104-020	Imminent threat from agricultural operations
	Hanover-Piermont (Connecticut River)	01080104-060	Imminent threat from agricultural operations
	Littleton Tributaries (Connecticut River)	01080104-230	Imminent threat from agricultural operations
	Ammonoosuc River (Connecticut River)	01080101-250	Imminent threat from agricultural operations
	Cornish-Plainfield Tributaries (Connecticut River)	01080104-090	habitat restoration needed for rare, threatened, or endangered species (Jessup's Milk Vetch, tiger beetle, dwarf wedge mussel)
	Bearcamp River (Chocorua Lake portion)	01060002-110	Water quality impairment in Chocorua Lake due to Route 16 runoff.
II	Upper Androscoggin	01040001	pollution prevention
	Upper Connecticut	01080101	pollution prevention
	Lower Androscoggin	01040002	pollution prevention
	Saco	01060002	pollution prevention
	Pemigewasset	01070001	pollution prevention
	Upper Connecticut-Mascoma	01080104	pollution prevention
	Middle Connecticut	01080201	pollution prevention
	Miller	01080202	pollution prevention
	Nashua	01070004	pollution prevention

Category	Watershed	Hydrologic Unit Code (as determined by USGS)	Reason
III	Peabody River	01040001-120	White Mountain National Forest
	Wild River	01040002-020	White Mountain National Forest
	Upper Saco River	01060002-010	White Mountain National Forest
	Swift River	01060002-020	White Mountain National Forest
	Cold River	01060002-040	White Mountain National Forest
	East Branch Pemi River	01070001-010	White Mountain National Forest
	Upper Pemigewasset River	01070001-020	White Mountain National Forest
	Middle Pemigewasset River	01070001-030	White Mountain National Forest
	Mad River	01070001-040	White Mountain National Forest
	Wild Ammonoosuc River	01080101-270	White Mountain National Forest

Watershed Size

It has been shown in many watershed projects across the nation that watershed management is most effective in small watersheds. People are often more concerned with the stream that runs through their community, or with their local drinking water source, than with the larger rivers downstream.

The UWA identified the Piscataqua/Salmon Falls and Merrimack 8-digit hydrologic unit code watersheds as priorities for restoration. Seven additional 11-digit hydrologic unit code (smaller sized) watersheds were also designated as Category I for various reasons. In the larger watersheds it is anticipated that DES will assign a watershed coordinator to facilitate watershed planning and restoration. Watershed planning, which may lead to establishment of designated uses, and ultimately watershed-specific water quality standards, will be conducted at the appropriate watershed scale, based primarily on local stakeholder interest.

For purposes of DES technical and financial assistance under this program, a watershed is defined locally to describe a geographic area that can be managed to maintain and enhance the quality of water within it. Local watershed management can protect rivers and streams, lakes and ponds, wetlands, and groundwater, or any combination of these.

Watershed Management Methodology

Nonpoint Source Investigations

DES began implementing nonpoint source investigations in the Coastal/Piscataqua watershed in 1996. Nonpoint Source program staff compiled a list of water bodies not meeting water quality standards. In the Coastal/Piscataqua watershed the top priority water quality issue was bacteria causing the closure of shellfish beds. Priority sites on the list were investigated to verify water quality problems. In addition, urban storm drainage systems were investigated during dry weather to determine whether wastewater was being diverted into the storm drainage system for direct discharge into estuarine waters. (See *1996 Nonpoint Source Coastal Assessment Report*, NHDES, May 1997, for a discussion of year one results, and *An Investigation of Water Quality in New Hampshire Estuaries*, December 1997, for a discussion of year two results.)

Where pollution sources are found, staff work with appropriate parties on remediation, which often requires technical and financial assistance, and in some cases, regulatory compliance and enforcement. (See *Elimination of Illicit Connections in Coastal New Hampshire Spurs Cooperation and Controversy*, September 1999.)

It is anticipated that initial investigations in the coastal watershed will be completed in 2000. In 2001, investigations will begin in the Merrimack watershed, and will focus on urban pollution sources, as well as other known "hot spots" where further investigation of sources is required. Merrimack watershed investigations are expected to occur during the 2001-2003 field seasons. Upon completion of initial investigations there, the Connecticut watershed will be investigated.

Category I Watersheds

DES staff will take the lead to address NPS water quality problems in all Category I watersheds. Where verification of water quality problems is needed, staff will perform site investigations, which may include shoreline surveys, land use surveys, water quality monitoring, and smoke and dye testing of discharge pipes. Where staff investigations are not feasible, DES will distribute a targeted request for proposals (RFP) soliciting detailed watershed restoration projects.

Where specific NPSs can be identified, staff will work with landowners and municipal officials to rectify problems. Where sources cannot be readily identified, staff will work with local entities to develop watershed strategies for water quality improvement. Such strategies may include:

- Initiating or expanding a volunteer monitoring program, with assistance from DES's Volunteer River Assessment Program or Volunteer Lake Assessment Program;

- Working with local watershed organizations, regional planning agencies, county conservation districts, local advisory committees, or other local organizations to develop a watershed management plan;

- Working with local interests to develop outreach materials and programs to improve pollution prevention techniques by individual landowners; or

- Developing, designing, and implementing BMPs at appropriate sites in the watershed.

The goal of this work is to improve the water quality such that the water body will meet clean water or other natural resource goals. Long term watershed planning may include identification of designated uses for specific water resources, and development of watershed specific water quality standards to protect designated uses.

In addition to local partners, DES will work with the numerous statewide organizations which represent watershed stakeholders. These organizations participated in the development of the *NPS Management Plan* and are listed in the Executive Summary. Many stakeholder organizations helped to develop the action plans included in Section 2 of the Plan, and are committed to supporting their implementation. DES will work through statewide organizations where appropriate to achieve local watershed management goals. Memoranda of Understanding with stakeholder organizations will be pursued if the need arises, however, at this time collaboration is expected to continue on an informal basis.

Other Watersheds

Category I watersheds focus resources on restoration activities. Watershed management for pollution prevention and resource protection is equally important. DES will support watershed management in other watersheds where resources are identified as being valuable by the community and where local resources and energy are directed to such efforts. DES, conservation districts, regional planning agencies, cooperative extension, and other organizations can assist communities in identifying valuable local resources. Pollution prevention has proven more cost effective with many environmental problems than treatment initiated in response to contamination. For this reason, it is imperative to expend some of DES's limited resources on watershed management in watersheds with relatively good water quality.

Effective management of local watersheds requires local energy and commitment. Upon application from a local watershed organization, DES may provide the following services:

- assistance in establishing a watershed management organization;
- assistance in developing a watershed management plan;
- assistance developing a Quality Assurance Project Plan;
- financial assistance;
- coordination of volunteer monitoring services through the Volunteer River Assessment Program or Volunteer Lake Assessment Program;
- interpretation of water quality information; and
- assistance in implementing a watershed plan.

The goal of watershed management is to assist local entities in establishing and meeting water quality goals in local watersheds.

Local Watershed Management Framework

Watershed management works best when a local organization has the interest and ability to perform the lead role. Local leadership is needed to expedite communications among various watershed interests, including landowners, municipalities, businesses, and others with interests in land management and water quality. A lead watershed organization, or facilitator, should be recognized locally and respected among the various watershed interests. It must be capable of consensus building and priority setting and have project management experience. Possible lead organizations include: watershed associations, regional planning commissions, conservation districts, resource conservation & development districts, business councils, municipalities, or water suppliers.

There is no one watershed management structure that works best in all situations. What's important is that a dialogue is established among watershed interests, a sense of purpose and direction is developed, and progress toward goals is measured. It may be useful to develop a formal structure, such as a watershed advisory committee to help set watershed management goals, priorities, and action plans.

The following groups are recommended for participation in watershed management :

- local governing body (selectmen, council, or aldermen)
- planning boards
- conservation commissions
- chambers of commerce
- economic development groups
- regional planning agencies
- county conservation districts
- resource conservation & development districts
- UNH Cooperative Extension county agents
- NRCS district conservationist
- local environmental organizations
- water users
- state agencies
- neighborhood associations
- academia
- business and industry

NPS Watershed Technical Assistance

DES funding for watershed management is available for restoration in Category I watersheds and for most watershed management activities in all watersheds. In Category I watersheds , DES will initiate contacts with local entities to enlist the participation of as many interests as possible and necessary, and will issue requests for proposals as needed. In other watersheds , DES will maintain a mailing list of known local organizations throughout the state and will publicize through newsletters and annual solicitations for proposals the availability of both staff assistance and financial assistance for resource protection and watershed management.

In non-Category I watersheds, priority for staff assistance will be given to those watersheds with active and competent lead watershed organizations who have successfully applied for watershed management funds through annual solicitations for proposals. Technical assistance from DES is available to local watershed management groups in the following areas:

- ambient stream sampling
- volunteer monitoring
- biological monitoring
- watershed management organization building
- field investigation of pollution sources
- general outreach materials and workshops
- source water protection
- trophic lake surveys
- watershed surveys
- outreach materials

DES will integrate these programs into local watershed management initiatives as much as possible. Local watershed organizations also should consult with other state agencies, including the Fish and Game Department and Department of Resources and Economic Development, and the Office of State Planning, to determine the level of assistance available from those agencies. DES staff can help groups identify other potential resources which may be available to help achieve their goals.

Watershed Action Plans

Watershed action plans can be as simple as applying corrective measures to a single pollution source, or as complex as developing a comprehensive watershed plan to address imperviousness through land use management, depending on watershed management goals. DES has funded and provided technical assistance to a range of local watershed management projects, including organization building, watershed planning, and implementation. Action plans can be as formal or informal as desired by the lead watershed management organization.

DES, or organizations funded by DES, will prepare Watershed Restoration Action Strategies (WRASs) to address identified problems in Category I watersheds. The WRASs will be brief and specific, describing the steps needed to address problems causing water quality impairments. Watershed Restoration Action Strategies will be developed for Category I watersheds according to the following timetable:

Chocorua Lake	September 2000
Coastal Watershed	September 2000
Lower Merrimack Watershed	September 2001
Connecticut River Tributaries	September 2001

Restoration work will be coordinated with the Department's Total Maximum Daily Load (TMDL) requirements under the Clean Water Act. Impaired water bodies which remain impaired after implementation of required treatment and BMPs must have their maximum pollutant loads determined and allocated among all watershed sources. Waters that require TMDLs to be developed by April 1, 2000 are listed in Table 1.2. Where TMDL studies identify nonpoint source restoration activities in Category I watersheds, such activities will be incorporated into watershed restoration action strategies and will be given high priority for implementation.

The goal of restoration work is to prevent water bodies from becoming so impaired that pollutant load allocation is required.

Table 1.2
WATERBODIES FOR WHICH TMDLS WILL BE DEVELOPED BY APRIL 1, 2000

Waterbody/Town	Water Quality Exceedance	Comments	Cat. I
Cocheco River/Rochester	Dissolved Oxygen	TMDL is currently under review by EPA.	X
Contoocook River/ Peterborough to Antrim	Dissolved Oxygen	Draft TMDL has been submitted; NHDES is currently working on final TMDL.	
Salmon Falls River/ downstream of Somersworth	Dissolved Oxygen Phosphorus	NHDES is currently working with EPA and the Maine DEP to finalize.	X
Androscoggin River/Berlin & Shelburne	Dioxin in Fish Tissue		
Frazier Brook/Danbury	Iron from Landfill		
Williams Brook/Northfield	Iron from Landfill		X
Beaver Lake/Derry	Algal Blooms due to Phosphorus	This was recently added to the 303(d) list.	X
French Pond, Henniker	Algal Blooms due to Phosphorus	This was recently added to the 303(d) list.	

In other watersheds, management plans will vary depending on the water quality issues of local importance. DES can assist the local watershed organization in defining its goals and setting priorities to address water quality problems. Making decisions about local priorities is the responsibility of the local watershed organization. The watershed organization may choose to develop a watershed management plan to guide its actions addressing the established priorities to achieve its goals, or it may choose a less formal, targeted approach to problem solving.

The lead watershed organization should develop an inclusive, consensus building process to create a watershed management plan. Consideration should be given to including the plan elements described in Table 1.3. The plan can be as broad or as narrow in scope as desired by the local watershed interests.

Table 1.3
ELEMENTS OF WATERSHED MANAGEMENT PLANS

Identify Concerns	Identify concerns about water resources, local economy, and social structure. Some concerns are based on science and some are based on perception. All concerns should be addressed.

Seek and Analyze Data	Find as much information as possible about the concerns, particularly water quality monitoring data. Map as much information as possible. Analyze and interpret the data to accurately describe the watershed issues.
Establish Objectives	Identify and prioritize challenges and opportunities for watershed management. Determine critical areas. Establish objectives to clarify the goals of the group.
Develop Action Plan	Select management techniques. Develop action plan, including how alternatives will be implemented, who will implement them, when they will be implemented, and how they will be funded. Determine how progress will be measured.

Nonpoint Source Management Plan

Section 2

[redacted]

1

Introduction to Section 2

Section 1 of the *Nonpoint Source Management Plan* describes watershed management in the context of local and state initiatives and state technical assistance. The watershed management program is supplemental to a foundation of water quality programs run by the state of New Hampshire and involving several state agencies. This Section of the *Plan* describes how each type of NPS pollution is managed statewide, including local, regional, state, and federal authorities and nongovernmental players.

The *Nonpoint Source Management Plan* was initially prepared by the New Hampshire Department of Environmental Services (DES) in 1989. This document updates and replaces the *1989 Plan*. It describes the status of nonpoint source (NPS) problems in New Hampshire and identifies various ways to improve water quality by preventing and controlling nonpoint source pollution.

As point sources have been brought into compliance with state and federal water quality requirements, NPS issues have surfaced as the key to future water quality protection. At present, statewide management of NPS problems relies on a mix of regulatory and voluntary programs, which are discussed under each of the fifteen NPS issues this *Plan* examines.

1

Nonpoint Source Management Strategy

Goal

The mission of the Department is to protect, maintain and enhance environmental quality in New Hampshire. In keeping with this mission, the overall goal of the NPS program is to abate NPS pollution such that, by 2015, receiving waters meet or exceed water quality standards and designated uses in all watersheds (Connecticut, Upper Merrimack, Lower Merrimack, Coastal/Piscataqua, and Androscoggin/Saco). As interim milestones, it is the goal of the NPS program that by 2005, 75% of receiving waters meet or exceed water quality standards and designated uses in all watersheds, and that by 2010, 95% of receiving waters meet or exceed standards and uses. It should be noted that currently less than 25% of New Hampshire's waters are assessed, and that DES is working toward greater assessment coverage of the state. The interim goals should be adjusted according to available assessment data. The *NPS Management Plan* is a blueprint for achieving these 5, 10, and 15 year goals.

A mix of short- and long-term goals are identified for each NPS type, discussed in this Section of the *Plan*. Ultimately, success in meeting these goals will be measured by the extent to which water quality standards are achieved and designated uses are protected.

Objectives identified in the *Plan* describe several preferred approaches to NPS management. They include:

Public education
Local involvement in problem solving
Implementation of Best Management Practices, whether as voluntary or mandatory
Reduction of pollution source materials
Recycling of biodegradable "wastes," reusable materials, and materials that can be

The *Plan* also recognizes the importance of enforcing existing laws and regulations at all levels of government and the need to monitor both environmental change and the effectiveness of proposed solutions to NPS problems.

Objectives

To achieve the NPS program goal, DES shall:

- Identify and categorize nonpoint sources of concern.

- Prioritize categories of nonpoint sources.
- Determine and relate the NPS pollutants of concern with their impact on water quality, if possible.
- Identify and describe actions for improving abatement and prevention of each NPS category.

Nonpoint Source Categories

In 1989 the NPS categories of concern were ranked, largely on the basis of ***perceived*** impacts, as follows:

Table 2.1: 1989 NPS Categories of Concern, Ranked

1	Landfills
2	Construction Activities
3	Subsurface Disposal Systems
4	Junkyards
5	Urban Runoff
6	Land Disposal of Septage and Sludge
7	Agriculture
8	Silviculture
9	Road Salt
10	Resource Extraction
11	Hydrologic and Habitat Modification
12	Underground Storage Tanks

In 1994, as part of the background material for this update, DES surveyed NPS newsletter readers, asking them to **identify what they believed to be the most serious NPS problems. The 30 respondents included state and federal agencies, conservation districts, planning commissions, watershed associations, river committees and municipal representatives. Table 2.2 reflects their thoughts.**

Table 2.2: Relative Importance of NPS Categories Based on Survey

1	**Stormwater (Urban Runoff)**
2	**Subsurface Disposal Systems**
3	**Construction; Agriculture**
4	**Landfills**
5	**Junkyards; Underground Storage Tanks**
6	**Septage; Road Salt**
7	**Land Disposal of Sludge; Silviculture**
8	**Hydromodification**

The DES NPS staff assessment differs from this characterization, particularly with respect to agriculture, junkyards, storage tanks, and "hydromodification" (i.e., hydrologic and habitat change). Staff consider agricultural impacts important where they occur, but large-scale agricultural operations are limited geographically and a framework for funding and implementing agricultural BMPs exists. Note that the owners of smaller scale farms (farms consisting, for example, of one or two horses) may merit special educational efforts as many are outside the traditional educational loop supported by conservation districts and the Natural Resources Conservation Service (NRCS). Staff ranked junkyards higher than landfills on the list because junkyards are presently unregulated, as such, except when located in wellhead protection areas, whereas DES has a regulatory program for minimizing potential impacts of new landfills and both a time line and funding assistance for closing unlined landfills. Similarly, DES has a relatively aggressive program for dealing with storage tanks. The low ranking given hydromodification by survey respondents may well reflect the term's ambiguity. Relatively recent research into the effects of development on stream morphology and habitat also influenced the staff ranking of this issue. Staff also considered biosolids and septage more significant than survey respondents given continuing uncertainty and public concern over risks and the likelihood that septage and sludge disposal will remain issues as New Hampshire's urban and rural populations grow.

The revised list of NPS concerns, reflected in Table 2.3, is based on the following factors:

- Danger to public health
- Magnitude and pervasiveness of the potential threat
- Potential impacts to receiving waters
- Professional judgement
- **Ability of existing regulatory programs to control pollution (assuming adequate enforcement capability)**
- **Adequacy of existing educational programs to promote pollution control**
- **Public perception, as discussed above**
- **Comments of NPS Management Plan Subcommittees**

Table 2.3: Current NPS Categories in Order of Priority

1. **Urban Runoff**
2. **Hydrologic and Habitat Modifications**
3. **Subsurface Systems**
4. **Junk, Salvage, and Reclamation Yards**
5. **Construction**
6. **Marinas**
7. **Road Maintenance**
8. **Unlined Landfills**
9. **Land Disposal of Biosolids**
10. **Land Disposal of Septage**
11. **Agriculture (Hobby and Commercial)**
12. **Timber Harvesting**
13. **Resource Extraction**
14. **Storage Tanks (Above and Below Ground)**
15. **Golf Courses and Landscaping**

Note that Table 2.3 is intended to guide NPS program activities. All categories represent important NPS sources, and any specific source of pollution may become a priority as a result of site specific factors. Note, too, that the impacts as discussed in this *Plan* focus on impacts to the land and water that result from relatively localized human activities, as contrasted with impacts that result from airborne contaminants. State, regional, and national efforts to reduce smokestack and vehicular emissions, in particular, are recognized as critical to long-term human and ecosystem health, from standpoints of both aerial deposition and global warming.

Nonpoint Sources of Statewide Concern

The overall **goal** of the DES NPS program is:

to abate NPS pollution such that the receiving waters meet applicable water quality standards including designated uses.

Water quality standards applicable to all surface water bodies are defined in RSA 485-A:8 and Env-WS 430 et seq. These standards consider such water quality parameters as *E. coli* bacteria, nutrients, turbidity, temperature, dissolved oxygen, metals, toxic substances, and pH. The standards are tied to water use classifications, of which there are two, Class A and Class B. Temporary partial use areas are a subset of Class B waters, where Class B standards cannot be met at all times as a result of combined sewer overflow events.

Designated uses are uses assigned to Class A and B waters. Specifically, Class A waters are "potentially acceptable for water supply uses after adequate treatment" and Class B waters are "acceptable for fishing, swimming, and other recreational purposes and, after adequate treatment, for use as a water supply."

Ambient standards for groundwater are established in RSA 485-C:6 and Env-Ws 1500 and Env-Wm 1403. They are focused on achieving the goal of potable quality.

The characteristics of the **receiving waters** into which polluted runoff is discharged influence the impact of pollutants. Impacts will vary, depending on whether the receiving water is a lake, a river, a stream, an aquifer, a wetland, an estuary, or the ocean and on the extent to which it is subject to cumulative impacts. In general, NPS pollution has a greater impact on lakes than on rivers and streams, primarily because pollutants tend to accumulate in lakes. Relatively small rivers and streams are also more prone to impact than large rivers, in which dilution and velocity lessen the effect of contaminants.

Chapters 3 through 17 focus on each of the NPS categories of concern. Throughout the discussions are references to **Best Management Practices** (**BMPs**). BMPs are variously defined as: technical guidelines for preventing pollution caused by particular land use activities; and recommended land treatment or operational techniques to prevent or reduce pollution. Respondents to the NPS survey indicated strong support for BMPs, whether mandated or implemented voluntarily and regardless of whether any water quality problems have actually occurred.

Typically, water quality and NPS concerns are analyzed by river basin. For broad planning purposes the state has been divided into five major **river basins**, the Upper Merrimack, Lower Merrimack, Androscoggin/Saco, Connecticut, and Coastal/Piscataqua (see Map 1). These five basins can be subdivided into sub-basins. There are 23 rivers in the state of 5th order[1] or greater size, each with its own watershed (see Maps 2 and 3). Most of the data presented in this report are grouped by the 5 basins and 23 sub-basins.

[1]Fifth order streams and rivers are defined as those reaches that result from many streams coming together, as follows: the elevationally highest year-round streams in a watershed are first order streams; the junction of two first order streams yields a second order stream; the junction of two second order streams yields a third order stream, et seq.

1

Urban Runoff

Problem Definition

The potential impact of urban runoff depends on the volume and rate of stormwater flow, the constituents in the stormwater, and characteristics of the receiving waters. Of these three factors, perhaps flow creates the most pervasive potential environmental problem associated with urban runoff. If the rate of runoff is not properly controlled, flow can cause erosion and sedimentation. Suspended sediments can cause increased turbidity and decreased light penetration, smother aquatic life, impair respiration, destroy habitat, and alter the substrate for plants. Excessive sedimentation can necessitate dredging to restore water supply or flood storage capacities or recreational uses.

The constituents of urban runoff also can cause environmental problems. Potential pollutants include:

- Oxygen-Demanding Substances
- Nutrients
- Metals
- Floatables/Solids
- Total Suspended Solids
- Pathogens
- Organics, including oil, grease, PAHs, MTBE
- Pesticides and herbicides

Oxygen demanding substances, like organic matter and ammonia, create a biological demand for oxygen, or BOD. High concentrations may deplete in-stream oxygen levels to a point where aquatic life cannot survive. During rainstorm events, when most of the stormwater is washed into surface waters, the velocities and re-aeration rates of water in rivers usually increase, so BOD and ammonia generally do not cause a problem in rivers, exceptions being rivers with extremely low flows. However, storm drainage to a small stream or pond may cause dissolved oxygen (DO) deficits, and situations involving streams and ponds need to be evaluated on a site specific basis.

The data from stormwater assessments of *synthetic organics* indicate sufficiently low concentrations to preclude significant impacts to aquatic life. However, they remain a concern because they can bioaccumulate and can be carcinogenic to humans (US EPA 1991).

High concentrations of *nutrients*, particularly phosphorus, can cause algae growth and deplete dissolved oxygen in slow moving streams and rivers, impoundments, and lakes. Excessive nutrients can also create odors and impair designated uses like swimming. A study in Maine documented phosphorus export from a developed watershed up to 10 times greater than from a forested watershed (Maine Department of Environmental Protection 1992).

Heavy metals, such as copper, lead, and zinc can be toxic to aquatic organisms even at very low concentrations. In addition, some metals can bioaccumulate in organisms and persist in the environment. What those longer term impacts to organisms are is unclear. Pitt and Field (1992 *in* Schueler 1994a) found evidence of longer term, chronic toxicity to aquatic organisms exposed to urban runoff, particularly where metals and hydrocarbons are able to accumulate in sediments, as in lakes and estuaries. Metals get into the environment from a multitude of sources, such as brakes (copper), galvanized pipes (zinc), and cadmium (tires).

Floatables can affect the aesthetics of a receiving water body while *solids* can contribute to sediment problems. Solids from winter sanding and erosion can cause increased turbidity, decreased light penetration, and destroy habitats (see discussion under Road Maintenance).

Pathogens may present a health risk to those engaging in primary contact water sports or ingesting contaminated food. Bacteria often serve as indicators for the presence of pathogens. Coastal shellfish beds, for example, are closed or open to recreational harvesting based on *E. coli* bacteria concentrations in surrounding water.

Oil and grease contain a variety of hydrocarbon compounds, which tend to accumulate in sediments where they can persist over time and adversely influence benthic communities. In sufficiently high concentrations petroleum-based hydrocarbons can kill aquatic life. Even small doses of certain compounds, like polynuclear aromatic hydrocarbons, can be toxic to aquatic life.

Studies have associated other toxics, including *pesticides* and *herbicides*, with urban runoff. These also are lethal to aquatic life in sufficient quantities.

In addition to affecting water quality, urban development can alter runoff regimes, stream flows, channel morphology, and groundwater recharge patterns. Increased runoff from impervious surfaces causes higher peak flows and lower base flows, potentially creating seasonal streams from perennial streams. Horner et al. (1994) state that information consistently indicates that impervious surfaces over 10 percent of a watershed create "significantly negative hydrologic, habitat, and ecological responses" because imperviousness changes the way water cycles through the watershed. Trees no longer intercept precipitation, and the storage capacity from trees and other vegetation is lost. Natural depressions are filled in. Pavement and structures prevent infiltration and promote surface runoff. Unpaved surfaces are often compacted, reducing infiltration. Pipes and engineered drainage systems move water quickly from developed areas to receiving streams. Not only is more water removed from the watershed, but it is removed more quickly under urbanized conditions than under natural conditions. As a result, streams during and after a storm must accommodate more water, with consequent potential for more flooding and stream bank/channel erosion; during periods of drought there is less groundwater to provide base flow. Leopold (1968 *in* Horner et al. 1994) identified a common increase in peak flow runoff rates from urbanized watersheds compared with preurban settings of two-to-five fold, with some streams showing even more marked increases.

Biological changes can occur as a result of changed hydrology. An extensive study in Washington comparing an urban stream and a rural stream, for example, correlated most differences in the size and diversity of salmonid fish populations and other indicator species with hydrologic changes caused by urbanization, not water quality changes (Horner et al. 1994).

Not only does it have a high potential for causing water quality problems, urban runoff also raises concerns because it is a statewide issue and its cumulative impacts are likely to increase over time due to population growth and economic development in the state.

New Hampshire Data

Quantitative New Hampshire data on constituents of urban runoff and their impacts on receiving waters are limited. In the late 1970s and early 1980s DES conducted two independent studies of urban runoff. The first study was performed in 1979 in Concord on 255 acres of mixed urban development and an 18-acre shopping center. The other study was conducted in 1982 in Durham on runoff from a 0.8 acre parking lot. More recently, DES completed a Stormwater Characterization Study (NH DES 1997a) based on two sites in Concord. The characterizations in this report are the basis for the desktop modeling in Total Maximum Daily Load (TMDL) studies, where the data are used as a *screening tool* to determine potential impacts. In situations where desk top modeling indicates a substantial NPS problem, the Department will follow up with site specific surveys as needed.

The DES characterization mirrors results of pollution loading studies from around the country. These nationwide studies indicate the highest loading is generally from industrial and commercial areas, followed by highways, higher-density residential developments, lower-density residential areas, and open space (Horner et al. 1994). Similarly, DES found from 2 to 14 times higher pollutant loadings in the stormwater draining a relatively high density urban land use area than in runoff from a light to medium density single family home area. Like other studies, the DES characterization also confirmed that most concentrations of pollutants in stormwater decrease after the "first flush," that longer periods of dry weather prior to a storm correlate positively with increased pollutant loading, and that more intense storms tend to cause increased loading.

Table 2.4 gives average concentrations and loadings for parameters measured in DES stormwater samples taken at the urban and residential sites during seven storms in June, September, and October 1996 (NH DES 1997a). Because it is believed that metals are more toxic to aquatic life in their dissolved form, the table includes the percentage for each metal tested that occurred in a dissolved state. Note that these percentages can change in receiving waters, where their impacts would be felt. Throughout the study, "clean techniques" designed to eliminate sampling contamination were used**.** Some clean techniques involve relatively simple adjustments, like the use of clean, nontalc gloves during sampling, while others are more elaborate and costly. "Ultra-clean" techniques probably would have resulted in lower concentrations for some of the more easily contaminated metals, like zinc.

Although Table 2.4 is the basis of current DES stormwater policy, other stormwater characterization studies are underway. Perhaps particularly noteworthy is the absence of any reference to mercury in Table 2.4. Mercury is the reason for health advisories on fish from all fresh water bodies in the state and is commonly found in analyses of coastal waters. Although industrial discharges historically accounted for a significant amount of the toxic contaminants present in sediments, most current sources are attributed to urban runoff, atmospheric deposition,

oil spills, and runoff from Superfund sites, golf courses and landfills, with “stormwater runoff” the most frequently cited source (UNH Jackson Estuarine Laboratory undated). Aluminum, lead, copper, zinc, and cadmium (to a lesser extent) were documented at concentrations in excess of the state’s water quality standards in DES and Jackson Lab studies in coastal New Hampshire (UNH Jackson Estuarine Laboratory undated).

Table 2.4
1996 DES Study of Urban Runoff Pollutant Concentrations and Loadings

Parameter	Pollutants in Rain	Average Concentration (mg/L unless otherwise noted)		Water Quality Criteria (acute) (in mg/L)
		Urban Site	Residential Site	
Minimum pH	4.8	5.9	5.9	As naturally occurs (Class A waters)
Maximum % Saturation		91%	67%	Minimum % saturation, 75%
Alkalinity		9.4	19.4	NA
Hardness	<1.45	14.2	30.2	NA
E. coli		6563 E. coli/100ml	3997 E. coli/100ml	406 (nondesignated swimming areas)
Turbidity		55 NTU	19 NTU	Class B waters shall not exceed naturally occurring turbidity by more than 10 NTUs
BOD5		21	5	30
TSS		58	28	30
TKN	<0.24	3.49	0.8	NA
NH3-N	<0.21	2.19	0.18	NA
NO3&NO2-N	0.11	1.04	0.52	NA
TP	0.005	1.08	0.15	Class B waters, only in concentrations that will not impair uses
Chloride	<2	15	17	860
Total Al (% Dissolved)	<0.04	1.52 (3%)	0.60 (7%)	0.75
Total Cd (% Dissolved)	<0.0005	0.0009 (91%)	<0.0005 (NC)	Dissolved = 0.00082
Total Cr (% Dissolved)	<0.005	0.0112 (42%)	<0.0051 (NC)	Dissolved = 0.0156
Total Cu (% Dissolved)	<0.003	0.0401 (43%)	0.0048 (69%)	Dissolved = 0.0048
Total Fe (% Dissolved)	<0.042	2.69 (5%)	1.79 (13%)	NA
Total Pb (% Dissolved)	<0.0025	0.0322 (22%)	0.0052 (NC)	Dissolved = 0.0141
Total Ni (% Dissolved)	<0.01	<.0107 (56%)	<0.01 (NC)	Dissolved = 0.0438
Total Zn (% Dissolved)	0.11	0.259 (67%)	0.052 (48%)	Dissolved = 0.0362
Oil and Grease		37	3	Class B waters, none in concentrations that would impair uses
PAH				Stds for protection of human health (ingestion), as opposed to aquatic life
Benzo(a)pyrene		<0.003	<0.00066	0.0000044 (fish/water) 0.000049 (fish)
Benzo(b)fluoranthene		<0.0035	<0.00074	0.0000044 (fish/water) 0.000049 (fish)
Benzo(g,h,i)perylene		<0.0035	<0.00066	NA
Benzo(k)fluoranthene		<0.0025	<0.0005	0.0000044 (fish/water) 0.000049 (fish)
Chrysene		<0.0025	<0.0067	0.0000044 (fish/water) 0.000049 (fish)
Fluoranthene		<0.00473	<0.00287	0.300 (fish/water) 0.370 (fish)
Indeno(1,2,3-cd)pyrene		<0.0031	<0.00054	0.0000044 (fish/water) 0.000049 (fish)
Phenanthrene		<0.005	<0.00125	NA for freshwater
Pyrene		0.00345	0.00213	0.960 (fish/water) 11 (fish)
All other PAHs		BDL	BDL	NA for freshwater

NC means the value could not be calculated because most concentrations were below the detection level (BDL).
The less than sign (<) means the value is probably less than shown because 50% or more of the samples were BDL.

No value in rain column signifies no measurement was taken. Of current concern, mercury was not measured due to funding constraints and the fact that mercury concentrations in the water column are generally quite low; mercury accumulates in sediments and tissues over time.

NA means there is no acute criterion.

Note that while the stormwater samples cited in Table 2.4 at times exceeded water quality standards, the quality of receiving waters may not have fallen below standards, depending primarily on dilution.

This table offers a number of conclusions.

- **As indicated above, the consistently higher concentrations of pollutants from the more urbanized of the two sites suggest that increasing urbanization raises the potential for water quality problems.**
- **Surface water quality standards were repeatedly violated in stormwater for total copper, zinc, and aluminum at both sites, and for total lead in the urban samples. Since only a small portion of the aluminum and lead were in dissolved forms, the potential for toxicity to aquatic life from these metals is considerably reduced. Whether copper and zinc pose immediate problems in the water column is in part a function of dilution. These and other metals that accumulate in stream or lake sediments could become a problem over time. The EPA has issued guidance levels for metals in sediments, but no sediment quality criteria have been promulgated.**
- **The pH of stormwater generally fell below water quality standards, but was higher than the pH of rain.**
- **Most pollutants detected in the stormwater samples were at higher concentrations than in the rain, with the exception of nitrate/nitrogen, total zinc, ammonia nitrogen, and total Kjeldahl nitrogen. Each of these pollutants, except zinc, is associated with acid rain. It is unclear what the source(s) of the zinc in rainwater is(are), but rain contributes significant amounts -- essentially all of the total zinc, as well as all the ammonia nitrogen in stormwater from the residential site was contributed by the rain.**
- At both urban and rural outfalls, *E. coli* bacteria concentrations exceeded current water quality standards. Whether the *E. coli* concentrations raise a public health risk is unclear, since nonhuman wastes may pose lower risks to human health than human wastes. There is also considerably less likelihood of people swimming during wet weather, and current water quality standards for bacteria are based on swimmability. DES is funding a stormwater study through UNH to evaluate the risk from *E. coli* in urban runoff.
- **Turbidity (TSS) standards can be exceeded temporarily as stormwater is discharged into a water body. Because dilution minimizes TSS impacts, the most severe cases of impairment occur in low flow streams and ponds.**
- **At 1 mg/L, total phosphorus concentrations generally were equivalent to the lowest concentration that advanced wastewater treatment facilities can achieve.**

DES studies of phosphorus loading in lakes due to surface water runoff indicate a range of input values of from 1 to 28 percent of the total load, depending on the amount of shoreline development and impervious surfaces (Estabrook 1995). A study focused on urban lakes (NH DES 1985) found significant impacts on lake water quality from storm event loading and recommended various BMPs to reduce stormwater inputs of not only phosphorus, but also bacteria and other pollutants.

Whether Hampton Harbor is open to shellfish harvesting or closed depends on rainfall. The operative management plan for Hampton Harbor currently requires closure following a rain event of 1/2 inch or more within a 24-hour period in November, April, and May. The limit is 1/4 inch if during December through March. In the case of shellfish beds, fecal coliform bacteria are the contaminant that triggers closure. Over the last ten years fecal coliform concentrations throughout the estuaries have declined, due to municipal

wastewater treatment plant upgrades. Polluted stormwater is considered a main source for this bacterial contamination. Potential sources for the bacteria in stormwater include impervious areas (roadways, parking lots and rooftops), ineffective septic systems, and sanitary sewer bypasses. Stormwater is also one of many suspected sources of metals in the estuaries, and adds nutrients to the water column (UNH Jackson Laboratory, 1997 *in* OSP 1997).

There are a variety of reasons for the trend towards eutrophication in New Hampshire lakes and the concern over toxics and solids in aquatic habitats, as cited in the New Hampshire Comparative Risk Project. Among them, runoff from highways and residential, commercial, and industrial lands is a definite factor in the NH Comparative Risk Project's ranking of surface water habitat degradation as the state's #1 environmental risk.

Ironically, a National Oceanic and Atmospheric Administration-funded study of the University of New Hampshire indicates there are significant erosion problems at most of the constructed storm water control systems assessed (T.P. Ballestero, pers. comm.).

In addition to surface runoff, at issue in many New Hampshire communities with sewer and stormwater systems are illicit discharges to the stormwater system. Direct discharges commonly originate in illicit sanitary wastewater tie-ins to the stormwater system (whether from residential, commercial, or industrial sources), residential and commercial laundry discharges to the stormwater system, and filling station or vehicle maintenance station discharges (NH DES 1997b, DES unpubl. data from 1997, 1998 coastal investigations, US EPA 1993a).

*Current Status of **Urban** Runoff Controls*

In cooperation with the Rockingham County Conservation District and USDA Natural Resources Conservation Service, the DES has published BMPs for stormwater management. They are compiled in *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, 1992. This publication is available from the sponsors for $25.00. One copy was distributed to each planning board in the state. To fully address permanent stormwater treatment BMPs in the context of state regulations, DES published *Best Management Practices for Urban Stormwater Runoff* in January 1996. This publication includes detailed information describing nine different stormwater BMPs. Note that these publications focus on new construction, as contrasted with existing infrastructure, which is often the major source of pollution from urban runoff.

Because many urbanized sites are too restricted to allow for typical BMP installations, more and more frequently New Hampshire communities are turning to manufactured units for water quality control. State regulations permit use of manufactured units in developed areas.

Excessive flow, which can cause erosion, *floatables*, and to some extent *pathogens***,** *nutrients, metals***,** and *hydrocarbons* are addressed under the following programs.

Terrain Alteration

RSA 485-A:17 governing terrain alteration projects of greater than 100,000 sq. ft. (50,000 sq. ft. within a Protected Shoreland, RSA 483-B) is the primary source of State authority to deal with urban runoff. The permits required under this program address both pre and post construction

control of runoff. Permits typically require installation of permanent BMPs, such as detention ponds, grassed treatment swales, vegetated buffer strips, wet ponds, and created wetlands that are designed to manage both water quality and flow.

The literature indicates that these BMPs are variously effective at reducing flow and removing pollutants (Spaulding January 1996). Vegetated buffer strips, for example, are designed primarily to remove soil particles and nutrients from overland flow, with probable removal ranges for total phosphorus of from 30 to 80 percent. The probable removal range for total nitrogen is 20 to 60 percent and for lead 30 to 80 percent and zinc 20 to 50 percent. Dry ponds, designed for temporary storage to reduce runoff rates, have probable removal ranges for various pollutants in urban runoff as follows: suspended solids, 50 to 70 percent; total phosphorus, 10 to 20 percent; total nitrogen, 10 to 20 percent; lead, 75 to 90 percent; zinc, 30 to 60 percent; BOD, 20 to 40 percent; hydrocarbons, 50 to 70 percent; and bacteria, 50 to 90 percent.

Regulations adopted September 1996 require that BMPs be designed to control runoff from a storm with a return frequency of once in ten years. The change was initiated to make BMP installations more nearly mirror natural conditions, under which a one or two year storm event determines the bankfull size (stream at high flow) of most stream channels.

Shoreland Protection

The Comprehensive Shoreland Protection Act (CSPA), RSA 483-B, regulates fertilizer application within 250 feet of a protected water body. Fertilizer use is prohibited within 25 feet of the shoreline, with the exception of lime. Between 25 and 250 feet from the shoreline only low phosphate, slow release nitrogen fertilizer and lime are permitted for lawn and grass areas. The act requires the maintenance of natural woodland buffers within 150 feet of a protected water body, where cutting is limited to 50 percent of the basal area, leaving a well-distributed stand of trees, saplings, shrubs, and ground covers. In addition, buildings must be set back 50 feet from the shoreline. Stump removal is prohibited within this setback. The Act is designed to prevent the degradation of naturally vegetated buffer strips and reduction of their water resource protection benefits. The more undisturbed the organic duff layer, the more effective the buffer for both nutrient attenuation and runoff infiltration.

The Shoreland Program presently has two staff people, one for education and one for enforcement. Enforcement actions generally are prompted by reports of suspected violations to the CSPA staff. Because building permits are issued locally, the Shoreland Program relies on code enforcement officers and building inspectors to abide by CSPA provisions. DES staff are working with communities to ensure that the Act is understood and local officials are both requiring its provisions be met and notifying the state of violations. During 1998, 41 Letters of Deficiency (requesting voluntary compliance), 3 Administrative Orders (ordering compliance), 3 administrative fines, and 29 variances were issued.

Federal Permits

Federal National Pollutant Discharge Elimination System (NPDES) stormwater permits are required for discharges of stormwater associated with industrial activity, which is defined to include but is not limited to construction on over five acres and certain heavy manufacturing industries. The permit also governs municipalities with more than 100,000 people served by a municipal separate storm sewer (MS4). There are presently no municipalities in New Hampshire

with more than 100,000 people on an MS4. The permit requires preparation of a stormwater pollution prevention plan to control stormwater. Certain industries must also sample their stormwater.

Proposed "Phase II" regulations issued in December 1997 designate two additional classes of facilities that will be subject to federal stormwater permitting requirements -- small municipal separate stormwater sewer systems (a population-based determination, including cities and surrounding suburbs ["contiguous incorporated places"]) and construction sites disturbing from one to five acres. Dover, Somersworth, Rochester, Portsmouth, Manchester, and Nashua, and potentially others as communities grow, will be affected by the new regulations, which are liklely to become effective towards the end of 1999. At a minimum, municipal stormwater permits, as proposed, will require the development and implementation of control measures covering public education and outreach on stormwater impacts, detection and elimination of illicit discharges, stormwater management measures (pre and post construction) in new development and redevelopment, and pollution prevention for municipal operations. There are proposed waiver provisions, including one for cities where an EPA-approved total maximum daily load study shows that stormwater runoff is not a water quality concern.

The proposed regulations include authority to permit other facilities on a case-by-case basis, including commercial, industrial, and municipal systems that fall below the threshold for automatic permitting (urbanized areas with between 50,000 and 100,000 people served by a municipal stormwater sewer system). The regulations are scheduled for final promulgation in October 1999.

Streets and Highways

DES has an agreement with NH DOT that NH DOT will utilize groundwater protection measures when constructing or improving roads. NH DOT cleans catch basins and sediment traps up to two times per year, in the spring and fall, depending on the need. All sediments are stockpiled for use in other projects. Stone-lined energy dissipaters installed below drainage pipes are also inspected periodically and cleaned out as needed. Within the last several years NH DOT has further attempted to reduce urban runoff by such practices as acquiring rights-of-way wide enough to accommodate stormwater management BMPs; installing sediment sumps at all culvert outfalls; specifying the design of all permanent stormwater BMPs; installing gated detention ponds in sensitive areas like water supply areas; sizing detention ponds for the 2-year, 24-hour storm, rather than a ½ inch storm; and conveying runoff outside aquifer recharge areas for treatment and release.

A variety of innovative urban runoff treatment devices are currently on the market for both new development and retrofit situations to capture some of the pollutants from urban runoff into catch basins along streets and parking lots.

[Road maintenance impacts are discussed in chapter 9 of this *Plan.*]

Other Programs

Other programs contribute to urban runoff control by reducing or eliminating polluting constituents of urban runoff. These include, for example, efforts targeting municipalities, generators, and haulers to control the disposal of used oil.

Community Role

Primary responsibility for urban runoff control rests with the communities. RSA 674:35 and RSA 674:43 authorize planning boards to regulate subdivisions and nonresidential and multi-family residential site development, respectively. A planning board has the authority to control runoff and prevent pollution, and may hire consultants, at the applicant's expense, to review subdivision and site plans, construction in progress, and as builts. Although many towns have subdivision and site plan regulations in place, it is reported by the Office of State Planning (OSP) that they are generally inadequate in terms of design standards for stormwater control and long-term maintenance requirements. The DES, OSP, and regional planning commissions have staff available to help communities address stormwater management questions. The conservation districts also have expertise and may provide design review services, although staff limitations restrict their capacity to actually monitor construction projects.

Communities are also responsible for inspecting projects and enforcing compliance with locally approved plans. Note that they do not have the authority to enforce site specific or wetlands requirements unless the local board specially incorporates state-approved plans into the local permitting process. The extent to which follow up inspections and enforcement activities are pursued is highly variable; in many communities, little or no follow up occurs.

1989 NPS Plan Recommendations Implemented

Since 1989 the State has developed stormwater BMPs, and at least three model stormwater ordinances have been written, by Lakes Region Planning Commission, North Country Council, and the NH Association of Conservation Districts Water Quality/Urban Committee, Erosion and Sediment Work Group. DES has addressed waste oil, another issue raised in the *1989 Plan*, by promotion of and grants for the establishment of municipal waste oil collection centers. In New Hampshire 148 municipalities presently collect waste oil. DES's goal is for all 234 communities to be offering programs or mechanisms for residents to dispose of waste oil responsibly. The NH DOT now considers drainage controls when acquiring rights-of-way and requires contractors to build erosion controls. A strong recommendation of the *1989 Plan*, training for local officials who deal with stormwater runoff issues, has not been implemented.

Goal

Local entities, where the fundamental authority for stormwater management resides, have the knowledge and tools with which to control runoff and maintain or enhance water quality over the long term.

Objective 1: Encourage planning boards via mailings, workshops, and easy-to-follow procedures booklets/manuals to adopt stormwater regulations and, where structural controls are installed, to develop, in concert with local code enforcement officers, quality assurance programs or procedures to perform inspections at appropriate times in the construction process and review stormwater control as builts. Key players: OSP, DES, RPCs, NH Municipal Association, Conservation Districts

a) Determine which municipalities currently have procedures in place to ensure a thorough stormwater control process; analyze weaknesses.
b) Engage key players in discussion of problem scope and ways to address it, including in discussions the efficacy and potential additional long-term benefits of nonstructural

approaches like stormwater retention/treatment on a lot by lot basis, retention of vegetated buffers along perennial streams and wetlands, the role of undeveloped land in reducing runoff, and the minimization of impervious surfaces.

c) Develop and implement plan, including any necessary research and development of informational materials.

Discussion: Prevention and enforcement are key to local control of stormwater impacts. Regulations should ensure that runoff from subdivisions and from projects subject to site plan approval is clean and its volume mirrors pre-development conditions as closely as possible. Regulations should focus on minimizing the amount of impervious coverage and encourage nonstructural controls, including maintenance of natural vegetation and existing topographic/hydrologic features. They should also detail enforcement procedures. Planning board review should include provisions for oversight of construction activities at critical installation points by an outside engineer, bonding requirements for larger projects, and plan approvals conditioned upon satisfactory completion of all stormwater control systems, where failure to complete a system is cause for plan revocation.

Measurement: The number of municipalities with stormwater regulations that meet or exceed the model ordinance developed by the NH Association of Conservation Districts and/or criteria established by the key players.

Objective 2: Encourage planning boards to require a schedule for ongoing maintenance of stormwater controls as part of the local approval process, including provisions identifying the responsible party. Key players: OSP, DES, RPCs

a) Include this element of stormwater control as one of the issues to be presented to planning boards in objective 1.

Discussion: Maintenance is a key component of urban runoff control. RSA 676:4-a provides for the revocation of approved plats if the applicant or a successor in interest "fails to conform to the statements, plans or specifications upon which the approval is based, or has materially violated any requirement or condition of such approval," thus establishing clear authority for enforcing maintenance schedules specified in the permit or recorded on plans.

Measurement: The number of local stormwater maintenance programs, particularly in communities with populations greater than 20,000.

Objective 3: Initiate and support locally initiated projects to promote: 1) acceptance and use of both structural and nonstructural controls in existing and new construction; 2) maintenance of structural controls; and 3) reuse of urban areas/rehabilitation of downtown buildings to minimize the increase of impervious surfaces and urban sprawl. Key players: DES, OSP

a) Assess the extent to which DES and OSP grants programs promote these goals.
b) Add project selection criteria that credit efforts that support these goals.
c) Provide technical assistance and publicity to efforts to protect water quality and minimize impervious surfaces, including stormwater system retrofitting.

Discussion: Education is key to full implementation of an effective stormwater management program. Examples of effective outreach programs to the general public include storm sewer stenciling, designation of environmentally friendly (green) neighborhoods where residents focus special educational efforts on improving their local environment, and written materials and displays explaining how our daily activities create pollution problems and offering solutions. Educational efforts must focus also on local officials, where an appreciation of cumulative impacts of development is critical to runoff control An understanding of the issues may not only change behavior but also provide the political support for more effective regulatory programs and financial support for maintenance of public stormwater management facilities. Outreach should stress the cost savings of erosion control.

Measurement: 1) The number of projects funded that meet a, b, or c above, 2) the number of participants in the NH Lakes Association's Watershed Stewardship Program or other comparable environmental awareness programs, and 3) the number of requests for technical or financial assistance with downtown renewal, urban runoff problems or potential runoff problems.

Objective 4: Encourage communities to identify and address existing problems through installation of packaged stormwater treatment systems or other retrofit measures, coordination of stormwater and sewer system maintenance with street repairs, practices like street sweeping, catch basin cleaning, and waste oil collection programs, and creation of urban green spaces to help treat runoff, improve air quality, and otherwise promote a livable environment. Key players: DES, Technology Transfer Center, RPCs, OSP, Conservation Districts, EPA

a) Publicize and provide training in the options available through technology trade shows, workshops, newsletters, demonstration sites, and other outreach to local officials and consulting engineers, in particular.
b) Develop fact sheets, a BMP guide, and/or other materials on retrofit solutions and greenscaping.

Measurement: Documented improvements to water quality in water bodies that receive stormwater discharges.

Objective 5: Explore funding sources to support retrofit projects. Key players: DES, OSP, EPA

Measurement: 1) The number of funding sources available and 2) the number of sources actually tapped.

Objective 6: Amend DES terrain alteration regulations to require runoff control from a 2-year storm event, in addition to the 10-year storm. Key player: DES

Discussion: Geomorphic changes to stream beds are a significant result of urbanization. Bankfull conditions usually occur at the 1.7-year storm. This rule change would require that stormwater from the storms that typically cause bankfull conditions prior to development would continue to release the same amout of water from a property after it has been developed.

Measurement: Regulatory change completed.

Objective 7: Update the *Stormwater Management and Erosion and Sedimentation Control Handbook* and *Best Management Practices for Urban Stormwater Runoff* and provide more generalized training for planning boards and technical training for engineers in the use of BMPs described in these publications. Key players: NRCS, DES, Conservation Districts, RPCs, UNH

a) Convene a group to determine what changes need to be made, what additional information is necessary.
b) Find funding for changes and lead author(s).
c) Test the revised drafts to ensure goals have been met.

Measurement: Completed publications and one or more workshops held.

1

Habitat and Hydrologic Modification

The term "hydrologic and habitat modification" covers a variety of activities that affect surface water hydrology and habitats. Such activities include bank stabilization and channel modification projects, dam construction, operation, and maintenance, the removal of vegetation along water bodies, urbanization as it affects stream flows and water quality, and wetlands alteration. The term habitat modification as understood in this Plan includes any loss of or change to riparian and aquatic environments, where riparian is defined to include both shoreland and upland areas in proximity to a wetland or other water body.

Problem Definition

The water quality impacts from hydrologic and habitat modification activities are not necessarily associated with pollutant loading, although increased turbidity and higher levels of nutrient or other inputs may result from activities that affect hydrologic regimes or shorelines. Nor can they necessarily be linked to what is happening at one or two particular sites. The gradual urbanization and cumulative increase in the areal extent of impervious surfaces in a watershed can change the volume and timing of runoff, altering stream channels and causing erosion. Similarly, while projects altering large wetland acreages contribute most to the total acreage of wetlands lost to development, the vast majority of the State-permitted wetland losses are less than one-half acre in size (DES 1994 in Comparative Risk Project 1997), and the cumulative impact of small losses to wildlife habitat or sediment retention in a watershed can be dramatic (Johnston 1994 in Comparative Risk Project 1997). It is because the impacts from urbanization and development are statewide, cumulative, ecologically and often recreationally important, and likely to increase over time that this issue is increasingly relevant and significant to NPS control efforts.

Specific environmental impacts associated with hydrologic and habitat modification result from:

Loss of shoreline vegetation
Stream channelization, whether direct or indirect
Dam construction, operation, and maintenance
Dredging, filling, draining, and in other ways impacting wetlands
Soil compaction and creation of impervious surfaces
Pollutants of concern include sediments, nutrients, and the toxics in stormwater runoff.

Loss of shoreland vegetation has a variety of impacts on both aquatic and upland habitats. Along rivers and streams, aquatic impacts include higher water temperatures, exposure to ultraviolet rays, and changes to instream habitat structure due to the loss of food and cover

typically provided by woody debris in streams. On any water body, shoreline vegetation helps filter out pollutants, reduce sedimentation from the land, promote bank stability, and reduce overland flow into receiving waters. It also provides important habitat for a variety of animal species, many of which depend on riparian areas for breeding, foraging, perching, travel, and nesting or denning habitat.

Stream channelization[2] is broadly interpreted in this Plan. It can be induced directly, by diverting water from a natural course to a new one, or indirectly, by taking an action that causes the stream to change its course or profile, as by riprapping a bank to protect the shoreline or increasing the amount and rate of runoff from the land as a result of development that does not take runoff control into account. Such changes can prompt scouring, stream bank erosion, and changes to the stream profile. Increased runoff also causes reduced flows during dry periods due to reduced groundwater storage (discussed below). Where channelization reduces flooding into riparian zones, oxbows, and adjacent wetlands, significant changes in ecological functions of surrounding lands are likely to occur. Channel modifications frequently degrade instream and riparian habitat for fish and wildlife. Other impacts include reduction of the natural system's ability to filter pollutants, erosion, and accelerated delivery of pollutants to downstream receiving waters.

In tidal areas, channelization, as caused by roads and railroads, can restrict tidal flows to tidal marshes, causing the natural marsh communities to change to the point where they no longer provide characteristic tidal wetland functions and values such as wildlife habitat or visual/aesthetic quality. If restrictions are severe enough, brackish or freshwater wetlands may replace the marshes.

Dams on rivers can adversely affect aquatic and riparian habitat, water quality, and hydrologic regimes. Dam siting, construction, and operation decisions all effect environmental change. Dams frequently restrict fish migration, impact wetlands up and downstream of the dam, and affect water temperature, flushing flows, stream channel and bottom habitat up and downstream of the dam, stream BOD, dissolved oxygen levels, nutrient loads, and riparian vegetation. Where dams separate downstream rivers from their floodplains, they disrupt natural, annual flooding cycles and the plant and animal communities dependent on them. Dam operations can cause wide fluctuations in water levels both above and below a dam. According to a Wisconsin Department of Natural Resources 1995 report (*in* U WI-Madison 1996), dams are "one of the most significant obstacles to restoring the integrity of riverine systems." Removal is an increasingly popular option, often prompted by considerations of public safety and the economics of dam repair, but resulting in habitat restoration benefits as well.

Dams are generally built and operated to serve public needs, like flood control, recreation, energy production, and more recently, stormwater detention, but they may be built or managed to improve waterfowl habitat, augment stream flows, or otherwise benefit certain species of fish or wildlife.

Sources of wetland impacts include (but are not limited to) dredging activities, filling of wetlands, draining, dam construction and operation, and the introduction of invasive plant species. These activities can impede a variety of wetland functions, including water quality protection, habitat for fish and wildlife, flood control, nutrient attenuation, opportunities for recreation and education, and aesthetic enjoyment. The loss of smaller wetlands, including

[2]As used in this context, channelization includes morphological changes caused by human activities, manmade diversions, and activities such as rip rapping that alter natural stream dynamics.

seasonally ephemeral pools, can significantly affect the population dynamics of some wetland animal species - most notably amphibians - including local extirpations. Wetlands losses are cumulative within a watershed, affecting both hydrology and habitat. Although some restoration of wetlands has occurred in recent years, it is doubtful all functional values can be recovered (Comparative Risk Project 1997).

In assessing impacts to wetlands from human activity, it is also important to assess the condition of the upland buffer. Buffers perform a variety of critical water quality and habitat protection functions, directly influencing the abutting wetland. A multi-agency publication, *Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities*, November 1995, recommends an average minimum upland buffer of 100 feet.

Soil compaction and creation of impervious surfaces contribute to reduction in groundwater infiltration and its corollaries, decreased travel time of runoff to receiving waters, heightened peak flows, reduced base flows, and channelized flow. As watersheds throughout the state are developed, these impacts will be increasingly visible and problematic.

New Hampshire Data

Historically, dams played a significant role in hydrological and habitat change. Today, alteration of wetlands and impacts of urbanization may be the most common actions effecting change. The DES lists 3,170 active dams in the state. They perform a variety of functions, including recreation, stormwater detention, hydro electric energy generation, water supply, flood control, and fire protection. About 40 percent create impoundments greater than one acre in size. Nine hundred thirteen brooks, streams, and rivers have one or more active dams on them; 607 of these dams create impoundments of greater than 1 acre.

In New Hampshire, only the most obvious changes induced by hydrologic and habitat modification have been quantified. Boisvert and Ballestero (1989) have documented the potential for low dissolved oxygen in impoundments. Section 305(b) water quality reports for 1994, 1996, and 1998 identify 8 locations, affecting 10.5 river miles, where dams are the probable cause of low (sub-standard) dissolved oxygen concentrations. All but one of these are reported in the most recent 305 (b)report. The most recent 305(b) report also identifies 11 sites where bypass reaches around dams pass too little or no water and one site, affecting 2.7 river miles, where dam operations are the probable cause of low flows that are adversely impacting state-listed freshwater mussels downstream of the dam.

More recent studies of impoundments on the Connecticut River and its tributaries by F.J. Magilligan and K.H. Nislow out of Dartmouth College have focused on the various ecological implications of flood control and hydroelectric generating dams as they relate to the timing, frequency, and magnitude of high and low river flows. While flow variations on the mainstem and tributary streams differed in some respects, the locations and operations of dams “effectively prevent a critical range of flows from occurring in the Upper Connecticut [River Basin],” with consequences for aquatic communities due to changes in river bottom characteristics and for floodplain communities (including habitat fragmentation) due to altered flooding patterns. Other impacts to aquatic life include the exclusion of anadromous fish from upstream reaches of rivers with dams lacking fish passage facilities and changes to habitat and species composition as systems are converted from riverine to ponded conditions.

Extensive bank erosion along the Connecticut River, to which human activities have contributed**,** has eliminated important riparian farmland and shorelines. Respondents to a questionnaire sent to 1300 landowners along the Connecticut River identified bank erosion as their number one concern. Inventories conducted by the county conservation districts document the nature and extent of erosion the length of the New Hampshire reach of river. The inventories identified the following key factors as promoting bank stability along the Connecticut: low banks (less than 5 feet high), shallow slopes (greater than 2:1, horizontal:vertical), and shoreline vegetation, except where trees were leaning or falling into the water, especially on silty or sandy soils, in which case the trees accelerated erosion. Areas with no buffer at all tend to have higher rates of erosion, particularly when associated with grazing livestock. Store and release hydroelectric operations, powerboats, ice, beaver, and "development" (a category used in the Section 305(b) report for 1998) also contribute to erosional problems along the Connecticut.

Erosion along rivers elsewhere in the state has not been systematically documented, although recent emphasis on watershed restoration may highlight some of the more egregious examples in category 1 watersheds. In 1997 DES received 46 applications, and in 1998 59 applications for bank stabilization projects, roughly divided between rivers and lakes, and six affecting tidal areas. Most of these represented new projects (as contrasted with repairs, but including expansions).

Section 319 funds support a multi-year soil bioengineering demonstration project for streambank protection that initially targeted three 500 foot sections of the Connecticut in Grafton County. One of these sites failed during the first year for a variety of reasons, including inadequate control over pastured cows. Another was vandalized. The third appears to be working, but has suffered some animal damage. The project includes a five-year monitoring component and workshops at the site designed to assess progress and inform landowners. Other bioengineering projects are underway elsewhere in the state, generally for situations where erosive forces are less intense than on the Connecticut.

In 1994 the NRCS identified 50 sites where the ecological integrity of tidal marshes may be suffering degradation due to restricted tidal flows (NRCS 1994 *in* Comparative Risk Project 1997). These sites represent 20 percent of the State's remaining tidal marshes. The NH Coastal Program in the Office of State Planning has funded several salt marsh restoration projects through its annual competitive grants program. The installation of a properly sized culvert at Wallace Road in Rye, for example, has the potential to revitalize 72 acres of presently degraded salt marsh. This project is one of several culvert replacements that the Town of Rye is systematically pursuing to restore salt marsh habitat.

Wetlands alteration activities occur throughout the state, with oversight, enforcement, and permitting by the DES Wetlands Bureau. DES estimates overall wetlands loss in New Hampshire at 100 acres of freshwater wetlands per year over the last five years through both permitted and unpermitted activities (K. Kettenring, pers. comm.).[3] In 1998, when some 56 acres of nontidal wetlands were approved for dredge or fill activities, roughly one-third of the state-issued wetlands permits affecting nontidal wetlands were for nonresidential development. Road construction and residential development together accounted for another 45 percent of impacts. In 1997, two airport expansion projects accounted for about 20 percent of the total nontidal

[3]This estimate does not take into account wetland mitigation projects for wetlands creation and restoration. As a general policy, the Bureau emphasizes preservation of existing wetlands and upland buffers over creation, where applicable.

wetland impacts for that year, affecting some 17 acres. Nonresidential development, residential development, and road construction were the top three activities in terms of acreage impacted accounting for permitted wetland impacts. The Wetlands Bureau processed 59 bank stabilization projects in 1998, and 46 in 1997. Of these 6 were in tidal waters.

One-third of New Hampshire's wildlife species depend on aquatic or wetlands habitats. Some of these species are uncommon, rare or threatened in the state or region. Habitat loss and fragmentation are the common reasons for many of the wetlands species' declines.

The *1989 NPS Management Plan's* statement, that "definitive information regarding water quality impacts resulting from hydrologic and habitat modification is scant and inconclusive," still holds today. The relative absence of data, while noted, did not, however, prevent the New Hampshire Comparative Risk Project (1997) from ranking "physical alteration of water and shoreland habitat" and "loss of water habitat (filling, draining)" fourth and fifth, respectively, among 50-plus environmental and public health risks reviewed by the Comparative Risk public advisory group and its consultants. The extent and frequency of impacts, and their ecological severity influenced the Project's ranking.

Current Status of Hydrologic and Habitat Modification Controls

BMPs governing hydrologic and habitat modification have been developed for agriculture and small dams. BMPs for agriculture are published in *Best Management Wetlands Practices for Agriculture*, July 1993, NH Department of Agriculture, in *Manual of Best Management Practices for Agriculture in New Hampshire*, August 1998 (revised), NH Department of Agriculture, Markets & Food, and in *Irrigation: Best Management Practices For Agriculture in New Hampshire*, March 1998, NH Department of Agriculture, Markets & Food. (Note that these BMPs do not necessarily protect all the various functional values of wetlands or water bodies and allow for draining of wet meadows dominated by poorly drained soils where agriculture has been or currently is being practiced.) BMPs for dams and small embankments are published in *Small Embankment-Type Dams and Their Ponds: An Operation and Maintenance Handbook*, by the Natural Resources Conservation Service, NH DES, NH Office of Emergency Management, and NH Association of Conservation Districts, 1993 and in *Best Management Practices for the Maintenance and Operation of Dams*, NH DES, 1995, WD-DB-13. BMPs for timber harvesting, including stream crossings, are published in *Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire*, by J.B. Cullen, NH Department of Resources and Economic Development, Division of Forests and Lands, April 1996, reprinted May 1997.

Regulatory protections and requirements for wetlands, rivers, shorelines, and dams are summarized below.

Wetlands Regulation

The DES Wetlands Bureau has jurisdiction over activities "in or on any bank, flat, marsh, or swamp in and adjacent to any waters of the state" (RSA 482-A:3, I) and "to all lands submerged or flowed by mean high tide as locally determined, any sand dune or vegetation thereon in the state of New Hampshire, and, in addition, to those areas within 100 feet of the highest observable tide line which border on tidal waters, such as, but not limited to, banks, upland areas, bogs, salt marshes, swamps, meadows, flats or other lowlands subject to tidal action" (RSA 482-A:4, I). Any activity affecting stream channels, banks, wetlands, or dams requires a permit from the Wetlands Bureau. The Department enforces its permits and levies fines for noncompliance (RSA

482-A:13 and 482-A:14). The only exceptions are: (1) repairs or replacements of existing structures, provided that there is no dredging, filling, or work in the water or wetlands, and (2) work in legally constructed drainage ditches, culverts, catch basins, and manmade detention ponds, provided no vegetation has grown in, there is no expansion of the facility, and the dredged spoils are not deposited in wetlands or water bodies. Forestry and selected other activities are governed by an expedited permit process, as described under Timber Harvesting in this *Plan*. All applications require the applicant to contact the New Hampshire Natural Heritage Inventory (NHNHI) to determine whether the project site is known to contain any plant or animal species in the NHNHI database.

Permits typically include conditions requiring: the installation of erosion and sedimentation control measures before work is begun; maintenance of control measures throughout the life of the project; and site stabilization upon project completion. Seasonal constraints and requirements for the disposition of spoils are also common conditions.

The regulations state a preference for vegetative methods of shoreline stabilization, including the requirement that natural vegetation be left intact to the maximum extent practical (Wt 404.03). Shoreline stabilization projects must use the least intrusive method available, with rip-rap and walls allowable only where conditions render other approaches impractical (Wt 404.04, 404.05). Projects that come before the Bureau for which there is a practicable alternative to wetlands dredge or fill are not permitted for the proposed activity. Fill proposed to achieve required setbacks for septic systems is not permitted. Impact assessments include an evaluation of potential impacts on stream habitat.

Locally designated "prime" wetlands (RSA 482-A:15) have the additional protection, that the applicant show and the Wetlands Bureau find, as required under RSA 482-A:11, IV, based on clear and convincing evidence, that there will be no significant net loss of values set forth in RSA 482-A:1 and that at a minimum four specific criteria are met, (Env-Wt 703.01 [b]) including consistency with wetlands protection from despoliation and unregulated alteration; infeasibility of impact avoidance; impact minimization; and use of appropriate and practicable compensatory mitigation. About 21 municipalities have adopted “prime wetlands” designations.

State Water Quality Certification

Any wetlands permit issued by the federal US Army Corps of Engineers (see below) under Section 404 of the Clean Water Act, and any license issued by the Federal Energy Regulatory Commission requires state 401 certification. Such certification confirms that the proposed activity will successfully maintain state water quality standards.

Shoreland Protection

The Comprehensive Shoreland Protection Act (CSPA) supports the maintenance of natural vegetation along protected shorelands (4th order or greater streams, great ponds, and tidal waters) by limiting cutting within 150 feet of the shore (excluding vegetation removed for construction) to 50 percent of the basal area of trees and 50 percent of the saplings, so as to retain a “healthy, well-distributed stand of trees, saplings, shrubs and ground covers in a 20-year period.” Dead,

diseased, unsafe and fallen trees may be removed without affecting the tree-density computation. Landowners are encouraged to preserve dead and living trees that provide dens and nesting sites. The Act also requires that all stumps within 50 feet of the shoreline be left intact in the soil to prevent erosion. Restrictions on the use of fertilizers within 250 feet of a protected shoreline, requirements for sedimentation and erosion control measures to protect surface waters, and other measures offer additional protection. Notably, however, the setback for "primary buildings" is 50 feet, which may be reduced by local ordinance, and agricultural operations are exempt from the CSPA, provided they are implementing BMPs.

Forestry cutting law (RSA 227-J:9) restricts harvesting to 50 percent of the basal area within a 12-month period, leaving a "well distributed stand of healthy, growing trees" within 150 feet of any great pond, standing body of water 10 acres or more in size, fourth order or higher stream or public highway and within 50 feet of any stream, river, or brook not included in the more stringent setback and any standing body of water less than 10 acres in size associated with a perennial watercourse. This law does not apply to situations involving land conversion.

Terrain Alteration

Large-scale projects (disturbing more than 100,000 sq ft or more than 50,000 sq ft if within a protected shoreland) are governed by RSA 485-A:17 and by rules at Env-Ws 415 et seq., a permitting process that requires treatment of runoff from impervious surfaces, generally by either vegetated treatment systems or sedimentation ponds. As presently regulated, applicants must control peak runoff. This program also requires erosion and sediment control practices for construction activities.

Wetlands Restoration Policies

Both the Coastal Zone Program through 306 and 306A grants and the Wetlands Bureau promote the restoration of wetlands and riparian areas. The Wetlands Bureau promotes wetlands restoration as mitigation for wetland losses.

State and Local Jurisdiction Over Dams

Dam construction and reconstruction, though not necessarily maintenance, requires Wetlands Bureau approval where rivers or wetlands are involved. If the site is sufficiently large, a terrain alteration permit is required; if it falls under federal Corps or FERC review, a 401 water quality certificate is required. DES is also responsible for regulating other aspects of dam construction, reconstruction, operation, and maintenance. Regulatory responsibilities fall on the Dam Bureau. Dam Bureau review is limited to dam safety, although the design is also reviewed for environmentally sound construction practices, such as erosion control. By means of filing requirements, RSA 482:9 provides the Dam Bureau opportunity to review any proposed dam construction or reconstruction for public safety, provided the dam has a height of at least 4 feet and a storage capacity of 2 acre-feet or more. Smaller dams do not come under Dam Bureau purview. DES is responsible for regulating lake levels on reservoirs and great ponds (RSA 481:1, 481:13, 482:4, 482:6, 482:79) and for arbitrating lake-level disputes.

A nine-member Dam Management Review Committee is responsible for developing policies and procedures relative to state-owned dams, dams under consideration for acquisition by the state, review of proposed legislative relative to dams, and guidelines for rulemaking as it relates to the state's water resources management program. Membership includes four representatives

from the House resources, recreation, and environment committee, four members from the Senate development, recreation, and environment committee, and the director of the Water Resources Bureau. The Committee must review all state-owned dams at least once every nine years and develop the criteria on which to base its recommendations for repair, breach, sale, or other action. Any proposed acquisition must measure the impact of breaching a dam against a range of public values, stipulated at RSA 482:93, including potential water supply, general environmental, scenic, historical, and ecological concerns, safety concerns, fish and wildlife values as determined by the Fish and Game Department evaluating the wildlife resource, with and without the dam, recreational value, energy potential, deeded access, and flood control potential.

RSA 482:55 establishes a nonlapsing Dam Maintenance Fund to cover the costs of work performed on State-owned dams.

Privately owned dams may be breached, or the water levels significantly lowered, only after notification to the local governing body, which in turn must convene a public informational meeting. State regulations at Env-Wr 504.11 and 504.08-.09 reinforce this law by referencing it and requiring compliance. Dams at impoundments of less than 10 acres are exempt from these provisions (RSA 482:13).

Federal Jurisdiction Over Wetlands, Dams, and Waterways

Section 404 of the Clean Water Act (33 U.S.C. 1334 et seq.) establishes the US Army Corps of Engineers' wetlands permitting program, designed to protect wetland and aquatic resources against adverse impacts from dredge and fill activities. In New Hampshire, the Corps has issued a "programmatic general permit" that allows state program applicants to proceed with the projects after they have received a state permit. The Corps reviews all state-issued Wetlands permits and may elect to issue individual permits on projects that in its judgement merit additional review. The EPA, U.S. Fish & Wildlife Service, and National Oceanic and Atmospheric Administration all have the opportunity to comment on 404 permits. Applicants receiving minimum impact permits from the state may begin work immediately, although the Corps could intervene within 30 days of the state's decision report. Applicants receiving minor permits are not authorized to begin work until 30 days from the date the state permit is issued. The federal agencies have ten working days to review the permit and report back to the Corps if they have concerns with it. Major permits require federal agency concurrence. The Corps must approve the permit in writing, and there is no specific time limit for such approval.

The federal Rivers and Harbors Act (33 U.S.C 401-467) requires federal approval to construct any structure (dams, bridges, piers, etc.) in navigable waters or to deposit refuse therein. This law aims at maintaining navigation channels and harbors open for commercial use and free of obstructions. It applies to the entire Connecticut River, the Merrimack, the tidal portions of New Hampshire's coastal rivers, and lakes that span two states, such as Lake Umbagog.

Hydroelectric facilities are governed by a federal licensing process administered by the Federal Energy Regulatory Commission (FERC), and preempting state jurisdiction over dams. (Such projects also are governed by Corps' 404 permits.) The FERC considers a wide range of environmental concerns in its review, including impacts on habitat, recreation, and water quality. The New Hampshire Fish & Game Department can participate in the FERC process, by authority of the Fish & Wildlife Coordination Act. Under Section 401 of the federal Clean Water Act the State must issue a Water Quality Certificate for any FERC-licensed project. The 401 permit must certify that the project will meet water quality standards. It may include monitoring requirements

to track water quality over time. 401 certification also may be required for large dams without power generating capabilities. Env-Ws 451-455, effective 3/10/95, codify 401 requirements of the federal Clean Water Act for state issuance of a 401 certificate.

NH Rivers Management and Protection Program

The NH Rivers Management and Protection Program (RSA 483) will establish protected flows on all rivers in the State program (there are presently 12 rivers or river segments in the program). It prohibits channel alterations on rivers classified as natural. There are 83.5 river miles classified as natural in New Hampshire on six rivers (Piscataquog, Swift, Saco, Connecticut, Ashuelot, and Pemigewasset). Channel alterations are broadly defined to mean "any human activity which changes the character of a river or stream channel including, but not limited to, filling, dredging, relocating, excavating, cleaning, deepening, widening, straightening, or riprapping." On rivers classified as rural, rural-community, or community, the Act allows for channel alterations, with conditions. No new dams may be built on natural, rural, or rural-community rivers. Breached dams may be rebuilt on rural, or rural-community rivers only if construction occurs within six years of breaching. Rules in the process of promulgation are designed to establish protected, seasonal flows below which withdrawals are not permissible except for limited public health and safety purposes. The local advisory committees established for each of the designated rivers have, among their responsibilities, review of any permit issued by the local, state or federal governments or any project funded or constructed by the government.

State Endangered Species Acts

The Endangered Species Conservation Act of 1979 (RSA 212-A) and the Native Plant Protection Act of 1987 (RSA 217-A) establish the state's interest in wildlife and plant species protection. RSA 212-A authorizes the Fish & Game Department to list species as threatened or endangered and makes illegal the taking, possession, transportation, export, or sale of listed species. It authorizes studies, cooperative agreements to advance species conservation, and upland and aquatic habitat acquisition. No income from license fees or sportsmen's equipment taxes can be used to support RSA 212-A, nor are agriculture, silvicultural practices, and the siting of bulk power supply facilities subject to its provisions.

RSA 217-A directs the Department of Resources and Economic Development to create a list of threatened and endangered plant species, and requires all state agencies to further ensure through their actions that listed plant species will not be jeopardized (as in NH Natural Heritage Inventory review of all wetlands application to screen for known populations of endangered species). No listed species can be uprooted, dug up, removed, taken, damaged, destroyed possessed, sold or offered for sale (excluding private property owners on their own land).

Local Ordinances

Many municipalities have enacted wetlands controls through zoning or subdivision regulations. They vary in terms of coverage (not all wetlands are necessarily governed by the local ordinance) and protection levels (some towns require setback of varying widths, others don't). Some towns exclude wetlands from lot size calculations; some automatically tax them as undevelopable open space. Efforts to develop a guidance document for planning boards to require wetland and soil delineations on subdivision plans, with backup documentation

identifying limitations for development were initiated during 1998[4] and completed in 1999. Many towns also have shoreland protection ordinances/regulations, typically limiting tree cutting and requiring setbacks from protected water bodies. Subdivision requirements relative to runoff control may be relevant to habitat and hydrologic impacts as well.

As indicated, about 21 towns have designated "prime" wetlands per RSA 482-A:15.

Regional Environmental Planning Program

In 1997 and again in 1998 the DES contracted with each of the nine regional planning commissions to implement the state's Regional Environmental Planning Program (REPP). Top priority during the biennium was land and habitat protection. During the first year, the RPCs were asked to provide communities an opportunity to identify their natural and cultural resource conservation priorities. More than 4,000 sites were selected, ranging from less than 1 acre to 25,000 acres. About half of the properties were characterized as water or ecologically significant resources. Currently RPCs are conducting discretionary projects to further resource conservation goals, such as natural resource inventories, local open space planning projects, and watershed and downtown river planning assistance. REPP funding for year three will support the preparation of documentation on specific conservation projects, NEMO activities, and discretionary projects.

REPP activities complemented legislative efforts initiated during the 1999 session to establish a permanent source of state funding for land and cultural heritage conservation projects at the community level. Although unsuccessful in 1999, the program has garnered wide-spread support and will be debated in the year 2000 session.

1989 NPS Plan Recommendations Implemented

The *1989 Management Plan* contained several recommendations with respect to hydroelectric facilities. These are: legislative requirements for both licensed and unlicensed hydroelectric facilities to restore minimum (7Q10) instream flows; monitor facilities for compliance with FERC permits, 401 Certificates, and water quality standards; and regulate impoundments so as to support designated uses, such as aquatic habitat, swimming, and boating. The proposed instream flow rules under the NH Rivers Management and Protection Program would subject hydroelectric facilities on designated rivers to minimum release requirements more stringent than the 7Q10 flow and consistent with the US Fish and Wildlife Service Interim Regional Policy for New England Stream Flow recommendations (2/13/81). The state now requires summer monitoring for temperature and dissolved oxygen above, below, and in impounded areas through 401 certification. FERC licenses also contain monitoring requirements. The *Plan* also recommended the development of plans that both specify flow management on river segments and inventory and recognize the importance of recreational rivers. The State Rivers Program addresses planning and flow management issues, at least on the designated rivers, as recommended in the *1989 Plan*.

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[4]The Office of State Planning and DES invited representatives from a number of professional and governmental agencies to assist with this project, including Granite State Designers and Installers, NH Water Council, NRCS, NH Municipal Association, NH Association of Conservation Commissions, Rockingham Planning Commission, Rockingham County Conservation District, NH Association of Conservation Districts, NH Board of Natural Scientists, NH Association of Consulting Soil Scientists, NH Association of Wetland Scientists, Homebuilders Association of NH, and other private soil and wetland consultants.

Goal

Human activities that may result in hydrologic or habitat modification are controlled to the extent that water bodies and riparian areas in urban, urbanizing, and rural watersheds alike are protected, and aquatic habitat is protected.

Objective 1: Target the most vulnerable watersheds for NPS grants and technical assistance, while assisting the implementation of preventive actions statewide. Key player: DES

a) Identify through the unified watershed assessment program those watersheds in the state that are presently in need of restoration; identify those that are threatened based on population and any other relevant criteria.
b) Publicize the availability of UWA restoration dollars for Category 1 watersheds (see Watershed Management discussion elsewhere in this *Plan*).
c) Maintain and publicize 319 grants and technical assistance for watershed management, using watershed vulnerability as a key criterion for allocating assistance.
d) Publicize any measurable environmental benefits achieved through restoration.

Discussion: Based on population density alone, the Lower Merrimack and Coastal drainage basins are the state's most vulnerable to the problems associated with hydrologic and habitat modification.

Measurement: 1) Number of successful restoration projects completed in targeted watersheds, 2) measured improvements to water quality in Category 1 watersheds, and 3) number of projects/-organizations assisted by DES for pollution prevention or restoration.

Objective 2: Identify sites, statewide, where water quality, buffers, or other features are impaired/need restoration and direct available funding towards them. Key players: DES, local watershed advocates, local advisory committees, town officials, NRCS, US Fish & Wildlife Service, Cooperative Extension

a) Support shoreline surveys or other activities designed to identify problem areas.
b) Connect projects with potential funding sources, including NRCS and US Fish & Wildlife Service programs.
c) Provide technical assistance to support restoration efforts.
d) Publicize the environmental benefits of solutions implemented.

Measurement: Number of restoration projects completed.

Objective 3: Promote protection of naturally vegetated buffer zones along water bodies and wetlands. Key players: DES, UNH Cooperative Extension, local river advisory committees, watershed associations, lake associations, conservation commissions, Natural Resources Conservation Service, Audubon Society of NH

a) Identify current stream enhancement undertakings in the state, who is presently promoting riparian buffers, what funding sources are available, to whom, for stream enhancement and buffer protection projects, and what kind of outreach is being done.
b) Establish a committee of interested people/organizations to work on this issue.
c) Identify the people who need to be informed, including riparian landowners, local planning boards, and conservation commissions.
d) Determine what tax or regulatory changes or incentives at the state and local levels would further buffer protection goals, including recommendations of *Buffers for Wetlands and*

Surface Waters: A Guidebook for Municipalities, prepared by Audubon Society of NH, UNH Cooperative Extension, NRCS, and NH Office of State Planning and tax assessment policies and laws.

e) Determine how to target and reach parties in a position to act upon buffer protection. f) Develop and implement outreach and action strategies.

Discussion: Buffers play roles critical to wetland functions. They are also important in controlling erosion; many erosion problems stem from runoff problems that buffers would minimize.

Measurement: 1) Establishment of a buffers outreach committee, 2) numbers of people reached with educational materials, and 3) number of protective actions taken.

Objective 4: Compile and assess data on cumulative impacts from changes in hydrology and loss of habitat, including cumulative impacts of BMPs; use assessment to make recommendations for addressing problems in regulatory and nonregulatory programs. Key players: DES, steering committee members, including UNH

a) Begin compilation, including Connecticut River macrosite data, NH Natural Heritage Inventory data, information from the NH Comparative Risk Project; identify individuals and organizations who might contribute to this effort, by providing information or serving in an advisory capacity.
b) Identify any comparable information from other states.
c) Analyze information; summarize findings.
d) Establish steering committee, consisting of natural resource professionals, planners, and local officials, to develop recommendations.
e) Determine how to implement recommendations.

Measurement: Completed assessment and follow up implementation.

Objective 5: Develop and implement a program to monitor changes occurring to New Hampshire water bodies and riparian habitats as a result of development on the land and dam construction or removal in water bodies. Key players: DES, NHACC

a) Design monitoring program, in consultation with activities under objective 3, above.
b) Determine funding/organizational niche for permanently maintaining the database.
c) Use information to promote habitat protection and clean water.

Measurement: Monitoring program established.

Objective 6: Minimize imperviousness and the disruption of natural hydrologic systems and maximize open space by encouraging communities to implement development strategies and land conservation programs that achieve those goals. Key players: OSP, DES, RPCs, Cooperative Extension, OSP Coastal Program

a) Convene a meeting of key players to determine what tools are available, extent to which such tools are already in use, the types of regulations that likely need to be changed, and how to market new approaches to planning boards, particularly, and to other local officials.
b) Target planning boards, beginning in the most populated parts of the state, for education and technical assistance.
c) Reconvene key players periodically, as determined by the group, to assess successes and shortcomings and improve the presentation, assistance, or other outreach.

Discussion: Land protection as understood in this objective includes riparian areas, wetlands, and uplands. Although riparian areas may exert the most immediate impact on water quality, changes in land use throughout a watershed ultimately influence hydrologic regimes and aquatic habitat.

Measurement: 1) The number of communities that have adopted innovation land use controls aimed at maintaining natural stream flows and aquatic habitat and 2) the number acres of land protected.

Goal

Remaining floodplain forests throughout the state are protected through permanent land conservation.

Objective: Support efforts to generate public money for land conservation. Key players: municipalities, nongovernmental organizations, DES, Department of Resources and Economic Development, Department of Cultural Affairs, Fish & Game Department.

a) Continue involvement with Land and Community Heritage Commission (appointed state agencies and nongovernmental organizations) and advocate ongoing funding for state land conservation program.
b) Lobby for state and national land conservation programs that could be applied towards floodplain and other habitats and significant resources, including the Land and Water Conservation Fund, Farmland Protection Program, and Forest Legacy Program.
c) Develop and implement a network for getting information on available grants to land trusts, conservation commissions, and other prospective applicants.

Measurement: 1) Acres and type of floodplain forest protected and 2) legislatively approved, permanently funded land and community heritage conservation program enacted.

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Subsurface Disposal Systems

Problem Definition

The characteristics of receiving waters figure importantly in determining impacts from subsurface systems. Ponds and lakes are the most vulnerable to impact, although other surface waters and groundwater can be contaminated, depending on the nature of the septic system failure and on local hydrology. Without adequate control over their construction and appropriate maintenance by homeowners, the potential for pollution from subsurface systems is relatively high -- about 75% of all new residential developments in New Hampshire are served by subsurface disposal systems. In New Hampshire, however, where the state has been responsible for permitting new systems since 1967, the primary concern for nonpoint source pollution from subsurface systems is with the substantial number of substandard systems, pre-dating state regulatory control, that are still in use.

The constituents of leachate most likely to cause problems are:

Nutrients
Pathogens

All subsurface systems generate nutrients, *phosphorus* and *nitrogen* being the two of potential concern. By increasing the supply of nutrients, phosphorus can cause a profusion of vegetative growth in water bodies. Organic matter in the waste materials and decaying vegetation reduces the amount of available oxygen in water, further impairing water quality and aquatic habitat. In coastal waters, nitrogen rather than phosphorus is generally the nutrient limiting plant growth and may cause the same environmental problems. Nitrogen (nitrates and nitrites) also can, but rarely has, affected infants through six months (blue baby syndrome).

Pathogens in the waste stream that enter surface or ground water may cause human health problems directly or indirectly, through ingestion of contaminated fish, mollusks, and other seafood. High concentrations of indicator organisms cause shellfish bed closure in New Hampshire's coastal estuaries. Although toxic materials in groundwater are more often responsible for life-threatening illnesses, pathogens from faulty septic systems are the cause of most groundwater-related health complaints nationwide (Yates 1985 *in* US EPA 1993). Research indicates that bacteria and viruses can travel more than 1,000 feet under saturated soil conditions, with bacterial survival times of 3 - 6 weeks and even longer viral survival times (Gerba 1985).

New Hampshire Data

New Hampshire data on impacts to water quality from subsurface systems document problems primarily on lakes. A sanitary survey of Baboosic Lake, Amherst and Merrimack, completed in 1985 (Flanders 1986), identified significant phosphorus loading from old, substandard (cesspool and dry well) systems and improperly functioning holding tanks on small, substandard lots. Systems often were sited on ledge or affected by high water tables. Most of the contribution from septic systems (42% of the total) was from saturated soils, as contrasted with surface flow. About two-thirds of the phosphorus loading from septic systems was attributed to detergents. Other possible sources of phosphorus levels cited in the report include lake sediments (estimated at 3%), tributary runoff (44%), and precipitation and dry fall (11%). Notably, nearly all homeowners indicated that their septic systems were in good or excellent condition, since there were no apparent surface outbreaks of effluent leaking from the systems. Area septic haulers, by contrast, indicated widespread problems.

In other DES pond studies, external phosphorus contributions attributed to subsurface systems were 28% to Robinson Pond, a eutrophic pond in Hudson, 13% to Ottarnic Pond, also a eutrophic pond in Hudson, and 12% to Crystal Lake, in Manchester (Connor et al. 1985, 1994). In fact, virtually all of the State's diagnostic/feasibility studies around lakes show phosphorus loading from subsurface systems as one of several sources of phosphorus. (Other sources are the atmosphere, tributaries, and direct runoff.) In all of these studies it is the old, pre-regulation systems that regularly contribute to loading.

Similar loading from substandard campground systems is also a concern. Although they have been subject to state subdivision and septic design review since 1971, many campgrounds failed to get the necessary approvals when expanding. Their systems may or may not meet state standards.

Based on their frequency in coastal communities where relatively extensive sanitary surveys have been conducted direct, illegal discharges of sewage and/or grey water into surface waters probably occur in communities throughout the state.

Elevated nutrient and bacterial levels in rivers have also been presumptively linked with subsurface systems. In their 1992-93 study of the Oyster River and tributaries Jones and Langan (1993) documented elevated levels of both contaminants, which they inferred were caused by on-site septic systems, as well as urban runoff and agricultural operations. A follow-up land use analysis of Johnson Creek, a tributary to the Oyster River, identified private subsurface disposal systems associated with residential development and a sewered trailer park as *probable* sources of excessive nutrients and bacteria (Jones and Langan, undated). Age of systems was not determined, nor were any water quality studies conclusively correlating surface water quality with pollution from subsurface systems performed.

Though infrequently documented, newer systems can be a problem if they were sited in marginal soils or marginal conditions that don't meet current standards (see, for example, Conner et al. 1992). Periodic maintenance is also key to the proper operation of newer systems (and ties in with septage disposal capacity, discussed elsewhere in this *Plan*).

Current Status of Subsurface System Controls

The State regulates the design, siting, and installation of subsurface systems under rules promulgated at Env Ws 1000 et seq. These rules constitute **BMPs** for subsurface systems.

The following programs address potential contamination from nutrients and pathogens in subsurface systems.

Subsurface Permitting and Operational Rules

The Subsurface Systems Bureau in DES is responsible for both subsurface system regulation (RSA 485-A:29) and testing of designers and installers (RSA 485-A:35 and 36), as well as complaint investigation. The Department has regulated subsurface system installations since 1967. Testing for subsurface system designers and installers has been required since 1979, and only a permitted installer is authorized to install new or replacement systems or repair systems, except where a homeowner is installing or repairing a system for his/her primary residence. The state's controlling role in subsurface systems has made for consistently high standards in force throughout the state.

Over the years, subsurface system design requirements have improved, and the level of expertise required of designers has increased. Although the current application, by its technicality and specificity, forces designers to maintain proficiency, the addition of continuing education or other professional requirements for designers is under consideration to ensure that all those permittees who are engaged in septic system site evaluations remain qualified and up to speed on developments in the field.

Land subdivisions creating lots smaller than 5 acres and all subdivisions within the State-protected shoreland[5], require State subdivision approval to ensure the lots are capable of supporting septic systems. Individual systems require State permits prior to installation and follow up inspection prior to backfilling. Systems being converted from part-time to full-time use or subjected to increased loading are required to seek new permit approval, though need not necessarily be rebuilt. In FY 90 the Bureau issued 12,885 permits for subsurface systems and subdivision plans, statewide. Permitting activity in subsequent years reflects the economic activity in the state, with 7,680 permits in FY91, 7,307 in FY92, 6,454 in FY93, 7,855 in FY94, 6,992 in FY95, and 5,664 in FY96.

Rules specify design requirements for treatment of effluent under Env-Ws 1000. Newly installed systems must be inspected before they are covered. Systems discharging 1,000 gallons per day or more that fail to meet minimum nitrate setback requirements are subject to groundwater monitoring requirements (Env-Ws 1500). In 1994 the State adopted "innovative/alternative technology" rules (Env-Ws 1024). These rules allow designers of alternative systems to submit designs for DES review, including descriptions of the advantages of proposed systems over conventional systems and any possible health and environmental risks. If DES determines that the system will be at least as effective as a conventional system in terms of operational reliability and effluent quality, then the alternative system can be approved for installation. An alternative system that requires professional maintenance must have a service contract in effect prior to operational approval. The owner of an innovative/alternative system must also execute a covenant to replace it with a conventional system if the alternative system fails. Such covenant runs with the land. Towns are notified when a septic system is approved, and enforcement of covenants governing alternative systems follows standard enforcement procedures at the local and/or state levels.

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[5]Protected shoreland is all land within 250' of the shore (reference line) of water bodies 10 acres or more in size, 4th order or higher rivers, estuaries, and coastal waters.

With each new system, the homeowner receives a pamphlet from the State explaining the system and detailing maintenance requirements. The Bureau's administrative rules provide for enforcement of system maintenance, requiring annual inspection of septic tanks and pumping when solids comprise 1/3 of septic tank volume. At present, however, there is no way to document whether homeowners are pumping their septic tanks regularly or otherwise maintaining their systems. RSA 477:4-c, effective 7/4/94, requires sellers to provide potential buyers with complete information on their subsurface systems, and in practice may result in tank pumping at least upon the sale of a building.

In addition, any developed waterfront property that is served by a subsurface system must be assessed to determine whether the lot meets current subsurface system standards prior to the execution of a purchase and sales agreement. This provision, at RSA 485-A:39, applies to all properties within 200' of a great pond or tidal waters, regardless of the subsurface system's location on the property. While nonconformance does not preclude sale of the property, the assessment findings become part of the listing, and future buyers must acknowledge receipt of the form and possible site limitations for on-site wastewater disposal.

DES rules, at Env-Ws 1023.03 and 1023.02, ban the disposal of toxic and hazardous materials, grease, and bulky wastes in subsurface systems, although many household products contain hazardous materials. There is no practical way to determine whether system users are keeping hazardous materials out of their systems.

The Bureau is authorized to bring enforcement actions against the owners of substandard systems "when a subsurface sewage or waste disposal system does not properly contain or treat sewage or causes or threatens to cause the discharge of sewage on the ground surface or into adjacent surface or groundwaters." (RSA 485-A:2, IV) In general, if effluent flows onto the land, the public will support system replacement. There is less support for replacement of substandard systems or failed systems below the surface, since impacts are not visible.

Systems built or expanded subsequent to 1971 that were not reviewed and approved for construction are subject to state enforcement action as well.

Ban on Phosphorus in Detergents

Historically, detergents accounted for 50 to 60 percent of the phosphorus in septic system effluent. Because phosphorus can be a major source of water quality problems in fresh water lakes and ponds, the legislature enacted RSA 485-A:55 and 56, effective 1/1/95, banning in New Hampshire the sale of soaps and detergents (except dishwashing detergent) that contain more than trace amounts of phosphorus (0.5 percent by weight, expressed as elemental phosphorus).

Local Authority

At the local level, health officers are authorized to inspect and remediate public health nuisances, including the ordering of improvements to faulty subsurface systems and requiring of sewer hookups on properties within a minimum of 100' of a pubic sewer (RSA 147, Sanitation). The State refers most of the complaints it receives to the local health officers.

Some communities have passed local ordinances that supercede state regulations with respect to replacement systems.

Other Programs

The Granite State Designers and Installers Association offers septic system professionals periodic training through workshops and conferences. These programs are well attended by the people who are most actively involved in designing and installing systems.

1989 NPS Plan Recommendations Implemented

Since the *1989 Nonpoint Source Management Plan* was written, NH RSA 483-B, the Comprehensive Shoreland Protection Act, has been passed and siting requirements for new systems on great ponds and other designated water bodies have been strengthened. The DES no longer supports 1989 recommendations dealing with development of guidance materials for municipalities willing to adopt criteria for siting subsurface systems in sensitive areas and an educational program for homeowners. A final recommendation, that alternatives for replacement of failed systems on substandard lots be developed, is being implemented through promulgation of innovative alternative rules.

Goal

New Hampshire citizens are educated to the importance of subsurface system operations and maintenance and financially equipped to deal with system replacements, particularly around lakes and in drinking water source protection areas.

Objective 1: Distribute information on subsurface systems maintenance and options for correcting substandard systems to rural homeowners throughout the state. Key players: DES, Granite State Designers and Installers (GSDI), municipalities (i.e., conservation commissions, town clerks, building inspectors), realtors

a) Develop new information, as necessary, following review of existing materials of DES, GSDI.
b) Convene key players to determine ways for getting information into the hands of people who need it.
c) Implement distribution plan.

Discussion: Many people moving to areas where subsurface systems are the norm for handling wastes, as well as some who already are served by subsurface systems, don't understand how their systems work or what is required to keep them functioning. Information on substandard systems should include tips for identifying where they are and what to do about them.

Measurement: 1) The number of parties (groups and individuals) involved in distribution of information on subsurface systems O & M and 2) the amount of septage pumped, quantified regionally, if possible.

Objective 2: Explore the use of State Revolving Fund monies or other sources (e.g., Community Development Block Grants; USDA rural development community loan program) to support the installation of disposal systems in areas where campgrounds or concentrations of

houses with inadequate systems exist, and work with municipalities, particularly those with lake and river frontage, to help them take advantage of such incentives. Key player: DES

a) Identify all potential sources, limitations on each source's use, probable funding levels, and availability.
b) Publicize information to potential applicants.
c) Assist interested parties, as appropriate.

Measurement: 1) The amount of money expended for system upgrades or replacements, 2) the number of water bodies affected by improvements, and 3) measured water quality improvements.

Objective 3: Explore sources of financial support, such as a tax on toilet paper, to assist qualifying owners of substandard systems with system repairs and replacements. Key players: DES, legislators

a) Research viability of various alternative funding sources in other states.
b) Develop credible argument for need in New Hampshire.
c) If need and rationale are persuasive, identify legislators to sponsor legislation and support legislation through the process

Measurement: Additional sources of funding available.

Objective 4: Work with communities to discourage local ordinances that prohibit installation of innovative alternative systems approved by DES. Key players: DES, health officers

a) Identify communities where local ordinances are an issue.
b) Work with local officials responsible for policies to determine rationale for policies and implement policy changes, as appropriate.

Measurement: Number of communities where problem was identified where changes were subsequently made.

Objective 5: Share the cost of household hazardous waste day collections with municipalities and in other ways support the elimination of household hazardous wastes from the waste stream. Key player: DES

a) Continue to provide financial assistance to municipally sponsored household hazardous waste collection days.
b) Explore and support, financially, through rule making, or by other means as appropriate, alternatives to annual collection days, such as permanent regional facilities and recycling of paint and oil.
c) Support efforts to eliminate hazardous materials from consumer products through homeowner/consumer education, publicity to environmentally friendly products, and other ways.

Measurement: 1) The level of state funding for and number of household hazardous waste collection days, 2) the number of alternative strategies for dealing with household hazardous wastes implemented, and 3) the number of household hazardous waste brochures circulated.

Objective 6: Consider expanding DES subsurface regulatory review to include lots of five acres or more. Key player: DES

a) Identify reasons for and against this change.
b) If change is more positive than not, pursue legislative amendment to RSA 485-A:29.

Measurement: Passage of legislation or evidence that change will not produce material benefits relative to costs.

Goal

Subsurface system requirements reflect the best technological information available.

Objective: Maintain research to monitor the effectiveness of state-of-the-art as well as older technologies, particularly with respect to nitrogen and phosphorus, and incorporate findings into rules, planning and zoning materials, and information for the general public. Key player: DES

a) Integrate relevant lake and river monitoring data and research findings into subsurface
b) bureau activities.

Measurement: Evidence of research and evaluation of its adequacy given findings.

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Junk, Salvage, and Reclamation Yards

Problem Definition

Although they may have slightly different connotations, for purposes of this *Plan* the terms junkyards, salvage yards, and reclamation yards refer to establishments or businesses maintained, operated, and used for storing, buying, processing, or selling damaged or unregistered motor vehicles and vehicle parts or scrap metal, junk machinery, or other material intended for salvage which contains or potentially contains contaminants. It does not include garbage dumps or sanitary landfills. The universe of motor vehicle junkyards can be divided into four functional groups: towing yards (where damaged vehicles are stored temporarily pending review for insurance purposes), salvage pools (where damaged vehicles are pooled for sale; there are two such facilities in New Hampshire), auto recyclers and dismantlers (who dismantle vehicles for their salable parts), and scrap processors (who shred or crush stripped vehicles and resell salvaged steel).

Potential environmental or health impacts from junk/salvage yard leachate and sediments depend on what the junkyard contains. The most likely pollutants of concern are:

Total petroleum hydrocarbons
Heavy metals
Acids
Suspended solids

Total petroleum hydrocarbons are constituents of gasoline and diesel fuels and motor oil. Their volatility varies. Some are known to be toxic to aquatic life at low concentrations. Some are probable or known carcinogens. Those with a high affinity for sediments can persist over time in bottom sediments, where they can be toxic to benthic communities. They have the potential to move off site via surface runoff and sediments. In heavily impacted areas, vertical migration of contaminants into groundwater can occur.

Heavy metals can be toxic to aquatic life. Where concentrations are high, metals can bioaccumulate in fish and shellfish. Heavy metals of primary concern include lead, cadmium, chromium, zinc, copper, nickel, aluminum, arsenic, and mercury. Their mobility, toxicity, and value as indicators of general contamination varies.

Acids, from sources like batteries, solvents, and degreasers, affect soil chemistry, hence plants and potentially human health, and can create conditions toxic to soil organisms.

Suspended solids in high concentrations reduce water clarity and light penetration through the water column,which in turn affects temperature and plant growth. Solids that settle out of the water can smother plants and invertebrates and alter benthic habitats.

New Hampshire Data

In 1991, DES inventoried all motor vehicle junkyards with 50 automobiles or more, see Map 4, and found they typically occur in low-lying areas, close to rivers or streams. There were 162 such mapped junkyards in the state, and an unknown number of smaller junkyards. An incomplete inventory of motor vehicle junkyards initiated in 1999 and compiled by DES from several different sources indicates there are at least 415 junkyards, ranging in size from 50 vehicles or fewer (about 30 percent of junkyards identified) to 2,000 vehicles (1 large facility). DOT licensing staff indicate that, particularly with respect to the smaller operators, who may or may not consider themselves to be junkyards, there is a tremendous educational need in terms of site management and BMP implementation.

Water quality data are limited. There are three sites where the installation of monitoring wells was required under groundwater protection rules. At two of these sites, both involving motor vehicle "junkyards," groundwater contamination was subsequently documented. The state's Groundwater Hazard Inventory identifies two additional sites where contamination related directly tomotor vehicle junkyard operations was documented, and three such sites are currently under investigation. Two scrap metal processing facilities have been responsible for contamination of municipal water supply wells. Generally, however, because monitoring requirements at the state level presently apply only to a few wellhead protection areas, the impacts of contaminated junkyard leachate would not be detected until problems in, typically, drinking water supplies occurred or an environmental site assessment, typically required by banks before they make loans on junkyard properties, documented contamination.

New Hampshire data from EPA stormwater discharge permittees (11 motor vehicle junkyard facilities, one or two grab samples from each, 10/1/96-9/30/97), indicate a potential for surface water contamination, as summarized in Table 2.5. Minimum, maximum, and average values for the four parameters measured were as follows:

Table 2.5
Values in mg/1 from EPA Stormwater Discharge Permit Reports

	Min	Max	Ave
Total aluminum	0.07	3.2	0.73
Total iron	0.05	2.1	0.67
Total lead	<0.01	0.17	0.04
Total suspended solids	<5	680	105

Comparable average values for these contaminants in runoff from urban sites, as summarized in the state's *Stormwater Characterization Study* (1997) are 1.5 mg/l for aluminum, 2.7 for iron, 0.03 for lead, and 58.3 for total suspended solids. Water quality standards for protection of aquatic life (acute criteria) are 0.75 mg/l for aluminum and 0.014 mg/l for lead in dissolved form (estimated for stormwater runoff at 22% of total lead). Acute standards for the other parameters are not available.

Data from Other States

Legislation passed in Minnesota in 1994 prompted a statewide evaluation of the state's 436 active motor vehicle salvage facilities. After visiting all sites and reviewing more detailed environmental assessments at 13 facilities, the state concluded that most facilities needed to improve waste management practices in order to control releases of contaminants into the environment. At some sites contaminants presented a threat to groundwater. Uncontrolled stormwater runoff represented one of the most significant pathways for contaminants to leave properties. Contamination of soils at facilities was common, though was generally limited in lateral extent and depth. Contamination of surface waters and wetlands was documented at several sites. About 50 sites will require cleanup, at an estimated cost of $2.25 million. (Minnesota Pollution Control Agency 1995)

Current Status of Junkyard Controls

"Regulated substances," such as used oil, antifreeze, and other vehicular fluids, are subject to state administrative rules (Env-Ws 421), which specify Best Management Practices for the storage and general containment of potential pollutants at vehicle service and repair shops, metalworking shops, waste and scrap processing facilities, and other "potential contamination sources" as defined in the Groundwater Protection Act at RSA 485-C:7. The sources of regulatory authority to control junkyard impacts and existing programs are summarized below.

Groundwater Protection Act

The Groundwater Protection Act, RSA 485-C, includes new junkyards[6] and salvage yards[7] among a limited number of uses that are prohibited in any class GAA (most protected) wellhead protection areas . However, GAA classification is a local option, and to date very few GAA classifications have occurred. Besides prohibiting new facilities, GAA classification subjects existing junk**,** salvage and waste processing yards within the class GAA wellhead protection area to groundwater release detection permit and monitoring requirements. DES can also require monitoring wells and remediation where there has ben a documented the release of contaminants into ground or surface waters, regardless of the classification.

The best management practices referenced above apply to all junk/salvage yards, regardless of their proximity to drinking water supplies and must be implemented. A junk/salvage yard operator may apply to the DES for a waiver from provisions of the BMP rules.

The drinking water protection program at DES trains public water system operators and municipal officials (at systems pumping more than 57,600 gpd or serving more than 1,000 people) to conduct site visits at any potential contaminant source in wellhead protection areas to ensure BMPs are being implemented. Junkyards that occur within wellhead protection areas are visited by trained officials at least once every three years to determine BMP compliance. These visits are required for participation in the state's protection program, which exempts participants from certain water quality testing mandates.

Other DES Authority

DES has regulatory authority under RSA 149-M, the solid waste management statute, and is developing regulations for the siting and operation of recylcing, dismantling, and scrap processing facilities for motor vehicles. Of these, only scrap processing facilities are currently subject to a permitting process. Other operations involving motor vehicles will, however, be subject to Best Management Practices. The authority under RSA 149-M is broad enough to require operator training, require permits, establish standards for facilities, permittees, and operators, require financial assurance, and require new facilities to demonstrate public benefit. Conditional permit exemption for certain types of facilities is an option.

DES also has authority for junkyard regulation under RSA 147-A, the hazardous waste statute, where such facilities generate a hazardous waste, including used oil not for recycling, antifreeze, air conditioning refrigerants, batteries, air bag cartridges, solvents/degreasers, shredder residue/"fluff", absorbents for spills/cleaning rags, and switches containing mercury.

DOT and Community Authority

The DOT and local governing bodies are required at RSA 236:90-110 and 236:111-129, respectively, to regulate junkyards. For DOT purposes, junkyards are broadly defined to include establishments where two or more unregistered vehicles or parts of vehicles amounting to two or more vehicles are stored, kept, bought, or sold, as well as automotive salvage or recycling yards,

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[6]Defined at Env-Wm 1403 as "a continguous land area for the storage or deposit, of unregistered motor vehicles which are no longer intended for,or in condition for, legal use on the public highways."

[7]Defined at Env-Wm 1403 as "a continguous land area encompassing one half acre or more, which has stored or deposited scrap metal, junk machinery, or other material intended for salvage which contains or potentially contains oil, liquids, or other contaminants."

garbage dumps, and sanitary landfills. For muncipal regulatory purposes, junkyards are limited to establishments with unregistered motor vehicles and junk machinery or scrap metal. State-approved facilities are not subject to local control.

Junkyards adjacent to local roads have been subject to regulation since 1965, and those adjacent to interstate highways, turnpikes**,** and federal primary aid highways since 1967. Junkyards within 1,000 feet of interstate highways, turnpikes, and federal aid primary system highways, 660 feet of other state highways, and 300 feet of local roads, or visible from such transportation facilities, are regulated**.** At present, a license and certificate of approval must be issued by DOT for junkyards adjacent to interstate highways, turnpikes, and federal primary aid highways. Municipalities are required to regulate these facilities, as well as junkyards adjacent to local roads, but many do not enforce the licensing requirement. Note that recent federal legislation has tempered DOT's regulatory authority with respect to federal aid primary system highways, and the state's licensing program and annual visits may be sunsetted.

While DOT and local governments issue junkyard licenses based primarily on aesthetic concerns, the law allows public health concerns to affect decisions on license applications (RSA 236:96, 236:118). As noted above, facilities regulated under RSA 149-M are currently exempt from local permitting authority.

The DOT's regulatory review is typically limited to visual impacts, although staff notify DES of applications. The DOT has denied proposals based on an applicant's poor compliance with other laws, including environmental laws, but not on the basis of environmental concerns per se.

Federal Permits

At the federal level, salvage yards classified as SIC 5015 (automobile salvage yards) or SIC 5093 (scrap recycling and waste recycling facilities) come under federal NPDES permitting authority for stormwater runoff unless they are municipally owned. The size of an operation is not important in determining whether a permit is actually required. If stormwater is discharged from the property via a channelized route to a stream, other natural water body, or a stormwater system, then NPDES permitting requirements apply.

NPDES stormwater BMPs and regulatory mandates are stipulated in the *Federal Register* Vol. 60, No. 189, 1995. The specific NPDES permit requirements for automobile salvage yards and scrap and waste recycling facilities differ, and they differ for processing facilities within the general category of scrap and waste recycling facilities. However, all the permits require pollution prevention plans for preventing and/or eliminating pollutants from stormwater runoff and stormwater monitoring for specified "pollutants of concern," unless the discharger can certify that materials and activities are not exposed to stormwater (alternative certification).

The BMPs are based on minimizing exposure of contaminated materials with stormwater runoff and precipitation. There are no specific effluent limitations on stormwater discharges from salvage yards due to a lack of baseline data and the diversity of salvage yard operations. However, facilities are required to continue monitoring runoff until such time as discharges sampled over the course of a year average below a pre-determined cut-off concentration for pollutants of concern.

Depending on the type of facility, additional federal permits may be necessary, including Resource Conservation and Recovery Act and 40 CRF Part 112 (Oil Pollution Prevention) regulations.

Other Programs

Towing yard and auto recycling facility owners have state-level membership associations, the New Hampshire Towing Association and the Auto & Truck Recyclers Association, respectively. Not all such facilities are members. Scrap processors are represented by a national association, ISIS.

1989 NPS Plan Recommendations Implemented

In 1989 the *NPS Management Plan* ranked junkyards a high statewide priority because of the potential threat of contamination to groundwater and surface water from toxic organics, metals, oil, and grease released from these sites. Since then, the largest auto junkyards have been mapped.

Goal

Surface and ground water quality in the vicinity of motor vehicle junkyards and metals salvage yards meet water quality standards in order to protect human health and the environment.

Objective 1: Promulgate and implement rules for the regulation of motor vehicle junkyards that compliment federal permit requirements, recognizing that regulatory requirements may differ for each of the different types of facilities. Key player: DES

a) Waste Management Bureau (WMB) assesses existing regulatory framework, DES resources, trade organizations, and ways of reaching owners and operators.
b) WMB determines appropriate regulatory structure and works with other DES programs and the potentially regulated communities to develop regulatory approach.
c) WMB determines educational needs, BMP guidance, etc., including education for municipal officials relative to state and local roles and responsibilities.
d) WMB promulgates rules, develops new/refines existing educational materials, training programs, site assessment/technical assistance programs, and in other ways supports DES oversight of junkyards and enforcement of regulations.

Measurement: Implementation of 1) rules and 2) educational program(s) that address shortcomings of facilities in terms of public health and environmental protection.

Objective 2: Establish and maintain an ongoing department-wide inventory of environmental problems related to junkyard operations, particularly as they reflect on BMPs and other operational practices in order to improve DES's ability to eliminate impacts, integrating information from a variety of sources. Key players: DES, NH Auto and Truck Recycling Association, Auto Dealers Association

a) Identify all potential sources of information, including EPA permitting data.
b) Determine how best to integrate surface and ground water information with the existing groundwater database and incorporate all relevant environmental information.
c) Select database manager and implement assessment.

Discussion: It will be important in analyzing the data to determine, where problems linked with a junkyard are detected, whether they stem from old practices or new practices as informed by BMPs and operator training.

Measurement: Application of information from database to state's regulatory program.

1

Construction

Problem Definition

The primary contaminants from construction activities are:

Sediment
Nutrients
Chemicals

Sediment is the primary pollutant from active construction sites. Sediment reduces light penetration in surface waters and may cause water temperatures to rise. Sediment can clog fish gills, destroy spawning and other critical habitat, smother larvae, fill in wetlands, and otherwise degrade water bodies.

Sediments may also carry *nutrients*, particularly phosphorus, attached to the particles. Phosphorus (and nitrogen in coastal waters) can stimulate plant growth in aquatic environments, potentially causing increased oxygen demand, nuisance algal blooms, eutrophication, and changes to the composition of aquatic species. Fertilizers applied to new sites are another source of nutrients.

Other potential contaminants at construction sites derive from *chemical applications* of pesticides, spills of petroleum products, paints, and solvents, and wastes from other construction activities.

Activities affecting less than 100,000 sq ft or 50,000 sq ft within protected shorelands are currently unregulated, yet can have significant water quality impacts. Sites that do come under State regulatory review frequently cause water quality problems and require enforcement action.

New Hampshire Data

New Hampshire data are often in the form of photographs depicting sediment-laden streams. In 1998 staff from the terrain alteration program issued 36 letters of deficiency for violations and 2 administrative orders. Virtually all the large-scale projects about which the State receives complaints are failing to abide by the erosion and sedimentation control measures in their plans. Impacts from smaller projects are similar, but at a smaller scale. Chemicals used at construction sites are not regulated under the state terrain alteration program. However, staff at the Oil

Remediation and Compliance Program report responsible treatment of fuels stored and used on site.

The Natural Resources Conservation Service estimates erosion rates from land in New Hampshire that is undergoing development at 30 to 40 tons/acre. Where the problem is severe, losses maybe as high as several hundred tons/acre. These rates contrast with erosion rates from undisturbed, forested sites, which are typically less than 1 ton/acre/year.

A significant number of projects are undertaken each year by NH DOT, which is not subject to site specific permitting requirements, though DOT projects do require other DES permits, such as wetlands permits. Currently DOT conducts weekly inspections of constuction projects to ensure appropriate controls are in place and functioning as a result of one particularly bad situation in southwestern New Hampshire where sediment loading to Granite Lake from a DOT project caused extensive turbidity, organic loading, and ultimately a change in the lake's trophic status. Other controls institutionalized for DOT projects include consideration in the design phase of water treatment during construction and wider rights-of-way to accommodate treatment. In 1998 DOT undertook a comprehensive review of its erosion control practices, from identification of need for controls at project sites through implementation of appropriate measures and inspection. This led to a report and series of recommendations, completed in 1999, which the DOT will be implementing.

Current Status of Construction Controls

Published **BMPs** are found in *Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire*, prepared by NH DES, Rockingham County Conservation District, and USDA Soil Conservation Service, August 1992.

Programs designed to minimize construction impacts are aimed at controlling runoff from a site.

Terrain Alteration

The principal program at the State level for controlling construction activity is a permitting program that governs "terrain alteration," or "site specific" activities affecting more than 100,000 sq ft of land, or 50,000 sq ft if the land is within 250 ft of a great pond (10 acres or more), a large river (4th order or greater), or coastal waters. Program review focuses on runoff control both during and after construction**.** Planning, sequencing, phasing, silt fencing, hay barriers, mulching and seeding, and temporary grade stabilization structures are among the techniques required for retaining eroded soils on site, stabilizing soil, and/or reducing the velocity of flow from a property to minimize its erosive potential. Many towns now make terrain alteration approval a condition of local subdivision approvals.

Shoreland Protection Act

The Shoreland Protection Act (RSA 483) requires a terrain alteration permit for projects affecting 50,000 continguous sq ft or more, and implementation of erosion and sedimentation

controls for any construction project, regardless of size, sited within the protected shoreland. Construction where only part of the project falls within the protected shoreland may be subject to erosion and sedimentation controls, depending on the particulars of the site and the need for controls. Enforcement of CSPA provisions is generally instigated by reports of violations.

Oil Remediation and Compliance

Sites where fuel is stored in tanks greater than 660 gallons in size are regulated as temporary tanks by the DES, at Env-Wm 1402.

Community Role

Municipalities may control pre- and post-construction impacts including maintenance of BMPs through site plan review regulations (governing multifamily residential and non-residential development) and subdivision regulations (generally limited to roadway runoff). Enforcement of such ordinances varies. Model regulations and ordinances developed for New Hampshire communities call for implementation of BMPs at development sites, required ongoing maintenance of BMPs, and professional review of design plans.

Federal Stormwater Permitting Program

Construction projects disturbing five acres or more presently require an EPA-issued National Pollutant Discharge Elimination System (NPDES) stormwater permit. Proposed stormwater regulations, scheduled for promulgation on October 31, 1999, will expand NPDES permitting requirements to include construction sites disturbing from one to five acres. Although the permit will be issued by the EPA, coordination and reference to the State's terrain alteration permitting program are anticipated. Such coordination will involve notification by the permittee (notice of intent) and permit by rule (permit issued subject to compliance with state standards). As presently construed, enforceable pollution prevention plans must be prepared for each site prior to construction, identifying erosion and sedimentation controls to be implemented during construction, as well as measures that will be installed to control post construction discharges from the site. Maintenance of controls is required. Current regulations for construction sites affecting 5 acres or more require permittees or multiple permittees cooperatively to retain qualified personnel to inspect disturbed areas at least once every 14 calendar days and within 24 hours of the end of a storm event of 0.5 inches or more. Current requirements for general permits for stormwater discharges associated with construction activity are cited in the Federal Register, Vol. 63, No. 31, Tuesday 2/17/98, 7858-8014. As presently construed, the EPA will be be responsible for permit enforcement. However, it is not clear how inspection and enforcement activities will implemented.

1989 NPS Plan Recommendations Implemented

The *1989 Nonpoint Source Management Plan* ranked construction activities the second most important nonpoint source pollution problem. Since then, several changes have occurred to improve runoff control, including the development of BMPs to control sedimentation, erosion, and stormwater, improved interagency coordination with the terrain alteration program, improved terrain alteration rules, and involvement of some of the conservation districts in the review of erosion and sedimentation control and stormwater plans for local boards.

Goal

Local decision makers implement and use available tools for controlling runoff from construction sites.

Objective 1: Encourage planning boards to incorporate in local subdivision and site plan review regulations erosion control standards based on published BMPs and including phasing, timing, inspection, and maintenance provisions. Key players: OSP, DES, RPCs

a) Review available materials for consistency, including consideration of federal general stormwater discharge permit requirements and process.
b) Determine the best way(s) of working with planning boards to implement changes at the local level.
c) Develop schedule for planning board contact(s).
d) Implement outreach.

Discussion: Smaller projects (those disturbing less than 100,000 sq ft or 50,000 sq ft within the protected shoreland) are not governed by state terrain alteration review but may cause water quality problems. Local standards should apply, at a minimum, to projects that in total will disturb more than 20,000 sq ft, that involve street or road construction, or that are proposed for environmentally sensitive areas, such as shorelands, steep slopes, highly erodible soils, and wetlands.

Measurement: Number of municipalities that incorporate recommended procedures in their regulations.

Objective 2: Focus additional educational efforts for erosion control on local officials (i.e., planning boards, road agents, building inspectors), emphasizing the need for and methods of controlling erosion and the importance of inspecting and maintaining controls. Key players: DES, OSP, RPCs, NHACD, Conservation Districts, UNH Technology Transfer Center, UNH

a) Identify existing educational materials and model regulations; develop consistent packet of outreach materials, including reference to federal inspection requirements, as appropriate.
b) Determine the best ways of reaching the different groups of local officials, e.g., workshops, mailings, meetings with boards, video presentations.
c) Develop outreach strategy, involving key players and others, as appropriate.
d) Implement outreach.

Discussion: Efforts will include how to engage consultants for project reviews within guidelines established by RSA 676.

Measurement: The number of municipalities that utilize design standards and/or consultants for controlling erosion from construction sites.

Objective 3: Maintain outreach efforts to involve local officials in implementation and enforcement of the CSPA. Key player: DES

Measurement: Improved compliance with CSPA as demonstrated by number of contacts with local officials, either for implementation or enforcement assistance.

Goal

DOT road construction projects that are presently exempt from regulation conform with construction site BMPs.

Note in this connection that DES will be instituting a permit by rule program for contractors on DOT highway projects to facilitate communication about BMPs and related measures.

Objective: Facilitate training for DOT engineers and project managers and cooperatively engage in monitoring of construction activities. Key players: DOT, DES

a) Develop a schedule and implement training for DOT staff.

Measurement: The number of DOT projects at which erosion and/or runoff cause environmental problems (with zero projects the goal).

1

Marinas and Recreational Boating

Problem Definition

The main sources of potential pollutants associated with marinas are boat discharges, stormwater runoff, and boat maintenance activities on land and in the water. DES studies (Bowser and Connor, unpubl.) of sediments and surface water at marinas show impacts from pollutants relative to background conditions. Loss or alteration of wetlands and poor natural basin flushing intensify water quality problems from boats and marina operations.

Key potential contaminants are:

Nutrients
Bacteria
Organic matter
Sediment
Heavy metals
Petroleum hydrocarbons
Nuisance plants and animals

Related concerns are:
Impacts to habitat

Nutrients, particularly phosphorus, can impact aquatic ecosystems, as discussed elsewhere in this *Plan*, if they are concentrated at sufficiently high levels. Waterborne *bacteria* indicate a potential for pathogens in the water column and when present at or above a specified concentration cause shellfish bed closures. Boat discharges have been identified as a contributing source of waterborne bacteria (Leonard et al. 1989 *in* US EPA 1993). High levels of *organic matter*, also from boat sewage discharges, depress oxygen levels.

Sediments washed from the land via ramps or eroded from the shore by boats moving at high speed can cause increased turbidity and phosphorus, which reduce water clarity, affecting temperature, habitat, and aquatic life. Increases in sediment oxygen demand can also cause depletion of dissolved oxygen. Propellers in water less than 15 feet deep and excessive speed can also disrupt bottom sediments and plant life. Construction activities and vessel scraping and sanding provide additional sources of sediment.

Metals found at toxic levels in marina waters elsewhere in the country include copper and tin (in the form of tri butyl tin, which is now regulated for boat use in bottom paint based on release rates and prohibited on nonaluminum recreational boats less than 25 meters long). Both are used as biocides in antifoulant paints on boats that are used in salt water. Rarely, copper also is applied to old wooden boats in fresh water situations. High levels of zinc (a corrosion deterrent; antifoulant), chromium (used in boat construction), and lead (in battery acid, a fuel additive and ballast that may be released through incomplete fuel combustion and boat bilge discharges) also have been documented in marina-impacted waters. Most metals tend to concentrate in sediments, where they can reach levels sufficiently toxic to affect fish and/or invertebrates, particularly in larval and juvenile stages. Cadmium (potentially from batteries, street runoff, sewage treatment plant and industrial effluent), chromium, and nickel (from brake linings, pavement, marina maintenance and repair activities, as well as engines) frequently are associated with marina dredgings (McMahon 1989 *in* NH DES 1995b). Certain metals have been shown to bioaccumulate in bivalves and other aquatic organisms (US EPA 1993).

Petroleum hydrocarbons, including oil, grease, and gasolene constituents, released during engine maintenance, refueling, and bilge or fuel discharges can inhibit growth among several types of aquatic organisms, may be toxic at concentrations as low as 0.1 to 0.5 ppm, and persist in the environment in sediments for years. Constituents include benzene, toluene, and MtBE. DES studies of marinas on Lake Winnipesaukee (Bowser and Connor, unpubl.) identified fuel spillage as one of two primary sources of pollutants causing water quality degradation. The other was parking lot and maintenance area runoff channeled to the water via boat ramps. These, too, are sources of petroleum hydrocarbons to the aquatic environment.

Nuisance plants and animals are exotic species that when introduced to uninfested waters, proliferate rapidly and can cause severe economic, recreational, and ecological impacts to infected water bodies. Once fully established, nuisance weeds are virtually impossible to eradicate. There are 14 exotic aquatic weeds governed by New Hampshire law. The principal exotic animal of current concern to New Hampshire waters is the zebra mussel. Zebra mussels, native to Eastern Europe, have been documented in Lake Champlain to the west and East Twin Lake, Connecticut. They can attach to nearly any surface and form a barnacle-like encrustation by which they have been known to shut down a municipal water supply system, sink marker buoys and docks, impair boat engines, and degrade swimming beaches. Nuisance species are spread principally by transient boat traffic but also by fishermen with bait buckets.

Habitat concerns from powerboats and motorized watercraft on both rivers and lakes stem from their potential to alter aquatic habitats and disrupt nesting waterfowl, particularly loons. Habitat impacts vary, and can include direct damage to rooted aquatic plants, toxicity to aquatic plants and animals due to chemical contamination, increased predation of nesting sites when adults are scared from their nests, changes in the aquatic food base due to turbidity, and physical and chemical changes to habitat (Connor, undated).

With recreational boating on the rise (as evidenced by the steady increase in boat registrations from 80,521 in 1993 to nearly 100,000 in 1998[8]) and enhanced efforts by the Fish & Game

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[8]This information is based on registrations of motorized and sail boats with the Department of Safety. It does not include canoes, kayaks, rowboats, and other human-powered watercraft. Note that not all boats that are registered in the state are actually launched here, since people may buy and register boats in New Hampshire in order to avoid sales taxes in their home states.

Department to improve and expand boating access to New Hampshire's rivers, lakes, and ponds, the problems associated with boats are likely to intensify unless they can be addressed.

New Hampshire Data

New Hampshire data for marina operations resulting from a 319-funded project conducted during the summers of 1992 and 1993 on Lake Winnipesaukee (Bowser and Connor, unpubl.) indicate that hydrocarbons accumulate in sediments near marinas. Alkylbenzenes and other hydrocarbons were documented at all three marinas studied, and xylene was found at one of the marinas. Toxicity tests performed in sediments at the marinas showed statistically significant reductions in Chironomid larvae (midge larvae) growth at one of the three marinas where flushing was limited and the fueling facilities were long-lived, stationary, and heavily used. The higher the concentration of methyl-t-butyl ether (MtBE, a highly soluble hydrocarbon), the lower the growth rate of benthic organisms. DES also found phosphorus concentrations and turbidity above background conditions (with no evidence of impairment), and lower dissolved oxygen levels compared with background conditions.

Although greywater and sewage discharges are prohibited in or near any fresh water in New Hampshire, most cabin boats have marine sanitation devices (MSDs) on board. To comply with state law, MSDs must be blocked from discharging. DES-conducted boat inspections on Lake Winnipesaukee during 1997 documented 20 violations of greywater and/or toilet requirements, some of which were on new boats still in marinas awaiting use. In 1997 the rate for boats on Winnipesaukee that met greywater requirements on the inspectors' first visit was 79 percent, slightly below average.

Milfoil, fanwort, and water chestnut were documented in New Hampshire in 36, 5, and 1 water bodies, respectively, as of fall 1998. Boating is the most significant cause of nuisance weed translocations. Motors, propellers, and trailers are particularly likely to catch and retain plant fragments. Other sources include aquaria contents dumped into water bodies, plants imported for sale or research, seeds or plants parts brought in by migrating birds, and fishing lures and bait buckets. Bait buckets, bilge, live wells, and engine cooling systems are important mechanisms for zebra mussel transport, as are the hulls of boats where mussels have attached. Other states are battling the round goby (fish), the spiny water flea (a cladoceran), and various crabs and insects, although none of these species has been documented in New Hampshire to date.

Looking at how motorized watercraft impact lake ecology, a DES review of the literature and New Hampshire data indicates a variety of chemical, physical, and biological changes that are largely density dependent, where "increased use translates into increased potential for impact. Some impacts have relatively distinct thresholds, however, so the relationship between density and impact is not always linear. Many impacts are most likely to occur in marina situations, suggesting that if effects are not observed in marinas they will probably not be detectable in the lake" (Connor, undated).

With respect to impacts on habitat, boat trauma is known to be the second most common cause of death among loons in New Hampshire.

Current Status of Marina and Boat Discharge Controls

The DES has developed **BMPs** for marinas, entitled *BMPs for New Hampshire Marinas: Guidelines for Environmentally Proactive Marinas*, NHDES-WSPCD-95-6 (1995) and designed to prevent pollutants generated by marina and boating activities from entering the water. Recommended practices include use of phosphate-free detergents (required by RSA 485-A:55, 56), periodic engine and other maintenance performed out of the water, containment booms for fueling stations, catch basins at boat launches, and provision of public restrooms and pumpout facilities. Stormwater BMPs are also recommended to reduce and provide treatment to runoff generated on site.

Regulatory and support programs to reduce pollution from boats and marinas deal primarily with control of discharges, wetlands impacts, and petroleum products. They include:

Wetlands Regulations

Marina construction and expansion are governed by the DES Wetlands Bureau, which must issue a permit for work in wetlands and surface waters or on banks before construction may start. Design standards for marinas, at Env-Wt 402.17, state that marinas "shall be designed to minimize visual impact, to avoid damage to environment due to leakage or spills of fuels, lubricants, waste products, or other pollutants, and shall not .. significantly degrade the environment."

The Wetlands Bureau also issues General Permits by the US Army Corps of Engineers for piers, floats, tie off piles, and mooring buoys in navigable waters, subject to Corps review. Dug-in marinas, while not currently prohibited in the rules, are usually not approved in practice. The Wetlands Bureau generally requires either restrooms or pumpout facilities at larger marinas.

Boat Inspection Program

RSA 487:2 prohibits wastewater discharges from boats into surface waters of New Hampshire. RSA 487:3, passed in 1983, contains the same prohibition against discharges of greywater from sinks or showers on boats, based on a 1976 study that documented additional water quality problems from greywater discharges. Currently with 319 funds, DES maintains a boat inspection program during the summer months. It presently focuses on Lake Winnipesaukee, and includes one day on Lake Sunapee during the annual Celebrate Your Lakes Day.

There are two part-time summer inspectors who randomly check boats with onboard facilities designed to receive or hold sewage or greywater, including sinks, showers, toilets, holding tanks, valves, and plumbing. Owners of boats in compliance receive decals to certify so. Although failure to comply may result in administrative fines of up to $2,000 per day and loss of boat registration, the inspectors emphasize bringing boats into compliance rather than fines. In 1998, 106 boats were inspected, of which 94 (89 percent) were new boats or boats that had never before been inspected. The inspectors estimate 10 to 20 percent of the boats with sinks, showers, or MSDs on Lake Winnipesaukee have not been inspected. The major source of violations is boats from out of state, particularly those coming from the ocean, many of which have not been used on Winnipesaukee before. In New Hampshire, pressure from local dealers has caused a significant

number of new boat manufacturers to bring boats destined for New Hampshire into compliance with the state's no-discharge laws prior to sale.

The boat inspection program has a strong educational component for both boaters and marine dealers. Most marinas on Winnipesaukee enthusiastically cooperate with the boat inspection program. Boater safety courses also include a strong pollution prevention component. Despite good support of local marinas and peer pressure, violations continue to occur.

On-site Fuel Storage

All regulated underground storage tanks (110 gallons or more nonresidential fuel tanks) not protected with a corrosion protection system were subject to a December 1998 deadline for either upgrading the tank with a cathodic protection system or closing it (Env-Wm 1401.32). Failure to comply is resulting in enforcement action by administrative order.

New Hampshire Clean Lakes Program

RSA 487:16-a, effective January 1, 1998, prohibits the sale, distribution, importation, purchase, propagation, transportation, or introduction into the state of 14 listed exotic aquatic plant species. Among the species listed are Eurasian milfoil (*Myriophyllum spicatum*), fanwort (*Cabomba caroliniana*), purple loosestrife (*Lythrum salicaria, L. virgatum,* and *L. alatum*), and common reed, or phragmites *(Phragmites australis, P. communis).* The act establishes a program housed in DES for preventing and reducing nuisance growths, calls for inter and intra agency cooperation, and establishes a Lake Restoration and Preservation Fund, to be funded by an additional $2 fee on boat registrations. A portion (25 percent) of this Fund is to be available for lake restoration and protection measures, exclusive of aquatic weed control. The remainder is allocated for exotic aquatic weed control.

Other Programs, State and Private

With funding assistance from the federal Clean Vessel Act, marina operators have constructed four pumpout facilities on the Coast, in Great Bay, Hampton Harbor, Little Harbor, and Rye (1999 construction date). An additional four facilities have been funded for inland lakes, including two pumpouts on Lake Winnipesaukee, one on Winnisquam, and a dump station on Sunapee. The facilities on Winnisquam and Sunapee are the first for these lakes. Also authorized for funding is a pumpout vessel for Coastal waters. The Clean Vessel Act has been reauthorization through 2004, at $10 million per year.

The Department of Safety is responsible for implementing and enforcing recreational boating laws, including but not limited to boat registration, boating speeds, horse power limitations, decibel limits, safety equipment and safe boating practices, rafting of boats, and ski craft (motorized watercraft or private boat less than 13 feet long as manufactured, capable of traveling at 20 mph or more, with a capacity of no more than two passengers). Regulations and rules are published biennially in the *New Hampshire's Boater's Guide.* The Department of Safety also regulates moorings in fresh water, and the Port Authority regulates coastal moorings.

By RSA 265 the Fish and Game Department is the lead agency for boating access. The Department's program includes land acquisition and facility development/rehabilitation components. Funding is generated from the unrefunded marine fuel tax, a five dollar surcharge on boat registrations, and US Fish and Wildlife Service Sport Fish Restoration Act dollars. The program aims to provide safe, functional, user friendly sites for hunters, fishermen, trappers, and

recreational boaters based on the Office of State Planning 11/91 publication, *Public Access Plan for New Hampshire's Lakes, Ponds, and Rivers.*

In addition to preparing the *Public Access Plan*, the Office of State Planning, though its Coastal Program, provides information on litter, MSDs, pump out facility locations and related issues to the coastal boating public.

The New Hampshire Marine Trades Association is a member organization to which about 40 percent of the marina operators belong. The Association holds regular meetings with educational components, is active in several DES programs, including membership on the Lakes Advisory Committee, and has assisted with DES projects.

1989 NPS Plan Recommendations Implemented

Pollution from marinas was not addressed in the State's *1989 NPS Management Plan*, although boat discharges were discussed in a 1977 DES NPS assessment. That review, based on a survey of knowledgeable individuals, concluded that water quality degradation due to boat discharges did not appear to be "a major concern in any one area but appears to generally be on the minds of New Hampshirites statewide" (NH Water Supply and Pollution Control Commission 1977).

Goal

Impacts of recreational boating on water quality are minimized or prevented.

Objective 1: Offer educational programs to the owners and employees of marinas, yacht clubs, and multiple docking facilities in order to teach marina BMPs. Key players: DES, NH Marine Trades Association, NH Department of Safety officers

a) Develop a comprehensive list of target audience.
b) With input from target audience, determine how best to reach people.
c) Develop/refine educational materials/programs.
d) Circulate materials/publicize programs/implement outreach plan.

Measurement: The number of marinas, yacht clubs, and multiple docking facilities that meet marina BMP guidelines.

Objective 2: Expand the DES boat inspection program. Key players: DES, Department of Safety

a) With DES, New Hampshire Lakes Association, Department of Safety, and other interested parties explore options and associated costs for expanding the program.
b) Select the most expedient option to implement.

Discussion: The DES boat inspection program is a part time effort limited to summer weekends on Lake Winnipesaukee and one day on Lake Sunapee (where no owners were available to make their boats accessible for inspections in 1997, when the one-day program was initiated). An expanded program is desirable and should include other major lakes (more time on Lake Sunapee and Winnisquam Lake, and Newfound), as well as coastal areas where boats with plumbing occur.

Measurement: The number of boats inspected each year and the extent to which boats meet holding tank requirements.

Objective 3: Create an educational program focusing on inadvertent transport of nuisance species via live wells for bass fishermen. Key players: DES, NH Fish & Game

a) Discuss approaches with NH Fish & Game, Department of Safety, and other appropriate groups.
b) Develop materials, as necessary, and implementation plan.
c) Implement plan in trial program, 2000.

Measurement: a) The number of fishermen informed and 2) the number of lakes and ponds apparently free of nuisance species.

Objective 4: Seek financial support for additional pumpout facilities and dump stations, where needed. Key players: DES

a) Identify municipalities or private marinas interested in pumpout facilities to ensure there are pumpout or dump station facilities on all major inland and coastal waters.
b) Submit 5-year plan for Clean Vessel Act funding.

Discussion: There are 19 pumpout facilities on Lake Winnipesaukee; 14 are open to the public. A dump station will be constructed on Lake Sunapee (1999). Winnisquam Lake acquired its first pumpout facility in 1998. On the seacoast, there is one pumpout facility in the Great Bay estuary, one in Little Harbor, one in Hampton Harbor, and one under construction in Rye Harbor.

Measurement: The number of pumpout facilities relative to need on major New Hampshire lakes and coastal waters by 2005.

Objective 5: Promote the use of automatic shut off vents (no-spill tank vents) or, at a minimum, fuel vent line whistles. Key players: DES, marina operators, boat manufacturers

a) Evaluate methods of getting information out, e.g., with boat registrations, in Boater's Guide, at fueling stations.
b) Select most effective method(s) and determine how to implement them.
c) Implement outreach/training.

Discussion: Overfill fuel vents are one of the largest contributors of fuel discharges from boats. Solutions to this problem include installation of fuel vent line float valves, which vent pipes to allow for fuel expansion and prevent the discharge of raw fuels, or at a minimum, fuel vent line whistles which use air displacement in the fuel tank to alert the operator when the tank is full.

Measurement: Number of boats that meet fuel spillage prevention recommendations relative to use of automatic shutoff valves and whistles.

Objective 6: Promote the use of environmental contracts between marina and boat owners. Key players: DES, NH Marine Trades Association, boating public

a) Work through NH Marine Trades Association to determine what prevents marina operators from using environmental contracts.
b) Deal with barriers to contract implementation.

Discussion: Contracts could include, for example, the requirement that all work below the gunwales be done by the marina staff in a controlled environment, a ban on boat washing using trisodium phosphate (exempted from phosphate regulation in the state), and the requirement that boat owners keep oil absorbent pads in bilges and engine compartments to absorb dripping oil.

Measurement: Number of marinas using environmental contracts with patrons.

Objective 7: Require out-of-state boaters to get a permit for boating on New Hampshire waters in order to improve educational opportunities. Key players: NH Lakes Association, Department of Safety, DES, NH Marine Trades Association, NH Fish & Game, Department of Resources and Economic Development

a) Establish a committee, including members from the organizations cited above, to develop legislation for the year 2000 session.
b) Actively support the resulting legislation.

Measurement: Enactment and implementation of legislation.

Objective 8: Track water quality at marinas on Lake Winnipesaukee where 1992-93 studies were conducted to determine what improvements to water quality have occurred as a probable result of BMP implementation. Key player: DES

a) Incorporate monitoring into work plan.

Measurement: Log and interpretation of water quality data.

Objective 9: Reduce shoreline and nesting habitat impacts from recreational boating. Key players: local river advisory committees, VLAP, VRAP volunteers, lake and watershed associations, Department of Safety, DES, Fish & Game Department, Loon Preservation Committee

a) Identify areas where boating speeds or other recreational boating activities are an issue via *Meanderings* newsletter, NH Lakes Association newsletter, other vehicles.
b) Assist local/regional organizations/concerned citizens with developing a solution(s).
c) Work with the Department of Safety to include shoreline and habitat concerns in the *New Hampshire's Boater's Guide: A Digest of Boating Laws* or other similar publication.

Measurement: 1) Number of coves/shorelines where waterfowl nests are undisturbed, 2) number of identified problem areas where solutions have been successfully implemented, and 3) inclusion of habitat information in Department of Safety publication(s).

1

Road Maintenance

Problem Definition

There are 16,500 miles of public roadway in New Hampshire. Two-thirds of the roads are municipally maintained and one-third are state maintained; 3,790 miles of roadway are gravel (class V roads), of which 22 percent are graded and drained, and 1,184 miles are dirt, many of which are not town maintained and posted for travel at one's own risk (class VI). An unknown number of private roads exist. Although there are BMPs for maintenance, state and local maintenance crews do not necessarily follow them consistently.

The principal concerns with respect to road maintenance, in addition to urban runoff addressed earlier, are:

Sedimentation
Phosphorus
Road salt
Snow removal and/or disposal

Sediment eroded from dirt roads, in particular, smothers roadside vegetation and can degrade water quality if it reaches a waterbody. Sediment from road washouts or other erosion, regardless of road material, can also cause water quality problems. Toxics from vehicles and vehicle exhaust that adhere to soil particles are carried with the sediments via ditches or directly from road surfaces to receiving waters.

Phosphorus, which readily attaches to soil particles, can stimulate plant growth and create a variety of adverse effects from reduced DO, increased organic matter, and impairment of habitat. The impacts of both sediment and phosphorus may be particularly long-lived in lakes and ponds, where both pollutants settle out. Poorly constructed and improperly maintained dirt or gravel roads used to access a waterbody are potential sources of phosphorus.

The widespread use of *road salt* has been and remains a visible public concern (see, for example, NHWSPCC 1977), from the standpoint of both salt applications and salt storage. High levels of chloride (greater than 230 mg/l when associated with sodium) can be toxic to aquatic, particularly benthic, organisms as well as zooplankton low on the food chain. Lower concentrations can affect some plant species at the base of the food chain. By increasing the difference in density between upper and lower layers in ponds and lakes**,** salt in high

concentrations can cause oxygen depletion in lake bottom waters. Over time, even moderate levels can kill roadside vegetation sensitive to salt, such as red and sugar maple, hemlock, black walnut, speckled alder, and red and white pine.

Other contaminants from winter road maintenance practices include sand, debris, and suspended solids (about 6 percent by weight of the deicing salt is insoluble particulate matter). All pose some threat to surface waters. Cyanide used in anticaking compounds also poses potential groundwater quality threats.

High concentrations of sodium in wells located near salted areas create a health risk for individuals on physician prescribed low-salt diets, but apparently have no other adverse health impacts. Chloride in drinking water affects taste, but has no known health risks. The EPA has established advisory levels for sodium and chloride based on objectionable taste and stringent restrictions on sodium levels for people on physician prescribed no-salt diets.

Snow dumping can introduce sediments, suspended solids, and debris into waterbodies. The result can be increased turbidity, reduced light, respiratory impacts on aquatic organisms, habitat modification, and reduced aesthetic value. Other pollutants in snow include petroleum products, additives, and metals deposited by vehicles on road surface snow, constituents of deteriorating roadways, and, particularly in urban areas, nutrients and toxic chemicals contributed atmospherically (Oberts 1994).

New Hampshire Data

In Maine an estimated 85 percent of all erosion and sedimentation problems in lake watersheds originate from the construction and improper maintenance of camp roads (Kennebec County SWCD). Pennsylvania in 1997 created a Task Force on Dirt and Gravel Roads to reduce the erosion, sedimentation, and other environmental concerns from these essential components of the state's transportation scheme. In New Hampshire, however, environmental issues associated with road maintenance activities do not focus on dirt and gravel roads per se. New Hampshire data documenting impacts (whether road washouts during or following a storm, or erosion due to inadequate controls during road and bridge construction) are largely anecdotal and generally don't distinguish between paved, gravel, or dirt surfaces. Sedimentation occurs to some extent on virtually every New Hampshire lake where steep dirt roads without adequate drainage provide access, but it is unclear how widespread and environmentally significant this problem is.

In terms of summer maintenance on dirt and gravel roads, oil formerly was used for dust control but its use is no longer permissible. Instead communities are using liquid calcium chloride or other more environmentally friendly dust suppressants.

With respect to winter maintenance activities, both salt and sand are applied to New Hampshire roads. Over the last 25 years the State has applied an average of 137,741 tons per year of sodium chloride (rock salt) on State-maintained highways, or 16.66 tons per lane mile. Towns establish their own application rates and mixtures.

The New Hampshire Comparative Risk Project ranked ecological impacts due to road salt 40th out of 53 identified environmental risks. It ranked human health concerns from groundwater contamination by road salt 42nd. Although salt damage to vegetation is ubiquitous, its impacts are localized to areas within 80 feet of salted roads and highways (Salt Institute *in* NH Comparative Risk Project 1997). Aquatic ecosystems near heavily salted roadways are receptors

of road salt, as evidenced by chloride concentrations of 20 mg/l and 55 mg/l in Dublin Pond, Dublin, and Cobbetts Pond, Windham, respectively, compared with a state median of 5 mg/l and a range of 1-190 mg/l. Both waterbodies lie in close proximity to state highways. Since 1981, the state has been spending an average of $200,000/year to replace salt-contaminated wells along state maintained highways. Over the last several years 24 wells/year have been replaced under this program.

On the other hand, any significant reduction in the use of salt would be difficult to achieve without creating hazardous highway conditions. The economic costs of slippery, hazardous roads are high, and highway departments have an obligation to their publics. Both salt storage and snow dumping concerns can be minimized through the use of BMPs.

Map 5 indicates the status of salt storage BMP implementation as of 1994. Snow dumping violations generate several calls to DES each winter. The reasons for keeping snow plowed from roads and highways out of waterbodies are reflected in findings of a 1977-78 DES study of refuse in two snow dumping sites in Concord. The study documented: car mufflers, bottles, cans, broken glass, paper articles, bags of garbage, plastics, car keys, wood, bits and pieces of cars, clothing, toys, cardboard, wire, shoes, batteries, light bulbs, animal feces, and other miscellaneous debris. Dumpsite melt from a site in Durham reached as high as 664 mg/l chloride, 50 mg/l COD, and 13 mg/l oil and grease (Pierstorff and Bishop *in* Oberts 1994).

Again informally, impacts to wetlands due to road sanding practices have been observed, though the extent of habitat loss is unknown.

Current Status of Road Maintenance Controls

BMPs for snow disposal are contained in a DES Fact Sheet entitled "Snow Disposal Guidelines," WD-SWQB-6 and in *Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials* prepared by DES, May 1994. See also, publications from the UNH Technology Transfer Center (TTC), specifically *Basics of a Good Road Manual*, *Manual of Practice for Anti-Icing of Local Roads*, and the TTC drainage manual; North Country RC&D's *Series of Quick Guides for New Hampshire Towns*, containing recommended road maintenance and construction practices for situations like Snow & Ice Control, Culvert Installation and Maintenance, and Ditch/Channel Construction and Maintenance, all available from North Country RC&D Area, Inc., 103 Main St., Suite 1, Meredith, NH 03253;

State Policies

The NH Department of Transportation's (DOT's) policy on road salt, dated 11/1/92, is based on the goal of bare, dry pavements as soon as practical after a storm has ended. Salt combined with plowing is considered the most effective, most economical, and safest deicing method available. "Only sufficient salt to restore safe travel conditions" is recommended, and all winter maintenance equipment is normally equipped with calibrated spreaders. DOT drivers maintain data sheets on application rates for each storm by area, a practice believed to be fostering more responsible salt use.

Snow and Ice Control Research

In 1994 the legislature passed an act requiring the DOT to implement a two-year pilot project in the Nashua area minimizing salt use. During the two winters, 1994-95 and 1995-96, test

sections on low traffic roads were treated with approximately one-half the amount of salt that the State typically applies. DOT evaluated road conditions, accidents, costs, environmental benefits, and public acceptance of the program at the three test sections and control sections. While poor driving conditions were noted on the test sections, reduced salt use did not compromise safety significantly. In each test section chloride levels in monitoring wells were substantially lower than those in corresponding control sections. Potential impacts from increased sedimentation in test sections were not measured. Public acceptance was mixed. From the study, DOT concluded that reduced salt applications work on low volume, low speed, relatively flat, straight roads. Where highways meet these criteria, DOT will consider conducting additional reduced salt programs in communities that request consideration.

Another DOT test, of potassium acetate (CF7) in Hanover, during 1993-95, concluded that while CF7 is easy to use and environmentally superior to salt, its cost, in terms of both the product and the additional equipment needed to apply it, at this time precludes its widespread use in New Hampshire. Other approaches which minimize salt use, such as improved plows, were considered more immediately practical (NH DOT April 1995).

Salt Storage and Snow Dumping

Three laws govern salt storage and snow dumping: RSA 483-B prohibits the establishment or expansion of salt storage yards within 250 feet of a "protected shoreland"; RSA 485-A:13, 15 prohibits dumping of debris (hence, road snow) in waterways; and RSA 485-C:12 prohibits new outdoor storage facilities for road salt or other deicing chemicals within any wellhead protection area. This act also requires that all potential sources of contamination in wellhead protection areas and areas of locally valuable groundwater be inventoried and managed; salt storage and use for roads and parking lots are identified as potential sources of contamination.

Every fall for the last several years DES been mailing a fact sheet on snow dumping (Snow Disposal Guidelines, WD-SWQB-6, 1996) to municipalities throughout the state. The Guidelines recommend plowed snow be dumped near flowing waters but at least 25 feet from the high water mark and fenced from it to prevent solids from washing into the river. DES provides this information in response to complaints. Water quality generally is not sampled.

Other Programs

While the State maintains a well replacement program, it is not legally required to replace salt-contaminated wells. Local communities, however, can be found negligent for contaminating water supplies and can be required to repair or replace wells.

The mission of the UNH Technology Transfer Center (UNH T2 Center) is to communicate technical and management information to people who maintain and repair local roads and bridges. It provides education and training through workshops, a 12-page quarterly newsletter called *Road Business*, and various information services such as publications, videos, and responding to questions. These cover the range of topics appropriate for the UNH T2 Center mission.

During calendar years 1995-1999, the UNH T2 Center held nine workshops on winter operations with 337 participants. In 1996 it published the *Manual of Practice for Anti-Icing Local Roads*, and it continues to distribute this publication through workshops and information services. Other frequently conducted workshops include Basics of a Good Road; Drainage,

Drainage, Drainage; Work Zone Traffic Control; and the Road Surface Management System. Each year since 1995, more than 1,000 local managers and crew members have attended UNH T2 Center workshops. The Center recognizes those who complete training requirements as "Road Scholars." This four level program has had more than 200 people complete the first level, and 42 have completed the highest level.

State law authorizes the DOT to provide financial assistance to communities for improvements to Class I, II, and III highways (RSA 235:10-21) and to Class IV and V highways (RSA 235:22-36). Improvements can include rectification of road-related NPS problems.

RSA 230:83, effective August 1993, established the DOT's Adopt-a-Highway Program, which directly involves citizens, groups, associations, and businesses in litter clean up activities, scheduled to occur four times each year on adopted roads.

Some communities sweep streets, typically once in the spring to remove winter sand, which is subsequently usually used as fill or cover materials in landfills. DOT catch basins and sediment traps are visited two times per year, in the spring and/or fall. Only those requiring maintenance are cleaned. Ditches on state highways are regraded annually, and sediments are stockpiled for use in other projects.

1989 NPS Plan Recommendations Implemented

The *1989 NPS Management Plan* characterized road salt storage and application as of minor significance statewide but of major concern in impacted areas. It recommended further investigation into the water quality impacts from salt use and a review of BMPs dealing with salt application and storage. The latter has been completed. Additional recommendations dealing with road salt reduction, sand removal, and regulatory control have not been addressed. The *Plan* did not identify erosion from dirt roads as an issue.

Goal

Surface and ground waters are protected from erosion due to road maintenance activities or poor planning, design, and construction, and from road salt impacts and abrasives.

Objective 1: Undertake a study of chlorides impacts to one or more lakes. Key players: USGS, US Forest Service, DOT, DES

a) Hold one or more meetings of key players to determine objectives, costs, design, and implementation plan.
b) Find funding, as necessary.
c) Implement study.
d) Publicize results and recommendations.

Measurement: Establishment of sampling protocols and an impact assessment plan, together with successful completion of such study and analysis of results.

Objective 2: Develop a process whereby municipalities can determine salt-sensitive areas, such as public water supplies, lakes, and ponds, and work with DOT on road salting alternatives for state and local highways in salt sensitive zones, while recognizing the importance of public safety. Key players: DES, DOT, municipalities

a) Identify communities where concerns over salting practices have been raised.

b) Identify staff at DOT and DES to assist in developing town-specific solutions.
c) Work with communities to find mutually acceptable solutions.

Measurement: The number of alternatives to salting in salt-sensitive areas established in practice.

Objective 3: Target local road managers and crews for training on winter maintenance BMPs, on culvert sizing, funding, and installation, on potential impacts to existing roads due to increased runoff or altered runoff patterns resulting from development of the land, and on erosion control practices. Key player: UNH Technology Transfer Center

a) Utilize existing workshops, *Road Business* newsletter, and other publications.

Measurement: The number of local road managers and crews attending training and the number of towns represented.

Objective 4: Focus educational efforts on salt storage piles. Key players: DES, UNH Technology Transfer Center

a) Review existing materials for adequacy.
b) Develop strategy for getting information to road agents and other appropriate town officials.
c) Implement strategy.

Measurement: The change in numbers of salt storage piles in compliance with BMPs (based on 1994 inventory).

1

Unlined Landfills

Problem Definition

There are approximately 200 unlined landfills in the state, most of which are no longer in use and in some phase of the closure process, or closed (see Map 6). Highly toxic compounds capable of contaminating surface and ground waters commonly occur in landfill leachate. Contamination from such toxics is the chief concern with unlined landfills, not all of which pose the same threat due to the types of material in them. The most common contaminants are:

Organic compounds
Heavy metals
Other compounds, such as iron, manganese, nitrates, and salts

Organic compounds, a generic term, generally are manmade materials containing carbon as one constituent. Volatile organic compounds (VOCs) include more than 100 compounds that vaporize at relatively low temperatures. Subcategories include chlorinated solvents (e.g., trichloroethylene and methylene chloride, which are components of some glues, solvents, and degreasers), nonchlorinated solvents (e.g., acetone, also a component of some glues, solvents, and degreasers), gasoline-related compounds (e.g., benzene and xylene), and freons (used as refrigerants or propellents in aerosol cans). Heavy organic compounds do not volatilize readily and include pesticides, herbicides, and PCBs. Some of these compounds are known carcinogens. Others are neuro-toxins or otherwise harmful when exposure to them is high, prolonged, or crosses the threshold of no risk. Household hazardous wastes are a significant source of VOCs.

Not all *heavy metals* (metals with atomic weights greater than that of sodium) are known to be toxic at low concentrations. Those that are, including arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver, can cause health problems and derive from common household products like batteries, televisions and radio components, plastics, and ceramics. They can be toxic to aquatic life and contaminate groundwater.

Among the *other compounds* common in landfill leachate are iron, manganese, chloride, nitrate, and sodium. Both iron and manganese occur naturally in the soil but can be leached from it under the highly acidic conditions that landfill leachate often creates. Both cause aesthetic problems in drinking water (staining, appearance, smell) and may affect taste; to date no standards based on health effects have been established. Similarly, the drinking water standard for chloride is based on an approximate threshold above which chloride may affect taste. Nitrate in drinking water is a health concern, primarily for infants. Nitrate typically occurs as a

groundwater contaminant only at sites that formerly received wastewater sludges or septage. Historically, septage lagoons for septic tank effluent were located at unlined landfill sites. Sodium can pose variable health risks as well, but generally only to individuals on sodium-restricted diets.

New Hampshire Data

In New Hampshire the DES Remediations Programs has identified at least 20 surface water quality problems caused by landfills. Data on groundwater contamination generally come from monitoring wells sited down gradient of a landfill site. Monitoring requirements typically include scheduled sampling (one to three times per year, depending on the parameter) for specific conductance, pH, chloride, sulfate, TKN (total nitrogen), nitrate, iron, manganese, static water level elevation, VOCs, arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. The location of wells is based on hydrogeologic studies required of all landfill closures.

Though groundwater monitoring is the primary source of data, surface water quality monitoring can also bring problems to light. The State's surface water quality monitoring program has documented only iron, manganese, and dissolved oxygen violations associated with landfills on monitored rivers and streams in the state. However, surface waters are not routinely monitored for VOCs.

Based on existing data, DES estimates that as many as one-third of the unlined landfills in New Hampshire release VOCs at concentrations significantly above groundwater quality standards. Heavy metal violations occur, but are considerably less common.

An example of a typical unlined landfill closure project is provided by the former "Tri-Town" landfill in Bennington, which served three small New Hampshire towns from 1970 to 1991. Wastes disposed in the landfill included municipal solid waste (MSW), sludge from a nearby paper mill, and metal shavings containing small amounts of cutting oils produced by a local factory as a process waste. Wells for monitoring groundwater quality were installed in 1983 and typically were sampled several times annually from 1986 to the present. Interest in the data was heightened by the presence of residential wells downgradient of the landfill. Well data showed a substantial impact on local groundwater quality prior to the landfill's closure. Of greatest concern were a number of VOCs consistently detected in the groundwater, including benzene, 1,2-dichloroehene, and vinyl chloride. Of these, benzene, a carcinogen, was present at concentrations above drinking water standards limits as defined in state groundwater protection rules. Groundwater quality was also affected by elevated levels of iron, manganese, chloride, and specific conductance.

The landfill closure plan approved by DES in 1992, included installation of a synthetic cap over the entire waste disposal area and extensive regrading to accommodate engineered stormwater controls. Given that the bottom elevation of waste in the landfill is 8 to 10 feet above the water table, DES determined that the cap would effectively *contain* the landfill wastes (by isolating them from infiltrating rainfall and snowmelt) and thereby eliminate groundwater contamination. Continued monitoring following cap installation shows that closure has been effective at furthering reductions in VOC levels that resulted from operational improvements in the early 1990s to essentially nondetectable levels.

The unlined municipal solid waste landfill problem is widespread--there are approximately 214 unlined municipal landfills, of which 204 are publicly owned. Seventy-nine of these landfills stopped receiving wastes prior to July 9, 1981 and therefore do not come directly under

jurisdiction of the Waste Management Division (WMD.) for closure. However, they may be required to be capped to WMD standards if contamination occurs. All other landfills are subject to capping requirements. Landfills where ambient water quality standards are violated must cap with impervious materials (generally including a layer of synthetic material), while those where standards are not violated may close with a low permeability material (generally till soil).

As of January 1999, 84 landfills have been officially closed and capped. Of these, 64 are public and 23 are private. Costs from recent closure projects indicate impervious caps cost on the order of $125,000 per acre, while the low permeability caps cost about $86,000 per acre. Presently there are 14 unlined municipal solid waste landfills that continue to accept MSW in New Hampshire.

In 1980 Congress passed the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), creating a national trust fund for the clean up of abandoned and uncontrolled hazardous waste sites. To date, 18 "Superfund" sites in the state have been listed under CERCLA, including some where the responsible parties are known. Of these sites, 4 are unlined municipally owned or operated landfills. One of the four, the Coakley Landfill in North Hampton, accepted municipal waste from surrounding towns and Pease Air Force Base from 1971 to mid-1982, when the landfill was reserved exclusively for ash from the Portsmouth Refuse-to-Energy plant. Contamination of wells in the vicinity was first reported in 1983. Regular sampling subsequently revealed 24 volatile organic compounds at or near the landfill, ranging from trace amounts to several thousand parts per billion and posing a potential health risk from recreational contact and drinking water. Contaminants at the site moved both overland through seeps and streams and in the groundwater. Concentrations of iron, manganese, and chlorides and specific conductivity were also higher than background levels in off-site wells (NH Water Supply and Pollution Control Commission 1986). All four parameters are characteristic of landfill leachate. Closure requirements mandated by CERCLA have slowed the closure process at the superfund sites.

Fifteen of the eighteen Superfund sites, including all four landfills, are now in the cleanup phase. Of the three remaining sites, two are ready for design of a cleanup remedy, and one is currently progressing from the investigation phase into the development of alternative clean-up remedies. By 2001, all 18 Superfund sites should have ongoing or completed clean ups.

Current Status of Landfill Controls

Landfill closure **BMPs** are published in the *Guidance Document for the Closure of Solid Waste Landfills in New Hampshire,* prepared by DES, May 1990. The hydrogeologic investigation portion of the guidance document was revised in October 1998.

State and Federal programs to prevent contamination or to remediate problems due to unlined landfills are summarized below.

Programs Governing Landfill Design

Construction and operating standards required by RSA 149-M, the New Hampshire Solid Waste Rules, and the federal regulations contained in 40 CFR part 258, emphasize site features, liners and leachate collection systems, monitoring wells, venting or recovery and monitoring of gas, the exclusion of hazardous materials, daily cover, control of stormwater runoff, and limited

site access. Note that landfills are, by state law, the least preferred approach to waste management, preceded, in order of statutory preference, by source reduction, recycling and reuse, composting, waste-to-energy, and volume reduction incineration.

Groundwater Release Detection Permits

A groundwater release detection permit, issued by DES under authority of RSA 485-C, is required for the siting or operation of new, lined solid waste landfills and for any existing solid waste landfill in a Wellhead Protection Area. The DES and local health officers are authorized to issue cease and desist orders for violations of the Groundwater Protection Act.

Landfill Closure Program

The Hazardous Waste Remediation Bureau provides assistance to the Solid Waste Management Bureau for landfill closure design requirements and permitting and for compliance with groundwater rules (Env-Wm 1403). Landfill closure, as defined in RSA 149-M:34, means "the process used to permanently cease use of a facility, or portion of such facility in a manner that will minimize future risks of environmental change." Performance-based closure guidelines are designed in part to minimize leachate production. Capping (which keeps precipitation from entering the landfill, thus reducing leachate generation), runoff control, and revegetation are required. Following closure, the site must be monitored, as indicated, for a minimum of 30 years.

State Aid for Landfill Closure

To reduce the costs to municipalities for municipal landfill closures, estimated to range from $100,000 to $200,000 or more per acre, the legislature in 1992 authorized the State to guarantee up to $30 million for the payment of bonds or notes issued by municipalities, solid waste districts, or counties for landfill closures and closures of other solid or hazardous waste facilities except at national Superfund sites. This allows towns to take advantage of the State's bond rating which may offer lower interest rates for the municipality.

Since 1994, DES has made State Revolving Fund (SRF) loans available to municipalities for unlined landfill closures. The SRF is capitalized with Federal Clean Water Act funds to make loans available to communities for capital costs associated with point and nonpoint source pollution problems. The loans are made well below market interest rates; loan payments are put back into the fund for future loans. Until 1994, the fund was used exclusively for wastewater treatment facilities and wastewater collection systems. The fund was opened to unlined landfill closures due to the extent of the problem in the state. Costs for transfer stations needed to replace landfills at the time of closure are also eligible for SRF loans. From 1995 through 1998, DES loaned municipalities $61,179,857 for unlined landfill closures.

In addition, effective July 1, 1995, the State pays 20% of the eligible capital costs for unlined municipally owned landfill closures. This grant program also provided reimbursement for landfill closure projects completed between the State fiscal years 1985-1995. The estimated cost of this program annually is about $3 million.

Other Programs

As part of a 10-state initiative to effect reductions of heavy metals in the waste stream, in 1990 the legislature amended RSA 149-M to require substantial reductions in the concentrations

of certain heavy metals used in packaging, particularly lead, cadmium, mercury, and hexavalent chromium. The legislature has also limited the sale of alkaline manganese batteries with more than 0.025 percent mercury by weight of the battery (RSA 149-M:22-a).

1989 NPS Plan Recommendations Implemented

The *1989 Nonpoint Source Management Plan* ranked landfills the State's top priority for NPS improvements. All of the recommendations in the *1989 Plan* have been addressed and are in process, including implementation of a comprehensive program to assess the threats from, and closure requirements for, all unlined landfills in the state. Also established or in process is the recommendation for State approval of all leachate treatment plans. Leachate collected at lined landfills, including the Turnkey site in Rochester which has its own leachate treatment facility, is sent to municipal treatment facilities.

Goal

All unlined municipal solid waste landfills, public and private, are properly closed by the year 2010, and lined landfills continue to be constructed and operated according to applicable state and federal standards and requirements.

Objective 1: Staff levels are, at the least, maintained to ensure closure of all remaining unlined landfill sites by 2010. Key player: DES

a) Work with the state legislature, as necessary, to ensure that state funding for this program, which is 100 percent state-funded, is maintained.

Discussion: Since the landfill closure program began, 61 publicly owned municipal solid waste landfills have been closed, at a rate of about 8 to 10 per year. As the program matures and new options are developed, the rate of closures may improve.

Measurement: Number and annual rate of unlined landfills closed.

Objective 2: Maintain State support for actions to eliminate household hazardous wastes from the waste stream. Key player: DES

a) Continue to provide financial assistance to municipally sponsored household hazardous waste collection days (currently provided by the Hazardous Waste Clean Up Fund, which is funded by businesses that generate hazardous wastes and, as businesses seek to minimize production of hazardous wastes, may be a less lucrative source in the future; in 1998, requests exceeded funds spent by $88,000).

b) Explore and support alternatives to annual collection days, such as permanent regional facilities and recycling of paint and oil.

c) Support efforts to eliminate hazardous materials from consumer products through homeowner/consumer education, publicity to environmentally friendly products, and other ways.

Discussion: As indicated, household hazardous wastes are an important source of VOCs in municipal landfill leachate (generated by solvents, cleaning fluids, furniture cleaners, and the like). Virtually all the larger landfills have VOC releases, and the presence of VOCs factors into cap design.

Measurement: 1) The level of state funding and number of household hazardous waste collection days, 2) the number of alternative strategies for dealing with household hazardous wastes implemented, and 3) the number of household hazardous waste brochures circulated.

Objective 3: Provide funding assistance in the form of loans and grants for unlined landfill closures. Key player: DES

> *Discussion:* Sources of funding assistance are the state-backed bond program providing low interest loans; a 20 percent grants program from the General Fund for municipally owned solid waste landfills; and the state revolving fund loan program, which relies on federal dollars for capitalization.

Measurement: Levels of funding over time for landfill closures.

1

Land Disposal of Sludge, or Biosolids

Problem Definition

Sludge is a byproduct of processing wastewater through a treatment plant (as opposed to septage, the byproduct of individual subsurface systems). Sludge, as typically disposed or recycled, is about 80-90 percent water. The rest is a mixture of organic and inorganic matter, including nutrients and pathogens. When sludge is approved for land application, the term biosolids is generally used. Land application of sludge improves nutrient levels, the water holding capacity and organic matter content of soils. Alternative disposal methods are typically land filling and incineration.

Sludge characteristics vary from facility to facility, depending on the initial wastewater composition, septage additions, and subsequent wastewater and sludge treatment processes. Sludge may vary seasonally, even daily, for the same reasons. Potential water quality and public health problems from biosolids applications due to improper management and disposal practices stem from:

Nutrients
Pathogens
Heavy metals
Vectors
Toxic organic compounds

Of the *nutrients*, nitrogen and phosphorus cause the greatest concern. In inland waters the concentration of phosphorus generally limits or promotes aquatic plant growth; in coastal areas, nitrogen is generally the limiting nutrient. Aquatic plant growth creates a variety of water quality problems. Excessive nitrogen, as nitrate/nitrite, in drinking water supplies is potentially dangerous to newborn children. Another form of nitrogen, ammonia, can be toxic to fish.

Pathogens are human disease causing agents. *Heavy metals and toxic organic compounds* can be toxic to terrestrial and aquatic life, can bioaccumulate, and ultimately can impact human health. Improperly stabilized or applied, biosolids can attract *vectors* (insects and rodents) to a site, which can be agents of pathogen dispersal.

Although not a water quality issue per se, the odors associated with land application of biosolids, as well as the uncertainties raised around long-term risks from accumulations of persistent organic compounds and metals in agricultural soils, have made land application a highly visible and controversial issue in the state. As the state's population grows and economic expansion occurs, the disposal of sludge will continue to challenge state and municipal residuals managers**.**

New Hampshire Data

In New Hampshire, a study of land applications from the Somersworth wastewater treatment facility failed to document any trends toward higher levels of contaminants in surface or ground water from biosolids applications (NHDES 1978). However, phosphorus concentrations more than 250 times presumed background concentrations and *E. coli* bacteria counts in an adjacent stream of up to 27 times Class B water quality standards were documented at a biosolids application site in Derry, where sludge was stockpiled during the winter without regard to runoff concerns. Preliminary data from a UNH study indicate that nitrogen also can pose water quality problems unless applied at site-specifically determined, agronomically acceptable rates. The variability of nitrogen concentrations in sludge complicates the determination of application rates, which farmers can address by underestimating crop needs for nitrogen, with corrective action part way through the growing season if they find too little nitrogen is available to plants.

In general, however, research and operational experience from around the country conducted on biosolids, including relatively long-term (20-30 year) USDA and other studies focusing primarily on metals, have repeatedly documented an absence of public health and environmental impacts when biosolids were applied according to guidance and regulations (US EPA 1994). Impacts predicted by researchers at Cornell University have not materialized in studies to date. Additional research now underway in New Hampshire will contribute significantly to the limited data on impacts of land application here.

As part of a rule-making process initiated in 1995, the NH Bureau of Health Risk Assessment (BHRA) reviewed the EPA's methodology for assessing human health risks from metals in biosolids applications. The BHRA concluded that "current allowable levels of metals in sewage sludge as given in the 503s [federal regulations] do not pose a significant acute or sub-chronic hazard. There is some concern, however, for long-term (chronic) exposures to pollutants in sewage sludge [particularly arsenic, lead, and mercury]. The potential for mobilization of metals in agricultural soil after decades of application at the current EPA limits certainly deserves further research, since such mobilization may result in a significant added exposure by one or more pathways outlined in the risk assessment." (Duff 1996) DES incorporated the BHRA's recommendations relative to metals in developing its rules and elected to require the most stringent of the federal requirements for some metals and more stringent requirements than the federal requirements for selected metals, including the three of principal concern.

In 1989, when the State's most recent *Sludge and Septage Management Report and Action Plan* was completed, approximately 30 percent of the state's sludge was being composted or land applied, for an estimated 4,358 "dry" tons of biosolids. The percentage today is higher, as landfills accept a proportionally lower share. In 1989 New Hampshire sludge was generated at 47 nonindustrial publicly owned treatment facilities, of which 6 (Manchester, Nashua, Concord, Portsmouth, Winnipesaukee River Basin, Keene) produced more than half the total sludge. Of four New Hampshire towns for which information was recently compiled, three - Concord,

Hanover, and Hooksett - recycle all their biosolids in the state (2,824 dry tons), and one, Nashua, has no land applications in the state.

Public concerns over potential environmental and public health impacts from land application of biosolids have resulted in legislative proposals at the state level and municipal actions. At least 10 municipalities have voted to ban land application of biosolids, and several towns have passed moratoriums.

Current Status of Biosolids Control

Regulations for biosolids are set forth at 40 CFR part 503, "Standards for the Use or Disposal of Sewage Sludge." Guidance documents include *Preparing Sewage Sludge for Land Application Or Surface Disposal: A Guide for Preparers of Sewage Sludge on the Monitoring, Record Keeping, and Reporting Requirements of the Federal Standards for the Use or Disposal of Sewage Sludge*, 40 CFR Part 503, EPA 831B-93-002a; *Land Application of Sewage Sludge: A Guide for Land Appliers on the Requirements of the Federal Standards for the Use or Disposal of Sewage Sludge*, 40 CFR Part 503, EPA/831-B-93-002b; *Process Design Manual: Land Application of Sewage Sludge and Domestic Septage*, EPA/625/R-95/001, and *A Plain English Guide to the EPA Part 503 Biosolids Rule*, EPA/832/R-93/003. NH Cooperative Extension has published **BMPs** in Biosolids Best Management Practices for agricultural applications of biosolids to supplement existing guidance materials in New Hampshire.

Additional publications of more general interest include *A Guide to the Biosolids Risk Assessment for the EPA Part 503 Rule*, EPA 832-B-005 and *Use of Reclaimed Water and Sludge in Food Crop Production*, ISBN 0-309-05479-6.

State and federal roles with respect to biosolids control are summarized below.

State Role

The State is responsible for permitting industrial sludge disposal sites in New Hampshire, as specified in Env-Ws 800, which defines industrial sludge as "sludge which is derived solely from processing industrial wastewater as defined in 40 CFR 503.9." All industrial sludge that is land applied in the state is short paper fiber wastes. In 1999 10 sites on 500 acres had active permits where land application of industrial sludge or mixing and stockpiling on site were actually occurring. A total of 38 sites on 3,624 acres were permitted for industrial sludge application. The industrial sludge sites represented 43% of the total sludge spread in New Hampshire in 1996 and 45% in 1997. The permitting function for industrial sludge falls within the DES Water Division. Application information includes site data and management plans, the type of treatment required to control pathogens and vectors, and pre-application soil testing and sludge analysis schedules. Permits are generally valid for five years.

As of 3/25/99, the state has a permitting program for land application of municipal sludge, i.e., biosolids, as well. The regulations include notification requirements, additional management practices, operating standards, setback requirements, and soil and sludge monitoring. In 1999, just prior to the implementation of biosolids permitting requirements, there were 86 sites and about 2,970 acres where biosolids were being land applied. As indicated above, just over half (57% in 1996 and 55% in 1997) of the total sludge spread is from municipal wastewater treatment facilities, whether located in-state or out-of-state.

The DES also regulates sludge when it is mixed with solid waste (e.g., paper, wood ash), or with products derived from solid waste.

Communities may establish additional controls, over and above those required by DES, although legislation could give state pre-emptive authority. The new rules recognize a dual permitting system, whereby applicants must get both local and state approval. If permits are denied at the local level, DES has the authority to issue a state permit. As of January 1999, at least 40 municipalities have passed ordinances governing biosolids applications.

State personnel are also active in public education and technical assistance to communities.

Federal Role

The EPA is responsible for permitting municipal facilities through the NPDES permit program and, with the State, assumes compliance responsibilities. Any wastewater, regardless of its source, is considered municipal sludge if it was treated in a municipal facility. NPDES permits are issued on a five-year basis. Under New Hampshire rules, generators must meet federal requirements for pathogen and vector attraction reduction, and for metal levels if the sludge is to be land applied. Generators and applicators are subject to a variety of federal record keeping and reporting requirements.

Reporting requirements for biosolids applications were promulgated in 1993, when EPA assumed responsibility for regulating domestic sewage sludge applications in New Hampshire. EPA is presently establishing a tracking system for biosolids applications from out-of-state sources and is accumulating the information for tracking in-state applications. In 1994 out-of-state sources contributed about 40 percent of the biosolids used or disposed of in New Hampshire (approximately 5,111 dry tons of biosolids and an additional 285 wet tons). Out-of-state sources accounted for 39% of biosolids spread in 1996 (11,732 wet tons) and 23% in 1997 (4,827 wet tons). DES tracks land applications where “Class B” materials are used, whether generated in state or out of state. Class B materials have been subject to pathogen reduction treatment but may still contain detectable levels of pathogens, as contrasted with composted (Class A) sludge, which has nondetectable pathogen levels.

Other Programs

The DES Groundwater Protection Bureau requires water quality monitoring when land application rates exceed recommended rates for the particular crop to be grown.

Processed sludge (composted, pelletized, heat processed) that meets EPA standards can be packaged and sold for soil improvement purposes but is still subject to metals and pathogen reporting requirements.

1989 NPS Plan Recommendations Implemented

The *1989 Plan* ranked sludge disposal of moderate significance statewide but acknowledged its potential significance as the availability of landfills and croplands diminishes. It recommended that "new utilization options, such as forest application and co-composting," be explored and supported development of BMPs for such activities. With two exceptions, none of the 1989 recommendations have been implemented. The exceptions are legislation passed in

1990 consolidating sludge regulation (excluding deposition in landfills) within WSPCD [now the Water Division] and establishment of a new permit system for sludge utilization/disposal sites, implemented by DES regulations adopted in 1996.

Goal

Biosolid applications on the land are regulated to the point that soil and water resources are protected from degradation and the organic matter and nutrients in them is recycled.

Objective 1: Maintain communications with the research community and interested public about potential impacts from land applications of biosolids, particularly long-term impacts, and respond appropriately to new findings through rule revisions or other means. Key player: DES

a) Identify key issues of concern over long-term impacts from biosolids applications.
b) Determine who, if anyone, is conducting research on these issues.
c) Establish a network or other means to maintain open communications with researchers and interested members of the public, including legislators.
c) Provide letters of support for proposals, fund, or otherwise support research that will
d) help answer questions relevant to state policies on biosolids applications.

Measurement: Level of research specific to New Hampshire needs being conducted.

Objective 2: Establish a network to connect biosolids sources with potential beneficial reuse sites. Key players: NRCS, Department of Agriculture, Markets & Food, New England Biosolids and Residuals Association, New Hampshire Water Pollution Control Association

a) Identify which agency is best suited to maintain a network.
b) Establish a network and mechanism to keep it up to date.
c) Publicize the network.

Measurement: Establishment of a network linking farmers with applicators.

Objective 3: Provide education and outreach to the general public about the environmental issues around land application of biosolids. Key player: DES

a) Prepare informational materials.
b) Distribute information, on request and generally, via fact sheets, press releases, newsletters, speaking engagements.

Measurement: Number of requests, speaking engagements, and written materials delivered.

1

Land Disposal of Septage

Problem Definition

Septage is the concentrated waste that is removed from a septic tank, cesspool, holding tank, or marine sanitation device. It may be from domestic, industrial, or commercial sources. It is about 95 percent water, with some inert solids such as grit, sand, and stones, particularly in cesspools or deteriorating systems.

Constituents of potential concern in septage are:

Pathogens
Nutrients
Salts (possible concern - of more concern in western states)
Heavy metals
Toxic organics

A concern specific to land application is the possible attraction of *vectors* to the application site. Improperly applied and stabilized, septage can attract vectors, such as flies, which in turn can carry pathogens and transmit disease.

Pathogens are disease causing agents, such as viruses or bacteria.

Nitrogen and phosphorus are the primary *nutrients* of concern from septage applications. Under the proper conditions, both nutrients stimulate plant growth, but in excess cause water quality problems, depressing oxygen levels, increasing turbidity, creating odors, and altering habitat. Nitrogen, in the form of ammonia, also can be toxic to fish and, as nitrate/nitrite, is potentially dangerous in drinking water to newborn children.

Excess *salts* (e.g., chlorides of magnesium, sodium, and calcium) can harm aquatic plants and animals. The salts come primarily from urine. *Heavy metals* and *toxic organics*, derived from inputs to a subsurface system, also can be toxic under certain exposure conditions.

With continued rural population growth and reliance on conventional septic systems, septage production will continue to increase. Even with our present population, septage haulers face disposal problems. Disposal capacity may actually have declined in recent years, intensifying the problem. Current options for septage disposal include wastewater treatment facilities, land application, lagoons, constructed wetlands, and solar aquatic systems. During 1998, 62,229,639 gallons of septage was generated in New Hampshire for disposal. Of this, about 10 percent was land applied on some 489 acres. More than half (64 percent) was treated at municipal facilities, 8 percent was treated in municipal lagoons, 9 percent went to private facilities, and 9 percent was

sent to private lagoons. As demand for septage treatment grows, the key will be to maintain pumpout services at a reasonable cost so homeowners do not defer maintenance due to high costs.

New Hampshire Data

About twenty years ago (Flanders and Mayer 1981) the state recommended land application as a preferred disposal option over lagoons at landfills, since, by concentrating wastes, the latter, once a common municipal practice, poses a much greater risk to ground and surface waters. In 1996 480 acres in New Hampshire were permitted for land application of septage. In1998, 64**8** acres in hay, corn, rye, and grass were permitted for septage land application, but not necessarily used, and 6,400,000 gallons of septage were land applied. There are no known problems relative to water quality or human health resulting from land applications in the state. Currently, New Hampshire rules have no surface or groundwater monitoring requirements for land application sites.

A Coastal 319 project in East Kingston supports the creation of wetlands to replace lagoons for the treatment of septage. The project, initiated in 1994, includes septage monitoring before and after treatment and groundwater monitoring via installed wells. The facility and monitoring wells were monitored quarterly for a two year period. Preliminary analysis suggests that of phosphorus and metals, which attach readily to particles, received adequate treatment due to filtering. BOD and bacteria were significantly reduced by treatment, but remained higher than desired.

Data from Elsewhere

In Maine, sites that don't meet septage application requirements must apply for a variance, and applicants must monitor surface and/or ground water quality for nitrates and bacteria. According to Jim Pollack, Maine DEP, data from monitoring wells at these few sites indicate no change in nitrates or coliform from background levels. At a site capable of handling septage where septage was illegally applied at rates ten times the permitted rate (3 million gallons as opposed to 300,000 gallons per year) follow-up groundwater monitoring showed no immediate or subsequent water quality problems.

Current Status of Septage Application Controls

There are two guidance documents (**BMPs**) for septage, both issued by the EPA, *Guide to Septage Treatment and Disposal*, EPA/625/R-94/002, and *Domestic Septage Regulatory Guidance: A Guide to the EPA 503 Rule*, EPA 832-B-92-005. New Hampshire rules incorporate this guidance and delineate additional requirements.

State efforts to control septage applications on land are summarized below.

Septage Permitting Program

The state has primary responsibility for permitting land applications of septage (RSA 485-A:4 XVI-a)**,** although municipalities may regulate it as well. At the state level, septage is governed by federal rules (40 CFR 503) incorporated into state regulations at Env-Ws 800. New rules, approved March 1999, are more restrictive than the federal rules in certain respects and are codified as Env-Ws 1600.

The rules govern licensing of septage haulers, suitability of the land application site, septage holding and storage tanks, and application rates. Permits are nontransferable and are valid for five years. The rules spell out procedures for situations where land permitted for septage applications is sold and for apprising landowners who do not own the storage tanks on their property of the tanks' registration and ownership status. Records are required of both the hauler and the recipient. The applicant assumes full responsibility for training of land appliers.

Sites for land applications of septage must meet minimum criteria (Env-Ws 808.02), including compliance with federal requirements specified at 40 CFR 503.12 et seq. These requirements limit the amount of nitrogen that can be applied to the land and specify when crops can be harvested or fields grazed after applications. There are also management requirements to control pathogens and vectors.

Groundwater Protection Rules

Groundwater protection rules, Env-Ws 1500, require discharge permits and groundwater monitoring where septage application rates will exceed crop utilization levels. Septage lagoons also require groundwater discharge permits. The rules require establishment of groundwater management zones, monitoring wells, and pollutant loading analyses.

1989 NPS Plan Recommendations Implemented

The *1989 NPS Management Plan* cites the *1989 Sludge and Septage Management Report and Action Plan*, which characterized septage disposal as a major statewide problem in need of a solution. All but one of the recommendations in the *1989 NPS Plan* have been implemented or initiated except the provision for funding to assist wastewater treatment facilities in upgrading existing septage handling and dewatering equipment. Recommendations outlined in the *1989 Sludge and Septage Management Report and Action Plan* have also been addressed. The Septage Program was transferred to the Water Division in 1990, regulatory programs have been consolidated, and rules and records have been improved; since 1993 the state has encouraged regional solutions through education and technical assistance (though it has not provided the recommended funding for regional solutions).

Goal

Septage disposal capacity meets all the needs of the public in an affordable, reliable way.

Objective 1: Uniformly implement RSA 485-A:5-b, which requires that "Each municipality shall either provide, or assure access to, a department of environmental services approved septage facility for its residents for a minimum of a 5-year period." Key player: DES

a) Determine which communities have made septage disposal provisions for residents.
b) Work with those that haven't made provisions to provide access to disposal sites.
c) Promote regional solutions to the septage problem, such as multi town septage treatment facilities, since they may be more cost effective and environmentally sound than town-by-town solutions.

Discussion: Examples like the City of Concord's and Plymouth Village Water & Sewer District's bans on accepting septage at their wastewater treatment facilities from communities that ban land application underscore the need for regionalism on this issue. Many municipalities have not adequately provided for septage disposal either by developing methods within the community or by seeking formal agreements with other municipalities.

Measurement: The number of municipalities with septage disposal agreements in compliance with RSA 485-A:5-6.

Objective 2: Seek alternative solutions to septage disposal capacity problems, including both traditional approaches like treatment plant septage capacity expansion and innovative technologies. Key players: DES, NH Association of Septage Haulers, waste water treatment facility operators, NH Water Pollution Control Association

a) Convene a task force of interested parties, including key players and others, to address capacity issues.
b) Identify one or more solutions for initial focus and implementation.

Measurement: The amount (in gallons) by which septage disposal capacity is increased.

Objective 3: Explore use of State Revolving Loan Funds for development of septage capacity. Key player: DES

a) Determine interest on the part of municipalities and haulers.

Measurement: Number of municipalities and total amount loaned in support of septage capacity-building projects.

Objective 4: Establish a mechanism for linking septage haulers with landowners to encourage development of additional land application sites. Key players: DES, NRCS, NH Association of Septage Haulers

a) Identify the mechanism for establishing and maintaining such communication.
b) Collect the information and establish the "network."
c) Publicize it among haulers and potential participating landowners.

Measurement: Establishment of a network linking haulers and landowners.

Goal

Regulations governing land application of septage protect the environment, and citizens are informed about what they need to do to ensure environmental protection, including education about proper disposal of household chemicals.

Objective 1: Maintain State support for actions to eliminate household hazardous wastes from the waste stream. Key player: DES

a) Continue to provide financial assistance to municipally sponsored household hazardous waste collection days.

b) Explore and support, financially, through rule making, or by other means as appropriate, alternatives to annual collection days, such as permanent regional facilities and recycling of paint and oil.

c) Support efforts to eliminate hazardous materials from consumer products through homeowner/consumer education, publicity to environmentally friendly products, and other ways.

Measurement: 1) The level of state funding for and number of household hazardous waste collection days, 2) the number of alternative strategies for dealing with household hazardous wastes implemented, and 3) the number of household hazardous waste brochures circulated.

Objective 2: Implement education and outreach to new homeowners about the importance of septic system maintenance, septage disposal options, and the importance of protecting their subsurface systems from household hazardous wastes. Key player: DES, Granite State Designers and Installers

a) Prepare informational materials.

b) Tap a variety of mechanisms for distribution, including local municipal channels, news media, the Internet, and realtors.

Measurement: 1) The number and types of outlets for information to homeowners and number of pieces of informational materials channeled through them and 2) the number of tanks pumped and gallons of septage hauled relative to the population on septic systems.

Objective 3: Keep abreast of research findings relative to impacts of septage land application and other technologies and respond to demonstrated needs for change. Key player: DES

a) Create an ongoing list of researchers and research projects throughout New England, New York, and elsewhere, as appropriate.

b) Periodically review findings of these projects.

Measurement: 1) The number of research projects tracked and 2) any changes made to rules to reflect the new research.

1

Agriculture

Problem Definition

The primary water quality concerns from agricultural runoff are:

Sediments
Nutrients
Pathogens
Pesticides, including herbicides, insecticides, fungicides, rodenticides, acaricides, and any other agent used to destroy a particular target or class of targets.

Sediments can cause turbidity in receiving waters which triggers a number of changes in the water column and substrate. Sediment also can transport pollutants attached to soil particles into receiving waters.

Nutrients, particularly nitrogen and phosphorus, from fertilized fields and manure piles are generally a concern because they can cause excessive plant growth, which in turn depletes the oxygen in water bodies, stimulates algal production, alters the habitat, and creates odors. Ammonia and nitrate/nitrite forms of nitrogen can be toxic to aquatic life and humans, respectively.

Pathogens, commonly including viruses and parasites, can be transmitted from animals to humans and may cause serious illnesses. One of current note, crytosporidium, is transmitted via feces, typically calf feces, to water. It is relatively resistant to chlorination in public water supplies and causes severe gastro-intestinal problems for people exposed to it.

Pesticides, created to kill target species, also may be lethal or harmful to nontarget species. They may move through the environment via runoff, aerial drift, atmospheric deposition, and the food chain, depending on the pesticides' specific properties.

In New Hampshire, the problems from traditional agricultural enterprises like dairy farming are generally experienced at the subwatershed level but, in the aggregate, can cause significant impacts where numbers of farms occur, as in the Connecticut Valley. Although a substantial infrastructure exists to address traditional enterprises, the significant rise in numbers of hobby

and small-scale horse farms throughout the state (an estimated 20,000 horses in 1998 producing 160,000-200,000 tons of manure and bedding/year) creates new educational and manure management challenges. Small animal and horse farms are the source of 80 to 90 percent of the complaints the Department of Agriculture, Markets & Food handles each year. Odors and suspected contamination trigger most complaints. Yet these same farms create opportunities for pro-active integration of small-scale agriculture into local planning and zoning decisions and municipal programs.

New Hampshire Data

In New Hampshire the Department of Agriculture, Markets & Food (NHDAMF) receives many complaints relative to erosion and bacteria in water bodies caused by improper livestock management, particularly when livestock or unmanaged manure have direct pathways to water. Several DES studies document water quality problems of varying severity from livestock and milkhouse wastes. Documented problems stemming from agricultural practices include high levels of total and suspended solids, calcium, turbidity, total Kjeldahl nitrogen, nitrates, ammonia, dissolved orthophosphates, total phosphorus, and bacteria (NH WSPCC 1979, NHDES 1994).

Solutions have varied. Prior to the implementation of BMPs, water quality samples from a ditch draining one milk room and manure pit showed consistently high bacteria concentrations and frequently, high phosphorus and conductivity readings at a station 1500 feet from the barn, relatively high BOD at that station throughout the year, and several low dissolved oxygen measurements. Ammonia concentrations were also high, particularly during the winter. To minimize pollution from milkhouse waste, a series of constructed wetlands has been installed.

At a dairy farm on Morris Brook in the Connecticut Basin BMPs included heavy use area protection, roof runoff catchment systems, and a stone ford crossing to reduce water quality problems. Physical and chemical data indicate little change, but the macroinvertebrate community has improved measurably, with greater diversity and fewer pollution-tolerant organisms, apparently as a result of reduced organic loading.

An approach for which there is federal financial support to assist farmers with implementation is vegetated buffers along water bodies. Conservation buffers not only help reduce potential pollution to surface and ground water by trapping pollutants for plant uptake or natural decomposition, but also reduce erosion by wind and water, increase infiltration, improve wildlife migration corridors and stream habitat, trap snow to increase moisture for crops, and add diversity to the landscape. Largely because it is not sufficiently advantageous financially, farmers in New Hampshire to date have not signed up for conservation reserve support.

Off-site manure recycling is another solution to water quality problems stemming from poor manure management. A 319 project supported the creation of composting facilities at four sites in the Coastal Basin to accommodate manure from, typically, the many small horse farms that don't have the land for spreading manure. Today there are several small-time composting operations in Rockingham County. One of the initial 319 projects in Exeter now composts not only manure, but fish wastes from Portsmouth, food wastes from Exeter Academy, grass clippings from local landscapers, and yard trimmings and leaves from Manchester. The owners are leasing land for the composting operation, which outgrew its original on-farm location. The principal challenge for this approach to manure management is transporting the manure to the facility - horse owners are generally unwilling to haul to composting sites, and composters can't afford the equipment and labor costs to haul for them.

Relative to soil erosion from farmland, data from the Natural Resources Conservation Service (NRCS, formerly Soil Conservation Service) indicate that conservation practices and BMPs have significantly reduced soil erosion from cropland in New Hampshire. NRCS statistics indicate that in 1982, half of the roughly 30,000 acres of cropland in the state (of which more than half is in corn for silage) was eroding at annual rates that exceeded the soil's ability to replenish itself, which is 3 tons/acre/year for most New Hampshire soils. One-eighth of total cropland was eroding at 15 tons/acre/year or more. By 1992, erosion rates had dropped by half due to conservation practices -- one-quarter of the cropland in New Hampshire was eroding at rates higher than soil replenish rates. Of total cropland, less than 1 percent was eroding at rates of 15 tons/acre/year or more. Erosion from hayfields and pasture is generally limited to less than two tons/year.

Erosion is most prevalent and problematic at dairy farms due to the animals' size and weight. Even with rotational grazing and good herd management, erosion still occurs, particularly at stream crossings. Farm construction projects, e.g., farm pond construction, can also be a problem, regardless of farm type, if poorly implemented. Bank erosion, particularly pronounced in the Connecticut River Valley, is an issue for some riverbottom farms.

In 1997 the NH Department of Agriculture, Markets & Food (NHDAMF) began monitoring private wells for the presence of triazine herbicides, commonly used to control weeds in sweet and silage corn and considered a potential problem in New Hampshire because these herbicides leach readily and have been detected in groundwater near to use areas elsewhere in the country. During 1997 one site was found where water quality standards were violated. Detectable but acceptable levels of the herbicides occurred at a couple other sites, where NHDAMF is working to determine what the farmers can do to prevent further contamination.

More common was the presence of nitrates, which are also sampled as part of the sampling effort, in excess of the 10 ppm federal drinking water standard. Where nitrate concentrations are high, landowners are advised to consult with the Office of Health Management, Department of Health and Human Services.

The state also collects water samples for analysis in enforcement actions. All public water supplies, both surface and ground water, are monitored by the water supply entities for a range of pesticides under requirements of the Safe Drinking Water Act. Pesticide monitoring studies in 1985 and 1986 failed to detect any water quality problems from pesticides, and there are no documented violations of health advisories due to agricultural operations in New Hampshire. The 7,790 herbicides, insecticides, and other pesticides registered for use in New Hampshire vary widely in their solubility, persistence in the environment, biomagnification potential, toxicity, and selectivity. Notably, the NH Comparative Risk Project ranked the unregulated home use of pesticides a higher risk than pesticide use by farmers, who are subject to state regulations that exceed those in most other states.

Although no major water quality problems have emerged from agricultural use of pesticides, concern over the potential for long-term impacts is reflected in a 1986 NHDAMF recommendation that planning boards consult with the Division of Pesticides Control before allowing residential development on agricultural land (NHDAMF 1994). A demonstration project using 319 funds on the Sugar River in the Connecticut Basin involving integrated crop management principles (including nutrient management and plant selection as well as pest control practices) was initiated in 1995 at dairy, blueberry, vegetable, and nursery operations. Currently

four small fruit and vegetable farms from this program are continuing to practice Integrated Crop Management without outside financial support.

Current Status of Agricultural NPS Controls

BMPs for agriculture have been published in *Manual of Best Management Practices for Agriculture in New Hampshire*, prepared by the Agricultural Best Management Practices Task Force and the USDA Soil Conservation Service, Durham, for the NH Department of Agriculture, Markets & Food, revised August 1998; in *Best Management Wetlands Practices for Agriculture*, NH Department of Agriculture, Markets & Food, July 16, 1993; in "Nutrient Management Requirements for Agricultural Operating Units Receiving Section 319 Funding," EPA Regional 319 Guidelines, April 1995; in "Pesticide Management Guidelines for Groundwater Protection," prepared by the UNH Cooperative Extension and NH Division of Pesticides Control, 11/92; and in *Irrigation: Best Management Practices for New Hampshire*, NHDAMF, March 1998.

State programs and authorities to deal with potential agricultural pollution are discussed below.

Manure, Agricultural Compost, and Chemical Fertilizer Handling

Agricultural operations fall under several authorities, not all of which have regulatory power. The NHDAMF is authorized under RSA 431:33-35 to investigate complaints regarding the above activities, in consultation with NH DES, NRCS, and other agencies, and to follow up with farmers to correct the problems through implementation of BMPs.

Local health officers (RSA 147:4) and/or DES (RSA 485-A:12) are responsible for any additional enforcement action.

Shoreland Protection Act

The Shoreland Protection Act (RSA 483-B) requires that agricultural activities within 250 feet of public waters, as defined by the Act,[9] use BMPs.

Pesticides

New Hampshire has one of the most comprehensive pesticides programs in the country. Every pesticide sold in the state must be registered annually with the Division of Pesticides Control and classified. Although not all pesticides require a license for their use, even General Use pesticides require a general use permit when used by farmers producing a commodity for profit, and all permittees must report the location, type, amount, and crop and acreage treated with pesticides. NHDAMF tracks pesticide use in the state based on these reports. Permittees must attend continuing education programs to maintain their licenses or permits, which are reviewed annually for renewal. BMPs are an integral part of certification and recertification training and testing. Note that crops produced for home use are not covered by state pesticide regulations.

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[9]Public waters for shoreland protection purposes include great ponds and artificial impoundments of >10 acres, coastal waters subject to tidal influences, and fourth order streams.

Pesticides may not be applied within 25 feet of a lake, pond, river, or coastal waters (Pes 1001). Additional rules govern pesticide use in the vicinity of public water supply wells, in wellhead protection areas, and in public water supply watersheds (Pes 502).

Integrated Pest Management (IPM) is a strategy for handling pest problems and reducing dependence on chemical controls. Rather than relying on a single control method (pesticides), farmers are taught to apply several techniques together. Monitoring is one key component of an IPM strategy. Pest populations, damage levels, predator populations, and weather conditions may factor into the monitoring equation. Traps, direct observations, or automated equipment can be used in monitoring. To reduce the chances of creating or intensifying pest problems, suppressive measures are also emphasized, including the use of resistant crop varieties, crop rotation, pruning, and use of natural control agents. Controls are recommended only when the results of monitoring show they are needed. For some pests, the specific population level that necessitates control (the "threshold" level) is known. In addition to chemicals, growers can use biological, mechanical, physical, or other types of controls.

UNH Cooperative Extension and County Conservation Districts have been helping New Hampshire growers employ IPM methods since 1978. Efforts have focused on sweet corn, apples, poinsettias, potatoes, and more recently, greenhouse crops, strawberries, field corn, and nuisance flies. In 1998 the NH General Court passed legislation to create an integrated pest management program in the NHDAMF aimed at instilling "the broadest possible application of the principles of integrated pest management to agriculture, horticulture, arborculture, landscape and building maintenance, and any other areas in which economic poisons are employed" (RSA 430:50 I). Program funding will derive from 10 percent of the pesticide registration fees collected from manufacturers each year and any grants, gifts, and donations to a nonlapsing IMP fund. Fees are expected to generate some $35,000 annually. Whether these efforts will increase the number of qualified technical assistance people enough to implement IPM on a wide scale is unclear.

With respect to monitoring, RSA 485-A:4 XI specifically requires that NH DES monitor "residual pesticides in the waters and in the aquatic resources in the waters of the state." RSA 485-C:8, protecting present or future drinking water supplies, requires DES or the local entity with jurisdiction over designated wellhead protection areas or high value water supply areas to conduct (1) inventories of all potential sources of contamination that might impact designated wellhead protection areas and locally valuable groundwater resources and (2) inspections of facilities once every three years to ensure compliance with BMPs (excluding certain farms and regulated pesticides governed by other inspection requirements).

As mentioned above, the NHDAMF initiated a groundwater monitoring program for triazine compounds in 1997. This effort, funded by licensing fees from pesticide applicators, is anticipated to provide long-term monitoring of the 80 farms where triazines are used. It includes a preventive component aimed at instituting BMPs at potentially problematic sites where monitoring results indicate groundwater quality is close to ambient groundwater quality standards. Where water quality standards are actually exceeded, responsibility for remedying the situation falls to DES.

Community Role

As indicated, local health officers are authorized to follow up on state recommendations relative to manure management. Under RSA 147:4, they may remove or destroy any nuisance or

other injurious thing. Through zoning, communities can also control the location of farms and either support or obstruct farm operations.

Other Programs

Technical and financial support for agricultural operations is available through the USDA Farm Service Agency (formerly Agricultural Stabilization and Conservation Service), the Natural Resources Conservation Service (NRCS, formerly Soil Conservation Service), and the 10 county conservation districts, as well as Cooperative Extension. The 1996 Farm Bill significantly enhanced the resources available nationwide through cost-share programs designed to conserve soil and water, improve water quality, and improve wildlife habitat and incorporate management requirements to those ends.

Among the more important NPS-related Farm Bill initiatives are the Environmental Quality Incentive Program (EQIP), the Wetlands Reserve Program, the Wildlife Habitat Incentive Program (WHIP), and the Conservation Reserve or Buffers Program. Of these, the last mentioned is essentially untapped because the payment for maintaining buffers out of production is too low. Farm Bill dollars are awarded competitively among the states, and the amount allocated to the NRCS for New Hampshire projects depends in part on what the national priorities are. Through EQIP New Hampshire received $301,000 in FY '98 for up to 75 percent of the cost to landowners for protection of surface and ground water quality, wetland ecosystems, and threatened or endangered aquatic species. The NRCS State Conservationist has identified priority concerns for EQIP dollars statewide as erosion and sediment control, shoreland restoration and management, and water quality. By law, at least half of the funding must be spent for livestock-related BMPs. Funds in New Hampshire are allocated on the basis of a proposal's relevance to one of the three statewide concerns or geographically, whether it lies in a priority watershed. Priority watersheds in 1997 were the Ashuelot, Connecticut, upper and middle Merrimack, and Great Bay. 1998 priorities are northern, middle, and southern reaches of the Connecticut River watershed, the Sugar River valley, the mid-Merrimack River watershed, and Great Bay.

The Wetlands and Conservation reserve programs and WHIP are also voluntary. Each involves both cost sharing and a commitment to maintain the practice for a specific length of time, if not in perpetuity. The Wetlands Reserve Program includes wetlands restoration as well as idling the land for agricultural purposes.

1989 NPS Plan Recommendations Implemented

In the 1989 NPS Management Plan agriculture is characterized as a nonpoint source threat locally. Animal and milk house wastes were the two key identified concerns. The NRCS, Cooperative Extension, and DES through the 319 program have contributed to implementation of 1989 recommendations, except recommended state cost-share revenues for pollution control programs, which have not been appropriated.

Goal

The owners of large and small farms alike use BMPs to eliminate pollution and minimize their applications of pesticides and plant nutrients.

Objective 1: Promote manure recycling options for small farms with animals throughout the state by such means as the 319 grants program, technical assistance, media coverage, and workshops. Key players: DES, NRCS, Conservation Districts (if funding is available to support staff time), UNH Cooperative Extension, NHDAMF

a) Convene a meeting of key players to identify ways of promoting manure recycling and
b) commit to supporting it.

Discussion: Small horse farms, in particular, tend to have poor manure management practices due to lack of available cropland for spreading manure. Successful strategies from the 319 project in Rockingham County exploring such alternative, off-site facilities (including composting) should help guide efforts to promote new options.

Measurement: The number of farms participating in manure recycling programs.

Objective 2: Promote Integrated Pest Management through technical assistance, grants, workshops, etc. Key players: UNH Cooperative Extension, NRCS, NHDAMF

a) Convene a meeting of key players to identify ways of further promoting IPM and commit to supporting these practices.

Measurement: The number of farms participating in IPM or operating under nutrient management plans.

Objective 3: Require farms of any size receiving technical and/or financial assistance from state or federal agencies to develop and implement nutrient management plans, whether developed by the owner or NRCS staff. Key players: NRCS, Conservation Districts

a) Work with NRCS offices and districts to implement a policy requiring plans.

Discussion: Nutrient management plans are designed to ensure that nutrients are applied at rates necessary to achieve realistic crop yields, applications are properly timed, crops/grasses selected are appropriate for the soils, and, generally, nutrients are used to fullest advantage in all aspects of farm activity. Key to nutrient management planning is a written plan and follow up records. The goal of nutrient management is to minimize field runoff of nutrients and leaching of nutrients from the root zone.

Measurement: The number (type and size) of farms with nutrient management plans.

Objective 4: Educate landowners about the benefits from and importance of vegetated buffers along streams, including erosion control. Key players: NRCS, UNH Cooperative Extension, Conservation Districts, DES

a) Review available outreach materials and determine which one(s) are most appropriate for each key player to use.
b) Develop new materials, as necessary.
c) Determine how to reach landowners most effectively, including review of all available funding sources.
d) Set landowner contact goals.
e) Implement plans.

Measurement: 1) The number of landowners contacted and 2) feet of shoreline restored to or maintained in vegetated state.

Objective 5: Promote community support for sustainable agriculture, targeting planning boards. Key players: RPCs, OSP, DES, NRCS, UNH Cooperative Extension, Conservation Districts, NHDAMF

a) Convene a meeting of key players to discuss this issue and identify what work currently is occurring around it.

b) Identify specific measures communities can take to support sustainable agriculture and minimize barriers, including review of zoning ordinances supportive of agriculture like Boscawen's ordinance, and ordinances that impede agriculture.

c) Develop and implement plan for reaching planning boards.

Discussion: This objective encourages planning boards to consider manure management and other animal husbandry issues when projects involving animals come before them. It also includes planning board consideration for the potential of agricultural operations in the planning of subdivisions, and ways generally of maintaining small horse farms and other agricultural enterprises in increasingly suburbanized communities.

Measurement: 1) Number of municipalities where actions to promote sustainable agriculture have occurred and 2) evidence that community support translates into land use.

Objective 6: Explore options for municipal recycling of manure. Key players: DES, Governor's Recycling Program, NRCS, Conservation Districts, NHDAMF

a) Convene meeting of key players to initiate planning and develop strategy for implementing this objective.

Discussion: This objective ties in with objectives 1, promoting manure recycling, and 5, promoting sustainable agriculture.

Measurement: The number of municipalities with manure recycling programs.

Objective 7: Educate landowners about pesticide use, abuse, and alternative approaches to pest problems. Key players: UNH Cooperative Extension, Conservation Districts, DES

a) Establish a committee of interested parties, including one or more interested homeowners, to review available outreach materials.

b) Identify how pesticides are currently used and abused. Identify viable alternatives to current inappropriate use patterns.

c) Develop new materials, as necessary.

c) Determine how to reach landowners most effectively, including review of all available funding sources.

d) Set landowner contact goals.

e) Implement plans.

Measurement: Numbers of contacts made.

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Timber Harvesting

Problem Definition

The key NPS issue relative to logging operations is:

Sedimentation

Sedimentation from poorly constructed logging roads and skid trails appears to be the most common NPS problem from forestry operations in New Hampshire. Sediments in water can destroy critical feeding and spawning habitat, clog fish gills, smother bottom dwelling species, and create aesthetic problems. Sedimentation and loss of riparian overstory vegetation can cause water temperatures to increase. Increased temperatures not only affect heat sensitive species, but also reduce dissolved oxygen levels in the water.

Studies at Hubbard Brook (see, for example, Martin and Hornbeck 1994) indicate the critical determinant for levels of erosion and sedimentation from harvested sites is not harvest intensity but the care taken during harvesting and implementation of best management practices (BMPs) to minimize impaction and other disturbances. Where care is taken (e.g., buffer strips along streams, water bar installation, minimal skid road grades), total sediment yields may increase, but effects on stream turbidity are generally minimal. On the other hand, poor practices can cause significant turbidity and disruption to the stream system.

Other potential effects of runoff from timber harvesting operations where regrowth subsequently occurs are generally short-lived. When large amounts of vegetation are removed, nutrients released from the soil system into surface or ground waters can cause water quality changes, particularly with respect to nitrate concentrations (Hornbeck and Leak 1992). In one water quality study in the White Mountain National Forest (Martin et al. 1986), measured nitrate levels over a four-year period following commercial clearcuts ranging in size from 2 ha (4.9 ac) to 24 ha (59.3 ac) peaked during the second year, then tapered back to pre-cut concentrations by the end of the fourth year. Year 2 nitrate values ranged from 1.4 to 27.3 mg/l, compared with reference stream concentrations of from <0.1 to about 4 mg/l, and the drinking water standard for nitrate of 10 mg/l. Within four years, nitrate concentrations returned to normal. Other water chemistry changes occur as a result of large-scale timber harvests, but nitrates pose the most likely potential risk.

Impacts on stream flow volume from timber harvesting are similarly short lived, with a rise in flow from harvested land in the years immediately following a harvest. Where harvests lead to

subsequent conversion of forestland to other uses, however, the impacts can be severe and more or less permanent, as discussed elsewhere in this *Plan*. Such changes that conversion from forestland to other uses causes underscore the value of forestland in watershed protection.

New Hampshire Data

In New Hampshire, from 10 to15 percent of the complaints received by the terrain alteration program in DES are for logging operations. They typically involve turbidity from skid roads, landings, and logging roads or from inadequate stream crossing provisions. According to DRED forest rangers, operators fail to comply with cutting limitations along water bodies occasionally, but far more commonly the question relative to basal area cuts is whether the project falls under forestry law or the shoreland protection act. Even more widespread is the failure of landowners/loggers/foresters to file the Notification of Forest Management Activities Having Minimum Wetlands Impact.

Although potentially a source of short-term water quality impacts, clearcutting is a legitimate silvicultural tool, practiced most often in Coos County and relatively rare in southern portions of the state. A 1995 assessment documented 1,732 clearcuts comprising 49,819 acres over a 15-year period (1978-1993) in New Hampshire involving a small proportion of the forestland in New Hampshire, approximately 1.1 percent. Cuts averaged 29 acres, with a range of from 3 to 621 acres. Most cuts occurred on private land. (Rubin and Justice 1995)

Use of chemicals for forestry purposes in New Hampshire is limited. On a large scale, chemical herbicides are used to suppress undesirable plant species in commercially managed forest stands, typically during the first year or two after a large timber harvest, and for control of major infestations. On a smaller scale, pesticides may be used to control weeds or pests in Christmas tree plantations**.** Commercial applicators are licensed by the state, as are commercial Christmas tree growers.

Status of Timber Harvesting Controls

BMPs for forestry are published in *Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire*, by J.B. Cullen, NH Department of Resources and Economic Development, Division of Forests and Lands, April 1996, reprinted May 1997.

Programs to support forestry BMPs and limit erosion are described below.

Professional Licensing of Foresters

Since 1990 the State has required that foresters be licensed to practice in New Hampshire according to the provisions of RSA 310-A. There are about 300 licensed foresters. Foresters must have completed an academic degree in forestry and demonstrated field proficiency to be licensed. They are required to take 20 hours of education credits recognized by the Forester Licensing Board over a two year period to maintain their licenses.

Professional Certification for Loggers

The certification training for loggers, initiated in 1994, is presently voluntary. After three years, roughly two-thirds of the estimated 1,400 full-time loggers in the state have participated in

at least one of four training programs for certification. Five hundred loggers have been certified. Training includes exposure to forestry and wetlands regulations as well as safety and introductory information on forestry fundamentals. A voluntary organization consisting primarily of loggers known as the Timber Harvesting Council is promoting logger certification as part of a broader effort to improve professionalism.

Intent to Cut Form

RSA 79:10 requires timberland owners to file an Intent to Cut form with the local community. Though the form is used for timber tax purposes, it requires knowledge of RSA 227-J, the timber harvest laws, which the person cutting or responsible for cutting acknowledges in signing the form. Intent to Cut forms are required of all logging operations except where a cut involves less than 20 cords for the owner's use, less than 10,000 board feet for personal use, or for manufacturing maple products. This form is distributed by the municipality where the cut occurs. It triggers State on-site inspection by the Division of Forests and Lands to ensure compliance with relevant state laws and regulations.

Limitations on Cutting and Slash

RSA 227-J:9 limits to 50 percent of the basal area the timber that can be cut within 150 feet of a fourth order river, great pond, other water body of 10 acres or greater in size and within 50 feet of any other perennial stream, river, brook, or standing body of water less than 10 acres in size associated with a perennial waterway within a 12-month period. The goal is “a well distributed stand of healthy, growing trees.” It allows for the director of the Division of Forests and Lands to waive cut limitation requirements subject to the waiver’s being consistent with the chapter’s public purposes.

RSA 227-J:10 regulates where slash can be disposed, including setbacks from rivers, streams, brooks, and water bodies of 10 acres or more, and restricts such slash piles to no more than 4 feet high.

Wetlands Regulations

Timber harvest operations affecting wetlands also fall under the Wetlands Bureau's jurisdiction (RSA 482-A). Temporary stream crossings for logging access and culvert or bridge installations to provide access for forest management require a Notification of Forest Management Activities Having Minimum Wetlands Impacts. This streamlined procedure requires landowners to certify that logging contractors have been directed to conform with BMPs as set forth in the DRED BMP Manual, which is referenced for logging operations of all sizes, whether expedited or not. The completed application, accompanied by a $25 fee, is the operator’s permit.

Projects that will impact bogs, marshes, tidal wetlands, designated prime wetlands, and other specific sensitive areas, harvesting operations undertaken in connection with land conversion to other nonforestry purposes, and crossings that exceed minimum criteria must file for a wetlands application and submit to the regular permitting process. The wetlands law is referenced in the timber harvesting laws at RSA 227-J:6.

Terrain Alteration

Timber operations disturbing more than 100,000 sq ft or 50,000 sq ft within a "protected shoreland" under RSA 483-B must get a terrain alteration permit from the DES, with the statutory conditions, that no fees are charged, and permits are obtained simply by completing the department of revenue administration's intent to cut form (RSA 485-A:17 III). The process is referenced in the forestry laws at RSA 227-J:7 and authorizes DES enforcement in the event of violations.

Other Programs

RSA 485-A:22-a authorizes the director of the Division of Forests and Lands or a designee to issue cease and desist orders on logging operations that violate water quality laws (RSA 485-A).

Forest pesticide applications are governed by the Pesticides Control Board and pesticide regulations (see discussion under agriculture for more detail).

Natural revegetation is the typical approach in New Hampshire, which good silvicultural practices facilitate. As a result, there are no programs specifically aimed at revegetation of cut over areas.

Several organizations in New Hampshire provide training and educational opportunities for foresters, loggers, and landowners. The Granite State Division of the Society of American Foresters provides training opportunities for foresters. The Timber Harvesting Council and its three cosponsors UNH Cooperative Extension, Thompson School of Applied Science at UNH, and Timberland Owners Association, together with the Conservation Districts, Natural Resources Conservation Service, Society for the Protection of NH Forests, DRED, and the Tree Farm Program are among these organizations. Bilingual fact sheets and training programs are offered, where appropriate.

The Sustainable Forestry Initiative (SFI) is a nationwide program of the American Forest and Paper Association (AF&PA) developed in 1994 to improve forest management on forest lands throughout the country. The SFI aims to promote a land stewardship ethic that ensures present timber needs are met without compromising the ability of future generations to meet their own needs by integrating forest management practices with the conservation of soil, air, water, wildlife, fish, and aesthetic resources. Other specific principles include protecting forest health and productivity, protecting special sites, and continuously improving forest management. Compliance with SFI principles is determined based on specific, measurable objectives and public policy goals. Although a timber industry initiative, the SFI affects management practices on private, nonindustrial lands, since much of the timber supply in New Hampshire comes from private lands, and procurement policies of SFI participants encourage landowners and loggers to use of BMPs, minimize harvesting during poor weather or in ecologically sensitive areas, and recognize Certified Professional Loggers.

In 1997 the New Hampshire SFI State Committee voluntarily established a review team independent of the AF&PA membership to evaluate the Initiative’s progress in New Hampshire. The Independent Review Team came to a number of conclusions, including “SFI is starting to lead to some meaningful change in the woods,” such as more thoughtful procurement practices and continued use of state wildlife biologists to help plan sales; and commitment to SFI principles varies from company to company and among levels within each company (NH SFI 1997). The SFI State Committee has already incorporated many of the recommendations from the independent reviewers. State conservation organizations and SFI company participants held a

forum in November 1998 to further stewardship goals through discussion among the interested parties.

Federal cost-share funds are available for conservation activities like planting trees, timber stand improvement, and site preparation on nonindustrial private forest lands. Cooperative Extension foresters are available to assist individual landowners with forest management decisions, and district conservationists are available to assist with road layout.

1989 NPS Plan Recommendations Implemented

In the 1989 NPS assessment timber harvesting ranked as a nonpoint source pollution problem of minor significance statewide and of moderate to major significance in some watersheds. Most water quality problems from forestry operations resulted from "inappropriate or inadequate application of BMPs." The assessment attributed improved operations to the training of resource managers and loggers and the increased awareness of landowners. All of the recommendations, which dealt with BMPs, have been implemented.

Goal

Timber harvesting operations reflect best management practices to control runoff and minimize wetland and other environmental impacts.

Objective 1: Conduct a scientifically valid field evaluation of logging operations to determine BMP use, their long-term effectiveness, the need for any additional BMPs to control adverse impacts from logging, and the role of certification in BMP implementation. Key player: DRED

a) Convene a meeting of interested parties to determine range of issues, methodology, and costs.
b) Develop survey.
c) Implement survey, analyze results.
d) Change informational materials, training programs and develop new materials, procedures as results dictate.

Measurement: 1) Completed assessment and 2) operational changes, as recommended by results.

Objective 2: Conduct field training session(s) at logging operation(s) for state forestry, wetlands, terrain alteration, shoreland protection act staff and other agency personnel, as appropriate, to discuss practices and achieve uniformity in interpretation of regulations and enforcement. Key players: DRED, DES, NRCS, Cooperative Extension

a) Identify key issues, site(s).
b) Convene session (s).
c) Determine what additional sessions would be helpful.

Measurement: Evaluation by participants at field training session(s) of training's contribution to their ability to assess logging jobs relative to compliance with state laws and regulations.

Objective 3: Improve coordination between DRED and DES office staff relative to handling of questions and complaints from the public so that either agency can initiate an appropriate state response to timber harvesting calls. Key players: DRED, DES

a) Develop a form for collecting information on calls relative to timber harvesting operations, to be used by both DRED and DES staff, including such information as site location, date, whether the project has a posted intent to cut form, nature of complaint.
b) Identify procedure for transferring complaints to appropriate agency/individual.
c) Implement process.

Discussion: Although this measure does not address NPS issues per se, it will help to ensure a prompt and coordinated state response to complaints that may otherwise get bounced between departments and result in frustration or ill will on the part of the public.

Measurement: Implementation of a workable system.

Objective 4: Improve timber harvesting notification system so forest rangers can more effectively monitor logging jobs and BMP effectiveness. Key player: DRED, DES, DRA

a) Convene a group of interested parties to identify ways of improving the present notification system.
b) Implement new system.

Measurement: DRED forest rangers know what land is being logged, by whom, within their districts and are able to time their visits to best ascertain how well the BMPs are implemented.

Objective 5: Provide information and education to town officials regarding the opportunities to improve timber harvesting in their towns. Involve them in the distribution of minimum impact notification, BMP, and other wetland/water quality information to landowners and loggers. Key players: DRED, DES, UNH Cooperative Extension, Timber Harvesting Council, NH Municipal Association, municipalities

a) Distribute minimum impact notification forms with each intent to cut form and BMP manuals when the applicant indicates unfamiliarity with BMPs.
b) Revise "Municipal Officials Guide to Forestry Laws of New Hampshire," including involvement of US Forest Service and NH Timberland Owners Association, as well as UNH Cooperative Extension and DRED.
c) Conduct timber harvesting workshops for municipal officials, including NH TOA as well as DRED, UNH Cooperative Extension and NH Municipal Association.

Measurement: 1) Number of towns requesting information for distribution locally; 2) completion of revised manual; and 3) number of local officials participating in workshops.

Objective 6: Promote landowner understanding of the different services provided by foresters and loggers to improve land management decisions. Key players: UNH Cooperative Extension, DRED, NH Timberland Owners Association.

a) Assess existing materials and ways information is conveyed to landowners.
b) Determine how to improve present outreach system.
c) Implement improvements.

Measurement: Number of publications/articles/other outreach pieces prepared and distributed.

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Resource Extraction

Problem Definition

This chapter focuses on the potential effects of gravel pit operations to surface water and ground water. Mineral extraction, which is locally regulated, has the potential to cause water quality problems, primarily related to sedimentation.

Although there are 13 active granite quarries in New Hampshire, nonpoint impacts from dimension rock quarries are minimal. Under authority of RSA 12-E, 12 of the 13 granite quarries are exempt from state regulation by the Department of Resources and Economic Development due to their grandfathered status. Rock crushing, which is locally regulated, can cause water quality problems, primarily related to sedimentation. Rock crushing is less common than sand and gravel excavation and is often accessory to site development. As such,it is subject to state terrain alteration permits and local site plan reviews. Although operational standards and sedimentation concerns apply to rock crushing operations, they are not a focus of this discussion.
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Key potential water quality contaminants from construction aggregate mining activities are:

Sedimentation
Nutrients
Petroleum products
Waste materials generated by pit operations or illegally dumped

Gravel pit operations can affect both surface and ground water quality. Because many pits are located over aquifers, groundwater impacts theoretically could be particularly significant to communities that may one day be looking to their aquifers as sources of drinking water.

Sedimentation affects surface waters and is initiated when stockpiled materials and/or soils stripped of vegetation are exposed to water or wind. Changes to the drainage system can also cause erosion if adequate safeguards are not in place. Erosion can occur when a pit is active or, if not properly revegetated, after it has been closed.

Many communities require topsoil from mined areas to be stored on site, and most operators stockpile topsoil on site for site revegetation and closure purposes. The *nutrients* that adhere to soil particles are released to aquatic systems when eroded sediments are deposited in them.

Unless they are properly handled and stored on site, *petroleum products* can cause both surface and ground water quality problems, as can other pollutants improperly disposed of either during or after activity at the site. Groundwater contamination is particularly likely when the operator has excavated too near to the seasonal high water table.

Waste materials generated during pit operations, typically oil and hydraulic filters and grease cartridges, are potential sources of contamination, as is illegal dumping. Many abandoned gravel pits historically have been used for junkyards and illegal dumps. Toxic fluids, chemicals, and heavy metals in dumped materials pose threats to surface and ground water.

Although not a contaminant as such, how a pit is mined and where disturbances occur can influence water quality impacts from future reuse of the site. Gravel excavation is often the first step in residential or commercial development. Final depth to the water table (a concern for septic systems and cellars, in particular), surface drainage patterns, and providing for future stormwater management by retaining green spaces are key considerations for pits undergoing excavation where future development is actually planned or likely to occur.

New Hampshire Data

New Hampshire data on gravel pit operations are site specific and generally stem from follow up on complaints. State investigations almost invariably involve erosion and sedimentation problems. Sedimentation also appears to be the key environmental problem at the local leve. However, in the absence of any systematic review of gravel pit operations or review of local enforcement of gravel pit operations or reclamation plans, it is difficult to know how well pit operations conform to state and local standards.

For a number of years, the DOT has been tracking aggregate resources in the state. Its database cites about 750 gravel pits, at least half of which are inactive or depleted. Many of the pits are small, mom and pop type operations, tapped by local highway departments or for other local needs. Most of the large commercial operations are owned by a handful of corporations headquartered elsewhere. The Department of Revenue Administration is developing a database of active pits and pits requiring reclamation based on excavation filings. As of 12/98 it contained about 700 entries, but many owners have not yet complied with the filing requirement.

Looking at raw data and excluding considerations of quality, previous extraction, and other factors, New Hampshire has more sand and sand and gravel than any other New England state (an estimated 41.154 billion cubic yards). The state's projected demand for construction aggregate (sand, sand and gravel, and crushed stone) through the year 2010 is 101.704 million cubic yards. The total regional demand through the same time period is 778.705 million cubic yards (New England Governors' Conference 1995). The amount of aggregate that has been extracted in New Hampshire is unknown.

A 1977 assessment of perceived significance of nonpoint sources of pollution in New Hampshire by the Water Supply & Pollution Control Commission (now, Water Division) states that "certain areas, especially along the Connecticut River where sand and gravel mining is extensive, appear to suffer occasional and probably minor adverse impacts from such mining." Local officials and experts at that time ranked sand and gravel mining of low (64%) or moderate (36%) significance. No one responding to the 1994 NPS issues survey considered gravel pits to be a serious NPS concern. However, an evaluation completed by attendees at the OSP's annual

conference for local officials (largely planning and zoning board members) identified gravel pits as a high priority for future educational workshops.

The terrain alteration program staff acted on 39 earth excavation applications in 1997, including 3 for aggregate quarries (quarries where stone is crushed, as contrasted with dimensional stone quarries regulated under RSA 12-E) and on 22 applications through mid-November 1998, including 2 for aggregate quarries. Given new Department of Revenue Administration data on taxable operations, this number significantly underestimates the number of pits that qualify for permitting under the state terrain alteration program.

Current Status of Resource Extraction Controls

Published **BMPs** are set out in the DES fact sheet, "State Alteration of Terrain Permit Requirements for Sand and Gravel Pits," WD-WEB-1. Operational standards for mining operations are stipulated in RSA 155-E:4-a. Reclamation standards also are codified, at RSA 155-E:5. *Vegetating New Hampshire Sand and Gravel Pits* (1991), prepared by the Soil Conservation Service (now Natural Resources Conservation Service), provides reclamation guidance. Groundwater BMPs at Env-WS 421 apply to fueling and maintenance of excavation and earthmoving equipment.

Regulatory controls over resource extraction activities are summarized below.

Community Role

Under RSA 155-E, local communities are responsible for regulating excavations. New areas are subject to a local permitting process. Excavations incidental to building, driveway, or parking lot construction, agricultural activities, or silvicultural activities are exempt from State permitting requirements. Active excavations existing as of 8/24/79, excavations associated with stationary manufacturing and processing plants on or before 8/4/89, and public highway construction projects are also exempt from permitting requirements but are held to the same operational standards as new operations. Expansions at exempted pits are subject to permitting requirements unless the land undergoing new excavation "has been contiguous to and in common ownership with the excavation site" extant in 1979 and "has been appraised and inventoried for property tax purposes as part of the excavation site as of that date." No expansion may violate minimum statutory operational standards related to setbacks from roads, boundaries, and water bodies. Although grandfathered pit owners were required to submit information to the town by mid-1991 in order to retain exemption status, few have complied.

The statutory, minimum operational standards include setbacks from public waters, perennial streams, standing bodies of water, and wetlands greater than 5 acres; vegetational buffers along water bodies; maintenance of natural drainage patterns for water leaving the site unless superseded by a State terrain alteration permit; control of sedimentation; and storage requirements for fuels, lubricants, and other toxic materials (specified at Env-Ws 421). Most local regulations mirror state regulations, although some communities require setbacks from streams of greater than 25 feet and limit the depth of excavations to within four to eight feet of the water table.

Minimum reclamation standards, applicable to all excavation operations regardless of permit requirements under RSA 155-E, include revegetation and soil amendments, as necessary to sustain vegetation, slope stabilization, and restoration of natural drainage patterns. Reclamation

must be completed within 12 months after a permit has expired or an excavation has been completed. Communities may adopt additional standards and have enforcement authority. The planning board has authority over gravel operations except where communities have elected to authorize selectmen or the zoning board of adjustment to handle them. Planning boards may require performance bonds for any regulated phase of gravel extraction. Performance bonds for reclamation previously unexcavated areas are required (RSA 115-E:4-a VII).

RSA 72-B establishes a $.02 per cubic yard excavation tax on excavated materials and an activity tax on pit areas that have not been brought into compliance with state or local reclamation standards based on intense commercial or industrial development of the property. All taxes are paid to the local municipality and come with significant new reporting requirements for pit operators. The only commercial operations excluded from regulation are those that ceased to be commercially useful prior to August 24, 1977. Governmental bodies are excluded from taxation, as are excavations exclusively for agriculture or forest management by the owner and excavations used on site or on contiguous parcels in common ownership.

Terrain Alteration

Excavations of 100,000 sq ft or more, or 50,000 sq ft if within 250 feet of a great pond, 4th order or greater river, or tidal waters (Protected Shorelands as defined in RSA 483-B**)** are subject to State terrain alteration review. Disturbed areas, or footprints, of excavations existing as of 5/4/81 are grandfathered, but site expansions disrupting 100,000 contiguous sq ft or more are subject to terrain alteration regulations. The review focuses on surface water quality protection. Gravel excavations that fall within State-protected shorelands are further governed by requirements restricting tree cutting within 150 feet of the shoreline and prohibiting the stumping of trees within 50 feet of a protected shoreline.

Federal NPDES Permits

National Pollution Discharge Elimination System (NPDES) permits for stormwater discharges are required of active or inactive mining operations and stone processing facilities from which water drains in a channelized way, as opposed to bermed operations where water is contained on site. Excluded are municipal pits, although municipally owned pits in cities that qualify under Phase II of the federal stormwater regulations will be regulated once Phase II kicks in. Permittees must prepare a pollution prevention plan and, unless they have qualified for exemption of monitoring requirements, must monitor TSS and nitrate plus nitrite nitrogen concentrations for a specified period of time. The EPA's recommended approach to pollution prevention involves implementation of source reduction BMPs, such as diversion dikes, vegetative covers, and berms. BMP selection is based on site specific characteristics, including size of area, hydrogeology, and setting. Only the major operations in New Hampshire have actually filed for NPDES stormwater permits.

Other Programs

The OSP, in cooperation with Southwest Region Planning Commission, completed a 20-minute video in 1998 geared towards local municipal boards and dealing with gravel pit regulation. Southwest RPC has developed a manual (*The Law Governing Earth Excavations, 1999*) about state statutes governing gravel pits and local regulatory options, including recommended procedures for addressing gravel pits locally, a model ordinance, application checklist, and sample application form.

1989 NPS Plan Recommendations Implemented

The 1989 NPS Management Plan indicated that off-site impacts could be controlled by implementing BMPs and recommended minimum operating and reclamation standards to assist municipalities in regulating extraction operations. Amendments to RSA 155-E, passed in 1989 and 1991, codified several mining BMPs. NRCS has published two reclamation guides. Recommendations in the 1989 Plan to institute a state permitting program, to identify water quality impacts, and to implement comprehensive BMPs including a minimum separation from pit bottoms to water tables have not been implemented.

Goal

Gravel operations:

- meet minimum operational and reclamation standards codified in RSA 155-E;
- comply with terrain alteration specifications spelled out in the permits; and
- comply with any additional local regulations.

Objective 1: Improve local capacity to deal with master plan goals and local regulatory requirements relative to gravel pits, gravel pit inventories, gravel pit applications, merging of environmental and economic considerations in negotiations with pit owners (e.g., depth of excavation may influence future site uses), reuse of abandoned pits, and enforcement issues via such means as updating and reprinting of the 1992 Southwest RPC excavations publication [completed 9/99], workshops, and presentations. Key players: RPCs, DES, OSP

a) Identify materials available to support this objective.
b) Convene a meeting/meetings of key players to discuss issues, determine approach, develop strategy.
c) Implement educational outreach.

Measurement: 1) The number of participants attending outreach activities, 2) the number of municipalities represented, and 3) completion of checklist of available materials.

Objective 2: Encourage planning boards to: (1) inventory all existing gravel pits, whether new or "grandfathered," and (2) establish and implement a system to determine, via site inspections, whether pits conform with minimum state operational and reclamation standards and applicable local ordinances and whether any adverse water quality impacts are likely occurring. Key players: Local planning boards or other locally authorized body, RPCs, OSP, DES (for follow up investigations)

Note: This objective should be integrated with objective 1 for implementation purposes.

Measurement: Increasing numbers of communities with pit monitoring programs in place.

Objective 3: Develop a geographic database of gravel pit sites, including site-specific data relative to water quality problems, if any, and related NPS issues. Key players: DES, Department of Revenue Administration, RPCs

a) Meet with DRA to determine how their activities can best support this objective in terms of identifying geographically where pit sites are and pinpointing potential problems.
b) Assign someone at DES to oversee database development and respond to inquiries re. water quality and related environmental issues. Make the contact's availability known to RPCs and local planning boards.

c) Determine whether more intensive review of sites for environmental issues is warranted.
d) If it is, determine how to implement review.

Measurement: Establishment of a statewide database on gravel pit sites.

Objective 4: Create and distribute an illustrated brochure for gravel pit operators that includes discussion of ways to minimize future development costs, federal and state permitting requirements, and site BMPs. Key players: DES, RPCs

a) Convene a meeting of interested parties (including invitation to members of the NPS Management Plan review committee) to brainstorm audience, brochure format and content.
b) Identify costs, writer, graphics source.
c) Find funding and implement brochure development.
d) Distribute brochure.
e) Evaluate audience response.

Measurement: 1) Development of educational brochure and 2) the number of people/-organizations receiving the educational brochure.

1

Storage Tanks

Problem Definition

Potential health and environmental impacts from storage tanks stem from the materials stored in them, typically:

Petroleum products
Other compounds

Gasoline, kerosene, fuel oils, other petroleum products, and hazardous materials contain compounds and additives that are known or suspected carcinogens. Hydrocarbons, derived from oil products, can be toxic to aquatic life and accumulate in sediments, where they can disrupt benthic communities. Small quantities of petroleum based products and hazardous materials typically found in storage tanks have the potential to contaminate large quantities of water. For example, one gallon of gasoline, can contaminate approximately 730,000 gallons of water to an unacceptable drinking water concentration of five parts per billion. While some constituents of gasoline are extremely persistent in the environment, others vaporize readily and are toxic if inhaled; other constituents can be potentially explosive.

The majority of regulated (nonresidential) underground storage tanks (USTs) and aboveground storage tanks (ASTs) in New Hampshire contain petroleum products. To a lesser extent, they contain hazardous industrial process materials. Some remaining USTs are unprotected single-wall steel tanks with a typical life expectancy of 10 years, depending on the environment in which they are buried. ASTs in contact with the ground that lack proper corrosion protection have a similar life expectancy.

All regulated USTs and most of the ASTs that have been registered with the state have been GIS located and can be plotted on Well Head Protection Area overlays for planning purposes. See Map 7 and 7 of 7(a).

New Hampshire Data

New Hampshire has identified approximately 2,500 regulated (nonresidential) facilities with leaking underground storage tank (LUST) systems requiring remediation. To date, more than 1,000 of these contaminated sites have been remediated to meet or exceed established categorical standards. Most of the existing LUST sites were discovered during State-mandated closures of unprotected single-wall steel tanks. Approximately 145 of these unprotected single-wall tanks

remain in the ground, and must be permanently closed because they do not comply with existing UST standards. Given the statistical data obtained from closure of more than 14,000 UST systems, it is likely that up to 20 to 25 percent of the remaining 145 UST systems will have caused contamination. This creates a large financial burden considering the average cost to remediate a LUST site is $70,000 to $1,000,000.

The top priority LUST sites affect drinking water supplies. However, many of the sites that have been remediated raised other human health concerns, requiring that buildings be evacuated due to hydrocarbon vapors, potential for explosion, or presence of toxic fumes. Other sites caused fish kills, damage to benthic communities, and destruction of wetlands.

By the year 2000 DES anticipates that the majority of the remaining LUST sites will have been investigated and prioritized, and the initial remediation phase of the cleanup will have begun. After this period most regulated USTs in New Hampshire will have secondary containment with leak detection monitoring, and the number of new LUST sites generated each year is expected to diminish substantially. However, adoption of Env-Wm 1402, Control of Aboveground Storage Tank Facilities, in April 1997 and the consequent inspections during 1998 and 1999 likely will generate additional contaminated sites requiring clean up.

Currently, problems with ASTs generate 150 to 200 calls to DES annually. Typical problems include spills from tanks that were installed on inadequate foundations, tanks that have corroded or been damaged, and leaks from copper piping installed under basement floors which over time has corroded.

An emerging concern in the state is the unregulated tanks. There are an estimated 248,000 unregulated tanks, most of them ASTs, containing fuel oil to heat New Hampshire homes. Additional small tanks containing fuel oil used for on-premise heating of office buildings and other small nonresidential operations are experiencing increased numbers of releases to the environment. During fiscal year 1998 more than 100 releases requiring remediation were reported. Most of these releases would have been preventable with proper installation and maintenance of the systems.

Current Status of Storage Tank Controls

BMPs incorporating industry standards and other technical criteria governing the design, installation, monitoring, and decommissioning of regulated substances in greater than household quantities are stated in Env-Wm 1401 and Env-Wm 1402.

Regulatory programs for USTs and ASTs are described below.

UST Program

Since 1985, the State has regulated nonresidential USTs containing motor fuel, heating oil, or hazardous materials. Current statutory (RSA 146-C) and regulatory (Env-Wm 1401) authority require that motor fuel and hazardous material USTs in excess of 110 gallons and heating oil USTs in excess of 1,100 gallons used for commercial purposes comply with all permitting, installation, monitoring, and decommissioning technical criteria set forth in the rule. A UST is defined as a tank system with at least 10 percent of its volume below ground, including any pipes attached to the tank. More than 4,500 USTs in use are registered with DES. UST rules require monitoring and the implementation of specific leak detection methods, such as tightness testing,

automatic tank gauging, tank interstitial monitoring, and line leak testing. The rules also include corrosion protection testing and secondary containment (for example, double-wall tanks with interstitial monitoring).

Costs associated with the remediation of LUST sites that are subject to state regulation under RSA 146-C and Env-Wm 1401 may be reimbursed from the State's Oil Discharge and Disposal Cleanup Fund, RSA 146-D. This fund provides financial assistance of up to $1,000,000 for clean up costs and third party damages due to leaks from USTs of 1,100 gallons capacity or more. The fund was created to address the increasingly apparent problem of insurance carriers refusing to cover petroleum releases and resulting environmental damages. UST facilities must be in compliance with Env-Wm1401. to be eligible for reimbursement. RSA 146-D created the Oil Fund Disbursement Board to govern the disbursement of funds. This Board, consisting of representatives from the NH legislature, the petroleum industry, state agencies, and the general public, is authorized to propose legislation and write rules for fund disbursement. The fund is financed by fees on oil imported into the state. In 1995 the legislature increased the fee on imported oil in order to generate enough money to cover anticipated clean up costs of $10,000,000 per year.

To date 12,000 USTs have been closed out. The Bureau has averaged approximately 900 closures per year for the last three years. The reasons for tank system closures include: tank system failure, a requirement to close unprotected single-wall steel tanks older than 25 years, requirement to upgrade steel tanks with cathodic protection, and voluntary upgrading of single-wall to double-wall tanks. There are approximately 145 unprotected steel tank systems that must be upgraded or permanently closed. They are owned predominately by small independent businesses ("Mom & Pop" businesses) and political subdivisions (school systems and municipalities). Many of the Mom & Pop businesses will be unable to finance the closure cost of $5,000 to $6,000 per tank system or $15,000 to $20,000 per facility.

Compliance with the technical criteria of Env-Wm 1401 is the key to release prevention, and onsite outreach, education, and compliance inspections have proven to be the most effective way to achieve compliance. Current resources at DES are inadequate to conduct the necessary number of on-site compliance inspections. The UST universe contains approximately 2,100 active facilities. Approximately 100 on-site compliance inspections are conducted each year. DES is currently evaluating ways to substantially increase this number.

AST Program

Env-Wm 1402 governing the registration, installation, monitoring, and decommissioning of aboveground petroleum storage tanks became effective April 25 1997. This rule applies to facilities that store oil for heating, fuel, or other purposes as defined at RSA 146-A:III in tanks with a capacity larger than 660 gallons or where the aggregate storage capacity of all storage tanks is greater than 1,320 gallons. Tanks 10,000 gallons or smaller, down to 660 gallons in size or 1,320 gallons in the aggregate that store virgin fuel oil used only to heat a structure on site are exempt from state regulations but must still comply with the Federal Spill Prevention Control and Countermeasure (SPCC) requirements as prescribed in 40 CFR 112. There are currently more than 1,900 ASTs registered in New Hampshire. It is uncertain what percentage of the total AST population this represents, since most on-premise use heating oil tanks are exempt from registration.

New Hampshire's AST rule requires that all regulated ASTs and oil-filled electrical equipment containing more than 660 gallons be registered with DES. New ASTs must conform with applicable industry standards, such as UL, API (American Petroleum Institute), and NFPA (National Fire Protection Association). Plans for new AST installations must be prepared by a professional engineer licensed in New Hampshire and submitted to DES for review and approval prior to installation.

The state also requires all new ASTs that fall under state regulation to have secondary containment, a liquid level indicating gauge, and an independent high level alarm that is both audible and visible to the person filling the tank. The high level alarm and the independent liquid level indicating gauge must be installed on all regulated ASTs no later than April 25, 2000. Piping in contact with the ground must be double-wall with all annular spaces between the two walls monitored with leak detection devices to identify seepages into or out of the system. New tanks in contact with the ground must be underlain with an impermeable liner or have a double bottom with leak detection devices.

Operators of state-regulated ASTs must inspect their facilities and document the inspections at least monthly. AST systems with a capacity of greater than 5,100 gallons must be taken out of service for a detailed inspection every 10 years (every 5 years for tanks storing gasoline). Inventory monitoring must be performed on AST systems where any portion of the tank system is in contact with soil, oil is stored for distribution, or motor fuel for a fleet of vehicles or aircraft is stored. Owners of regulated AST facilities must maintain a copy of their SPCC Plans, prepared in accordance with 40 CFR 112, on file. It must be reviewed at least once every three years.

Owners of regulated AST facilities must comply with applicable federal and state regulations in order to be eligible for reimbursement from state funds available to pay for clean up costs associated with oil spills from ASTs. Money from the two funds, the Oil Discharge and Disposal (ODD) Cleanup Fund discussed above and the Fuel Oil Discharge (FOD) Cleanup Fund (RSA 146-E), is available to clean up spills from motor fuels and heating oil, respectively. The same Oil Fund Disbursement Board responsible for administering the ODD Cleanup Fund administers the FOD Cleanup Fund, which also is funded by an oil import fee.

Other Programs

Authority to regulate the generation and disposal of hazardous wastes is established in RSA 147-A:4, the Hazardous Waste Management Act, and RSA 147-C, the NH Hazardous Waste Facility Review Act. DES is charged with implementation of these laws and regulations, which are specified in Env-Wm 100-1000.

RSA 485-C, the Groundwater Protection Act, authorizes local entities to manage potential sources of contamination in designated wellhead protection areas. BMP rules, adopted by the DES at Env-Ws 421, apply to the use, storage, handling, and disposal of potentially hazardous materials in other than household quantities.

The Groundwater Protection Bureau has outreach materials for UST owners. Recommended procedures for closing a residential UST are available from the DES, which can also provide information on tank closure contractors who frequently do business in the state and on disposal practices. Information on a State law requiring fuel overflow devices on all home heating tanks, effective 7/1/95, has been provided to fuel delivery companies for dissemination. Although one-

on-one explanations are the most effective way to instigate action on this issue, the approach has limited potential due to limited numbers of staff.

1989 NPS Plan Recommendations Implemented

The *1989 NPS Management Plan* characterizes USTs as a statewide groundwater contamination problem. The *Plan* calls for an inventory of all regulated USTs, whether active or abandoned, which the state has completed. It also recommends that communities inventory all unregulated USTs, delineate sensitive groundwater areas, and develop local regulations for unregulated USTs to protect water resources, and the state develop and distribute BMPs for tanks less than 1,100 gallons in capacity. Information on the care and responsibilities of UST and aboveground tank ownership has been developed for wide circulation. As of 7/1/95 all home heating oil tanks must have vent alarms to prevent overfilling.

Goal

Financial and technical assistance to remediate or avoid problems from above and below ground storage tanks are available to qualifying parties.

Objective 1: Increase the number of on-site UST compliance inspections, which presently average 100 annually. Key player: DES

a) Initiate a programmatic shift by reallocating staff time from tank replacement activities
b) to compliance inspections.

Measurement: Number of annual compliance inspections.

Objective 2: Investigate use of the State Revolving Loan Fund, as well as other sources, to assist small facility owners and municipalities with bringing USTs into compliance. Key player: DES

Measurement: The amount of money available and allocated for bringing remaining USTs into compliance.

Objective 3: Continue state financial support for waste oil tank containment facilities at municipal recycling centers. Key player: DES

a) Maintain appropriations and staff capacity to support grants program.

Discussion: Home owners generate large volumes of used motor oil each year in the state and need a place to dispose of it responsibly.

Measurement: 1) The number of municipalities with waste collection programs and 2) the amount of money allocated by the state to support containment.

Objective 4: Expand preventive outreach to home owners who heat with oil. Key players: DES, home heating oil suppliers and tank installers.

a) Identify spokespersons for the key groups involved.
b) Discuss among key players the type of information to be developed and a distribution mechanism or mechanisms for it.
c) Develop a plan for implementation of outreach activities, including prototype effort, if

appropriate.

d) Implement plan.

Measurement: The number of home owners receiving information on tank leak prevention and safety issues.

Goal

Up-to-date information on the status of UST sites is available.

Objective: Establish an on-line database with information as to phase of LUST projects and compliance of all USTs. Key player: DES

Discussion: LUST owners, prospective property buyers, municipal officials, and interested public need efficient, quick access to information on the status of LUST sites.

Measurement: The establishment of an accessible, on-line database.

1

Golf Courses and Landscaping

Problem Definition

The contaminants of concern are:

- Pesticides
  - Insecticides
  - Fungicides
  - Herbicides
- Nutrients

Pesticides are defined broadly at Pes 101.21 as any chemical or biological agents used to control pests. They are "intended for preventing, destroying, repelling or mitigating any insects, rodents, fungi, weeds or other forms of plant or animal life or viruses which the [pesticides control] board declares to be a pest..." Pesticides may be classified by use (e.g., herbicides, rodenticides, fungicides) or by chemical family (e.g., pyrethroids, carbamates). Pesticides contain active ingredients, inert ingredients, and synergists, which are added to heighten the effects of the active ingredients. Toxicity studies typically are done on the active ingredients, which are toxic to the target pest. However, inert ingredients are also biologically active and may be equally or more toxic from a general biological standpoint. They are simply inactive with respect to the target pest.

The *New Hampshire Comparative Risk Project* (1996) separates the persistent organochlorides (e.g. DDT, PCBs, dioxin), which do not readily breakdown in the environment and tend to bioaccumulate through the food chain, from the pesticides commonly used in turf and lawn care. With respect to the latter, the Comparative Risk report indicates that effects of these relatively nonpersistent chemicals are generally localized. It also cautions that toxicity to nontarget species is often unknown.

When improperly applied, the *phosphorus* and *nitrogen* in fertilizers can contaminate surface and ground water, causing algal growth and related water quality problems. Nitrogen is readily water soluble, so may pose a more general threat than phosphorus, which adheres to soil particles but can cause problems when there is insufficient grass or other cover to prevent erosion. To the extent filamentous algae replace diatoms in an enriched system, the food source for aquatic herbivores is impaired.

New Hampshire Data

There are about 89 golf courses in the state where pesticides and fertilizers are regularly used. The extent of professional lawn care applications is not known, nor is residential use by homeowners tracked.

In 1986 the state Division of Public Health Services, DES, and the Division of Pesticide Control assessed groundwater from selected sites near apple orchards, agricultural lands, and golf courses for potential health problems and risks. In this assessment too few sites were studied to provide statistically significant results, but no problems were detected. The report made several recommendations, however, including development of a statewide pesticide monitoring program and education on potential pollution problems from pesticides. The primary source of monitoring information on pesticides in New Hampshire currently is public water suppliers, none of which have documented pesticide contamination.

The *New Hampshire Comparative Risk Project* (1997) cites only one incident of wildlife mortality due to pesticides on a golf course that occurred in the late 1980s and killed four to five geese. Despite initial concerns over potentially adverse impacts of pesticide use, the US Fish & Wildlife Service determined that a federally endangered mussel population in the Ashuelot River adjacent to a golf course is threatened by sedimentation, not pesticides.

The *Comparative Risk Project* ranked nonpersistent pesticides, whether used on lawns, in homes, or commercially, 21st out of 53 environmental and public health risks.

Documentation of Problem Elsewhere

Elsewhere in the country, monitoring data from golf courses are "quite scarce" (Schueler 1994b). One study of four courses representative of worst case scenarios on Cape Cod (i.e., sandy soils of glacial origin, above normal pesticide and nutrient applications, and continuous operation for up to 30 years) detected 10 out of 17 pesticides in groundwater, mostly in low concentrations in association with tees and greens. The only pesticide detected at levels exceeding health guidance levels was chlordane, banned for use on turf grass in 1978 but persistent and relatively immobile.

Nitrate-nitrogen levels from the Cape Cod courses averaged 1 to 6 mg/l, high enough to cause problems in nitrogen-sensitive coastal areas but not likely to cause human health problems (10 mg/l is considered a public health threat). One conclusion drawn from the research was the potential for improved nutrient and pest management practices to protect groundwater at golf courses, including the timing of applications and type of chemical used, e.g., slow release fertilizers (Schueler 1994c). Note that in New Hampshire, use of slow release nitrogen fertilizer is widespread among commercial applicators. Urea and other quick release, water soluble fertilizers are typical only of homeowners.

Statewide, the Massachusetts' experience vis a vis golf course pesticide applications and drinking water supplies matches New Hampshire's in that no threat to water supplies has been documented (Cooper 1990). A nationwide study by the Golf Course Superintendents' Association involving some 12,000 samples and 50 pesticides reported fewer than 0.07 percent hits above the cutoff of 50 percent of their maximum contaminant limits. Turfgrass density, root

systems, and thatch development help to retain water, absorb nutrients, and degrade contaminants.

There are few studies of lawn care impacts on water quality or the environment. Most have been conducted on test plots and simulated urban lawns. Several studies have documented near-zero runoff and from well maintained, dense turf areas and negligible nitrate leaching (Alessandroni and Hale, unpubl.). At least one study suggests that it makes no difference whether the turf is "very dense or only moderately so" in terms of its buffering capacity (Gross et al. 1991 *in* Schueler 1995a). Others indicate that over-watering may be the critical variable, at least with respect to leaching of nitrogen (Schueler 1995b).

On the other hand, homeowners typically apply fertilizer regardless of whether their lawn needs additional nutrients. There is little information on actual application rates, although one Maryland study (see Barth 1995) determined that homeowners commonly apply nitrogen at rates rivaling those used on golf fairways and crops, and lawn care services apply more nitrogen than is typically applied to golf courses or cropland. As indicated, whether nitrogen leaches through the soil may be largely a function of watering practices. Where fertilized lawns are heavily watered, salt water bays and estuaries are most likely to be impacted; concentrations are unlikely to affect drinking water supplies (Morton et al. 1988).

The amount of runoff from lawns is influenced by a number of factors, including compaction, slope, proximity of impervious surfaces, extent of bare spots in the lawn, and the care with which chemical applications have been made (i.e., avoidance of driveways or other impervious surfaces).

A national assessment of stream nutrient levels, completed in 1992, indicates that base flow concentrations of nitrate and total phosphorus in urban streams were second to concentrations in streams draining agricultural areas; urban phosphorus concentrations were frequently as high as agricultural concentrations except where intensive row cropping was practiced. The assessment did not determine the extent to which stream nutrient levels can be linked with lawn care practices (Barth 1995). According to Barth (1995) "only one study has measured phosphorus concentrations in lawn runoff." That particular study in Wisconsin found total phosphorus concentrations in lawn runoff up to 2.6 mg/l. Lawns were the source of the highest total phosphorus concentrations in the urban study area.

On well maintained turf, where runoff and nitrogen leaching are not a problem, the major impact from chemical applications is likely direct exposure of wildlife to pesticides. Among the most problematic of these is diazinon, which has been banned for use on golf courses and sod farms but remains available for home use under various trade names (Basudin, Diazol, Garden Tox, Sarolex, Spectracide). Diazinon was responsible for 49 poisonings during 1996 in New York State alone (Stone 1997). Studies investigating current *home* lawn care practices document a positive correlation between insecticide use (i.e., diazinon, chlorpyrifos [common trade name is Dursban], and acephate) and toxicity to invertebrates in the soil and to birds (Schueler 1995c).

Current Status of Golf Course and Landscaping Controls

BMPs are specified in "Management Practices To Reduce Ground Water Contamination In Home Lawns," UNH Cooperative Extension, undated, and "Pesticide Management Guidelines for Groundwater Protection," prepared by the Division of Pesticides Control and UNH Cooperative Extension for all pesticide applicators and as a reference for towns, groups, organizations, and

individuals. BMPs are also recommended in “A Guide to Developing and Re-Developing Shoreland Property in New Hampshire,” North Country Resource Conservation and Development Area, Inc., 1994, and “A Homeowner’s Guide to Nonpoint Source Water Pollution in the Connecticut River Valley,” Connecticut River Joint Commissions, 1994.

Authority for state action with respect to pesticides derives from RSA 430:28-40. The Pesticides Control Board is the lead agency. Licensing and operational programs to control impacts of runoff from golf courses and landscaped areas are summarized below.

Licensing

Golf course maintenance staff and people who work for lawn care companies are considered commercial applicators of pesticides and must be licensed. Users must submit annual reports of pesticide use, including the amount used, the crop used on, and the number of acres involved. Training emphasizes BMPs as codified in regulations of the Division of Pesticides Control. The BMPs deal with management issues like storage, record keeping, and the mixing and loading of pesticides.

Pesticide Rules

Overall, New Hampshire has the most stringent pesticide rules among New England states and the most stringent storage requirements of any state (see discussion under “agriculture”). Special pesticide regulations govern certain "high value" areas: designated wellhead protection areas, designated public water supply watersheds, and class A surface waters. Protection measures include a prohibition against drift into waterbodies; a prohibition on pesticide use within 400 feet of gravel packed wells used for public water supply or within 250 feet of other public wells without prior approval (Pes 502.07); special permits for applications within pubic water supply watersheds (Pes 502.06); and the possibility of restrictions on the use of certain pesticides. In addition, no applications are permitted within 25 feet of lakes, ponds, rivers, and coastal waters, nor is pesticide drift within the 25 foot buffer allowed (Pes 1001).

Most of the pesticide rules are geared towards licensed applicators, but the setback requirements at Pes 1001 expressly include residential as well as commercial users.

Shoreland Protection Act

The Shoreland Protection Act restricts fertilizer applications within the protected shoreland. Fertilizer use is prohibited within 25 feet of the shoreline, with the exception of lime. Between 25 and 250 feet from the shoreline only low phosphate, slow release nitrogen fertilizer and lime are permitted for lawn and grass areas.

401 Water Quality Certification

Pesticide monitoring may be required of golf course operations under the Section 401 water quality certificate issued by DES. Water quality certification is required for any federally approved activity which may impact water quality. For golf courses, 401 water quality certification is typically triggered by the need for a federal Section 404 permit issued by the Army Corps of Engineers for dredge and fill in wetlands.

Other Programs

Virtually all commercial golf course superintendents in New Hampshire have as a goal, use of Integrated Pest Management techniques to reduce their need for chemicals. According to Stanley Swier, Pesticide Education Coordinator with UNH Cooperative Extension, their tolerance for damage varies, depending on several variables, including the expectations of management and players.

The UNH Cooperative Extension and county extension educators provide technical assistance and educational programs for commercial applicators and homeowners. UNH Cooperative Extension has developed several fact sheets on cultural practices for home lawns.

The DES has responsibility for dealing with violations of ambient water quality standards. The Pesticides Control Division would be involved in remedial planning should a violation arise.

1989 NPS Plan Recommendations Implemented

Nonpoint source pollution issues associated with golf courses and lawn care were addressed in the *1989 NPS Plan* under urban runoff, with the recommendation that the amount of fertilizers and pesticides applied to lawns and recreation areas, such as parks and golf courses, be reduced through environmentally sound lawn care practices. The Shoreland Protection Act and revisions to pesticide control rules have improved setback requirements from sensitive waterbodies, as recommended in the *1989 Plan*. Other recommendations include research into chemical migration over turf under varying conditions, development of guidelines for chemical use, promotion of low-input vegetation, and education. Public educational efforts have included recommended cultural practices and use of low maintenance plants.

Goal

Nutrients and pesticides of all kinds are applied, if at all, at recommended levels and do not run off or leach to surface or ground water.

Objective 1: Promote homeowner understanding of backyard maintenance practices, including pesticide use and abuse; use of fertilizers; benefits of well maintained, low maintenance turf grass for lawns; pitfalls of overwatering; and benefits of landscaping plant selections that require little or no fertilizer, are relatively insect and disease free, and tolerate low moisture. Key players: UNH Cooperative Extension, DES

a) Meet with cooperative extension agents, technical college teachers of landscaping, and other interested parties to review existing materials.

b) Determine whether materials are adequate and if not, develop additional materials and homeowner BMPs, for use by Cooperative Extension, DES, conservation districts, and other outreach organizations.

c) Explore additional avenues for getting information out to consumers, e.g., retailers, 319 demonstration projects, workshops, and identify funding sources.

d) Determine research needs, if any, and seek funding to implement identified needs.

Discussion: A study of suburban lawn care practices in North Virginia, where 79 percent of those interviewed used fertilizers and 66 percent pesticides, showed significant changes in

attitudes and practices following implementation of a demonstration project exemplifying recommended lawn care practices (Schueler 1994e).

Measurement: 1) Content and number of different materials available and 2) estimated number of homeowners reached.

Objective 2: Continue to seek ways to maintain sufficient staff for follow-up into pesticide detections in ground and surface waters. Key player: NHDAMF

Measurement: The number of staff hours devoted to follow-up inspections of pesticide detections.

Objective 3: Explore the possibility of reduced licensing requirements for landscapers who use certain specified, relatively low toxicity pesticides to promote licensing of all those who currently practice landscaping and use pesticides. Such licensing would require training in the application of the selected pesticides. Key players: NHDAMF, NH Landscapers Association

a) Create an advisory committee, including representation from the NHDAMF, NH Landscapers Association, UNH Cooperative Extension, and DES to determine the extent of the problem and whether reduced licensing requirements would accomplish environmental goals.
b) Implement the ad hoc committee's recommendations.

Measurement: 1) Committee recommendations completed and 2) if recommended, licensing program established.

Objective 4: Continue to work with members of the golf course community to promote golf course design and maintenance practices that minimize erosion and support sustainable maintenance practices. UNH Cooperative Extension, DES

a) Identify individuals from UNH Cooperative Extension, DES, existing golf course management, and other entities interested in working together to adopt and promote a set of principles/guidelines for golf course design and operation that promote natural resource protection.
b) Develop a methodology for determining whether principles are being implemented.
c) Meet periodically to assess where New Hampshire courses stand vis a vis principles and respond to identified needs.

Measurement: 1) Principles/guidelines adopted and promoted and 2) number of golf courses that meet guidelines.

Nonpoint Source Management Plan

Maps, Appendices, Acronyms, and References

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Maps

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Appendices

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Appendix B

Specific federal financial assistance programs and projects that relate to nonpoint source pollution concerns.

Department of Defense/Army Corps of Engineers Proposed dredge and fill applications, breakwaters, channel alterations, reservoirs, dams, beach replenishment projects, and other wetland modification projects, whether submitted by or to the CoE. Reviewed by DES Wetlands Bureau; if of sufficient size, by DES Site Specific (Terrain Alteration) Program. This is perhaps the most pervasive and prevalent activity.

Department of Energy/Federal Energy Regulatory Commission Licenses for hydropower dam installation and operations, construction and operation of or facilities for transportation or storage of natural gas. Reviewed by Wetlands Bureau, Watershed Management Bureau, Site Specific (Terrain Alteration) Program.

Department of Defense/Air Force, Army and Navy Location, acquisition, and design of new or enlarged defense installations, construction activities. Reviewed by DES Site Specific (Terrain Alteration) Program.

Department of Agriculture/Forest Service Management activities on the White Mountain National Forest.

Department of the Interior/Fish and Wildlife Services Management activities on wildlife refuges, of which there are two in New Hampshire, at Great Bay and at Lake Umbagog.

Department of Transportation/Federal Highway Administration Location, design, and construction of highways and related installations; financial support to state projects. Reviewed by DES Wetlands Bureau at different stages through the process.

Department of Transportation/Federal Aviation Administration Permit and license for the construction, operation, or alteration of airports.

Environmental Protection Agency National Pollution Discharge Elimination System permit. Coordinated with DES Permits and Surveillance Section.

As of this time DES has no memorandum of understanding relative to federal activities affecting nonpoint source concerns. Regulatory programs within the Department ensure consistency with state law.

Appendix C

Population Density[1]

Sub-basin #	Basin	Density (people/sq mi)
	Connecticut	**725**
18	Ashuelot	1,232
12	Sugar	1,103
9	Connecticut 6th	910
2	Connecticut 5th	421
4	Ammonoosuc	419
21	Miller	198
	Upper Merrimack	**588**
11	Merrimack 6th	1,023
19	Contoocook 5th	674
13	Contoocook 6th	528
10	Pemigewasset 6th	459
7	Baker	287
6	Pemigewasset 5th	402
17	Beards Brook	100
	Lower Merrimack	**2,781**
23	Nashua	5,022
14	Merrimack 7th	3,089
20	Piscataquog	1,777
22	Souhegan	1,058
	Coastal/Piscataqua	**2,304**
15	Coastal Drainage	2,849
16	Lamprey	734
	Saco/Androscoggin	**997**
3	Androscoggin	2,592
5	Saco	304
8	Ossipee	139
1	Dead Diamond	0.2

[1]US Census, 1990

Appendix D

1997 Building Permits, by Planning Sub-basin

This table represents relative construction activity, by river sub-basin, based on 1997 building permits issued in 111 NH towns. Permits from one town were allocated to river sub-basins based on the percent of the population in each sub-basin. Although the permits reflect from 80 to 90 percent of total permits issued statewide, the data likely under-represent construction activity in some river sub-basins.

River Basin	River Sub-basin	Number of Permits Issued	Percent of Sub-Basin Population in Reporting Towns
Androscoggin/Saco		**132**	**58**
	Androscoggin	5	68
	Dead Diamond	0	0
	Ossipee	23	16
	Saco	104	90
Coastal/Piscataqua		**1,227**	**99**
	Coastal	1,072	99
	Lamprey	155	100
Connecticut		**433**	**57**
	Ammonoosuc	15	38
	Ashuelot	157	81
	Connecticut 5th	63	23
	Connecticut 6th	44	52
	Miller	47	73
	Sugar	107	81
Upper Merrimack		**599**	**62**
	Baker	13	47
	Beards Brook	10	64
	Contoocook 5th	63	74
	Contoocook 6th	44	32
	Merrimack 6th	411	86
	Pemigewasset 5th	9	19
	Pemigewasset 6th	49	30
Lower Merrimack		**3,019**	**97**
	Merrimack 7th	2,297	98
	Nashua	221	100
	Piscataquog	305	92
	Souhegan	196	97

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Source: Bureau of the Census, Construction Statistics Division, Building Permits Branch, "State/County Permit Authorized Construction in Permit Issuing Places," C-40 Series, December 1997 (year-to-date with imputation).

In 1997, ten communities* issued 100 or more residential building permits. All are located in basins experiencing the highest growth in 1997, the Lower Merrimack and Coastal. Seven are located in the Merrimack 7th subbasin, as follows: Bedford (225 permits), Merrimack (163 permits), Manchester (159 permits), Londonderry (139 permits), Hooksett (128 permits), Hudson (115 permits), and Windham (106 permits). One, Nashua (144 permits) is in the Nashua River subbasin. The other two centers are in the Coastal Basin, Dover (112 permits) and Hampton (104 permits).

*Source: Bureau of the Census, Manufacturing and Construction Division, Building Permits Branch, C-40 series. 1/22/98, covering through December 1997 [figures in final report may change slightly from those cited].

Appendix E

Site Specific Applications 1/1/86-3/11/98

River Basin	River Sub-basin	Number of Permits Issued
Androscoggin/Saco		**197**
	Androscoggin	37
	Dead Diamond	1
	Ossipee	61
	Saco	98
Coastal/Piscataqua		**817**
	Coastal Drainage	669
	Lamprey	158
Connecticut		**471**
	Ammonoosuc	61
	Ashuelot	100
	Connecticut 5th	74
	Connecticut 6th	144
	Miller	21
	Sugar	71
Upper Merrimack		**641**
	Baker	24
	Beards Brook	5
	Contoocook 5th	95
	Contoocook 6th	97
	Merrimack 6th	267
	Pemigewasset 5th	79
	Pemigewasset 6th	74
Lower Merrimack		**1,661**
	Merrimack 7th	1,323
	Nashua	116
	Piscataquog	109
	Souhegan	113

Source: DES Site Specific program. Permits from a town in more than one basin were allocated to all basins in which the town lies based on areal percent of the town in each basin. Numbers are rounded.

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Appendix F

Active Permitted Sludge and Septage Land Application Sites, 1996

River Basin	River Sub-basin	Town	Acreage
Androscoggin/Saco			**143.3**
	Androscoggin	Jackson	2.3
	Ossipee	Tamworth	11.5
	Saco	Conway	94
	Saco	North Conway	35.5
Connecticut			**467.9**
	Ammonoosuc	Groveton	105
	Ashuelot	Langdon	4.8
	Ashuelot	Marlow	40
	Connecticut 5th	Lancaster	15
	Connecticut 5th	Littleton	3.6
	Connecticut 5th	Monroe	22.3
	Connecticut 5th	Stratford	30.6
	Connecticut 6th	Canaan	50
	Connecticut 6th	Hinsdale	5
	Connecticut 6th	Lebanon	53.5
	Connecticut 6th	Walpole	53.2
	Sugar	Claremont	54
	Sugar	Springfield	65.9
Upper Merrimack			**882.5**
	Pemigewasset 6th	Bristol	13
	Pemigewasset 6th	Hill	361.8
	Pemigewasset 6th	Sanbornton	14.1
	Baker	Plymouth	15.1
	Baker	Warren	23

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	Baker	Wentworth	11.2
	Contoocook 5th	Antrim	13
	Contoocook 6th	Newbury	3
	Contoocook 6th	Webster	18
	Merrimack 6th	Boscawen	298.2
	Merrimack 6th	Canterbury	79.3
	Merrimack 6th	Franklin	32.8
Lower Merrimack			
	Merrimack 7th	Atkinson	34
	Merrimack 7th	Barnstead	19.4
	Merrimack 7th	Concord	154.3
	Merrimack 7th	Epsom	87
	Merrimack 7th	Gilmanton	33.5
	Merrimack 7th	Hooksett	6
	Merrimack 7th	Londonderry	9.7
	Merrimack 7th	Loudon	184
	Merrimack 7th	Pembroke	17.4
	Merrimack 7th	Penacook	121.2
	Merrimack 7th	Pittsfield	51
	Souhegan	Wilton	30
Coastal/Piscataqua			**180.3**
	Coastal	Farmington	2.1
	Coastal	New Hampton	65.3
	Coastal	Rochester	40.3
	Coastal	Rollinsford	72.6

Actual locations within any given town were not determined for purposes of this chart. Where one town fell into two or more watersheds, the application site was assigned to the watershed with the highest proportion of land in the town.

Appendix G

Farm Land, 1992

County	River Basins	Total Acres in Agriculture	Total Acres in Cropland*	Total Acres in Pasture
Belknap	Merrimack 6th (39%), 7th (25%), Pemigewasset 6th (17%), Coastal (0.1%)	20,910	6,232	3,183
Carroll	Saco (38%), Ossipee (37%), Merrimack 6th (17%), Coastal (5%), other (3%)	25,439	6,233	2,293
Cheshire	Ashuelot (54%), Connecticut 6th (20%), Contoocook 5th (11%), Miller (10%), Beards Brook (5%)	33,935	11,868	6,090
Coos	Connecticut 5th (54%), Adroscoggin (29%), Dead Diamond (10%), other (6%)	46,056	16,885	9,828
Grafton	Connecticut 5th (25%), Pemigewasset 5th (23%), Ammonoosuc (20%), Pemigewasett 6th (13%), Baker (12%), other (7%)	75,733	27,071	14,300
Hillsborough	Merrimack 7th (25%), Piscataquog (22%), Souhegan (18%), Contoocook 5th (16%), Nashua (9%), Beards Brook (6%), other (3%)	39,844	15,936	6,234
Merrimack	Contoocook 6th (41%), Merrimack 7th (36%), 6th (11%), Pemigewasset 6th (6%), other (6%)	46,610	16,677	6,724
Rockingham	Merrimack 7th (39%), Coastal (34%), Lamprey (26%),	34,292	14,010	4,958
Strafford	Coastal (83%), Lamprey (7%), Merrimack 6th (6%), 5th (5%)	24,716	8,394	3,063
Sullivan	Sugar (44%), Connecticut 6th (43%), Beards Brook (5%), Ashuelot (5%), other (2%)	38,297	12,131	5,668

*Cropland includes harvested cropland, cropland used only for grazing, other cropland, cropland on which all crops failed, cropland not harvested and not grazed, cropland in summer fallow, and idle cropland. Source: 1992 Census of Agriculture; NH DES for watershed data. For census purposes, a farm is any place from which $1,000 or more in agricultural products were produced and sold, or normally would have been sold.

Appendix H

Statewide Rivers and Lakes Advocacy Organizations

New Hampshire Lakes Association	7 South State St	Concord, NH 03301
New Hampshire Rivers Council	54 Portsmouth St	Concord, NH 03301

Watershed Associations

Androscoggin River Watershed Council	125 Manley Road	Auburn, ME 04210
Baker River Watershed Association	RR1 Box 133	Rumney, NH 03266-9709
Connecticut River Watershed Council	1 Ferry Street	Easthampton, MA 01027
Lake Sunapee Protective Association	PO Box 683	Sunapee, NH 03782
Lake Winnipesaukee Association	PO Box 1624	Meredith, NH 03253
Lake Winnipesaukee Watershed Partnership	103 Main St	Meredith, NH 03253
Lamprey River Watershed Association	55 Wiswall Road	Durham, NH 03824
Merrimack River Watershed Council	56 Island St, Box 1377	Lawrence, MA 01842-2577
Nashua River Watershed Association	529 Main Street	Groton, MA 01450
Newfound Lake Region Association	HC 60 Box 368A	Bristol, NH 03222
Pemigewasset River Council	PO Box 552	New Hampton, NH 03256-0552
Piscataquog River Watershed Association	122 Mansion Road	Dunbarton, NH 03045
Powwow River Watershed Association	Main Street	South Hampton, NH 03827
Souhegan River Watershed Association	157 Nanticook Road	Merrimack, NH 03054
Squam Lakes Association	PO Box 204	Holderness, NH 03245

Other Lakes with Lay Monitoring or Weed Watchers Programs and/or DES Affiliations through 319 or Other Programs

Armington Lake	Piermont
Ashuelot Lake	Washington
Austin Cate Wetland	Strafford
Ayers Pond	Barrington
Baxter Lake	Farmington
Bearcamp Pond	Center Sandwich
Beaver Lake	Derry
Big Island Pond	Atkinson/Hampstead/Derry
Blaisdell Lake	Sutton
Bow Lake	Strafford
Broad Bay	Ossipee
Canaan Street Lake	Canaan
Cass Pond	Richmond
Center Pond	Stoddard
Chalk Pond	Newbury
Chase Pond	Wilmot
Clement Pond	Hopkinton

Clough Pond	Loudon
Cobbetts Pond	Windham
Cole Pond	Andover
Contoocook Lake	Jaffrey
Conway Lake	Conway
Crescent Lake	Acworth
Crescent Lake	Wolfeboro
Crystal Lake	Gilmanton
Crystal Lake	Manchester
Daniels Lake	Weare
Deering Lake	Deering
Dorrs Pond	Manchester
Dream Lake	Amherst
Dudley Pond	Deering
Duncan Lake	Ossipee
Dutchman Pond	Springfield
Eastman Pond	Grantham
Echo Lake	Franconia (2000)
Emerald Lake	Hillsboro
Flints Pond	Hollis
Forest Lake	Whitefield
Forest Lake	Winchester
Franklin Pierce Lake	Hillsboro
French Pond	Henniker
Frost Pond	Jaffrey
Gilmore Pond	Jaffrey
Gould Pond	Hillsboro
Governors Lake	Raymond
Granite Lake	Stoddard
Great Pond	Kingston
Gregg Lake	Antrim
Halfmoon Lake	Barnstead
Halfmoon Pond	Washington
Harantis Lake	Chester
Harrisville Pond	Harrisville
Harvey Lake	Northwood
Highland Lake	Andover
Highland Lake	Stoddard
Hills Pond	Alton
Horn Pond	Exeter
Island Pond	Stoddard
Jenness Pond	Northwood
Kezar Lake	North Sutton
Kolelemook Lake	Springfield
Laurel Lake	Fitzwilliam
Leavitt Bay	Ossipee

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Lees Pond	Moultonboro
Long Pond	Lempster
Long Pond	Northwood
Loon Pond	Gilmanton
Loon Lake	Plymouth
Lowd Pond	Madison
Lower Beech Pond	Tuftonboro
Lucas Pond	Northwood
Lake Mascoma	Enfield
Lake Massasecum	Bradford
May Pond	Washington
Meetinghouse Pond	Marlboro
Melendy Pond	Brookline (2000)
Merrymeeting Lake	New Durham
Messer Pond	New London
Millen Pond	Washington
Monomonac Lake	Rindge
Mountain Lake	Haverhill
Mt. William Pond	Weare
Mountainview Lake	Sunapee
Mud Pond	Dublin
Northwood Lake	Northwood
Norway Pond	Hancock
Lake Nubanusit	Nelson
Orange Pond	Orange
Otter Lake	Greenfield
Otter Pond	Sunapee
Partridge Lake	Littleton
Pawtuckaway Lake	Nottingham
Pea Porridge Pond	Madison
Pearly Pond	Rindge
Pecker Pond	Rindge
Perkins Pond	Sunapee
Pine River Pond	Wakefield
Pleasant Lake	Deerfield
Pleasant Lake	New London
Poole Pond	Rindge
Post Pond	Lyme
Lake Potanipo	Brookline (2000)
Powwow Pond	East Kingston
Province Lake	Effingham
Rand Pond	Goshen
Rock Pond	Windham
Rockwood Pond	Fitzwilliam
Rockybound Pond	Croydon
Round Pond	Wakefield

Rust Pond	Wolfeboro
Sand Pond	Marlow
Sebbins Pond	Bedford
Shellcamp Lake	Gilmanton (2000)
Silver Lake	Harrisville
Skatutakee Lake	Harrisville
Sondogardy Pond	Northfield
Spofford Lake	Chesterfield
Stinson Lake	Rumney
Stocker Pond	Grantham
Stone Pond	Marlborough
Storrs Pond	Hanover
Lake Sunapee	Sunapee
Little Lake Sunapee	New London
Suncook Pond	Barnstead
Sunrise Lake	Middleton
Sunset Lake	Alton
Sunset Lake	Greenfield
Swanzey Lake	Swanzey
Thorndike Pond	Jaffrey
Lake Todd	Newbury
Tolman Pond	Nelson
Tom Pond	Warner
Tucker Pond	Salisbury
Turee Pond	Bow
Warren Lake	Alstead
Lake Waukewan	Meredith
Webster Lake	Franklin
Lake Wentworth	Wolfeboro
White Oak Pond	Holderness
Lake Wicwas	Meredith
Wilson Pond	Swanzey
Winnepocket Lake	Webster
Winnisquam Lake	Belmont/Laconia
Winona Lake	New Hampton
Zephyr Lake	Greenfield

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Acronyms

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Following is a list of acronyms that appear in this *Plan*. Although we attempted to minimize their use, the length of the list suggests many still made their way into the text. We hope their presence will not be annoying or distracting.

7Q10 The average 7 day lwo flow that occurs on the average once every 10 years, used for calculating permit limits for discharges
AST Above ground storage tank (plural - ASTs)
BMP Best management practice - a recommended way of dealing with a specific nonpoint source pollution problem (plural - BMPs)
CWAP Clean Water Action Plan - a federal initiative, 1998, to restore and protect rivers, lakes, and coastal waters throughout the country keyed to cooperative actions within watersheds
DES Department of Environmental Services (New Hampshire); also NHDES
DOT NH Department of Transportation
DRA NH Department of Revenue Administration
DRED NH Department of Resources and Economic Development (includes Division of Forests and Lands)
EPA Environmental Protection Agency - a federal agency
FERC Federal Energy Regulatory Commission
gpd gallons per day
IPM Integrated pest management - application of various methods for reducing reliance on chemical controls
LUST Leaking underground storage tank (plural - LUSTs)
MSD Marine sanitation device (plural - MSDs)
MSW Municipal solid waste
MtBE Methyl tertil-butyl ether - an additive used in reformulated gasolines
NEIWPCC New England Interstate Water Pollution Control Commission
NEMO Nonpoint education for municipal officials - a project of the University of Connecticut's Cooperative Extension System in collaboration with U. Conn. Natural Resources Management and Engineering Department and Connecticut SeaGrant College Program
NH TOA NH Timberland Owners Association
NHACC New Hampshire Association of Conservation Commissions
NHACD New Hampshire Association of Conservation Districts
NHDAMF NH Department of Agriculture, Markets & Food
NHWSPCC NH Water Supply and Pollution Control Commission - forerunner of the Water Division of DES
NPS Nonpoint source (NPSs are nonpoint sources)
NRCS Natural Resources Conservation Service - housed in US Department of Agriculture and organized on a county basis
OSP NH Office of State Planning
PAH Polynuclear aromatic hydrocarbon (plural - PAHs) - an organic compound

PCBs Polychlorinated byphenyls - organic compounds
ppm parts per million
REPP Regional Environmental Planning Program - a multi-year, state funded initiative with the regional planning commissions administered by DES
RPC Regional planning commission (plural - RPCs)
SFI Sustainable Forestry Initiative - a timber industry program to improve forest management on forest lands nationwide
SRF State revolving fund - managed by DES to provide low interest loans for a variety of purposes
TMDL Total maximum daily load - an assessment used in determining allowable discharges to surface waters
UL Underwriters' Laboratory - evidence that a product meets a particular standard
UNH University of New Hampshire
USGS United States Geological Survey
UST Underground storage tank (plural - USTs)
UWA Unified watershed assessment - performed by DES (1998) in response to the federal CWAP initiative to identify impaired, threatened, and pristine watersheds for water quality protection purposes
VLAP Volunteer lakes assessment program - DES citizen-based monitoring program
VOC Volatile organic compound (plural - VOCs) - a generic term that includes more than 100 compounds that vaporize at relatively low temperatures
VRAP Volunteer rivers assessment program - DES citizen-based monitoring program

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