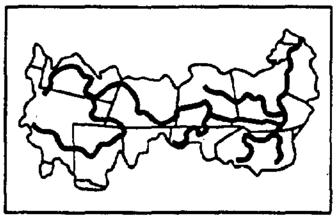
Attachment 95.6.2 - Pt. #2



Exeter/Squamscott Watershed Nonpoint Pollution Control Project

Office of State Planning
New Hampshire Coastal Program
Written in Cooperation with the Rockingham Planning Commission

December 1995

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FIGURES

APPENDICES

ABBREVIATIONS

CNPCP-Coastal Nonpoint Pollution Control Program
DES-Department of Environmental Services
JEL-Jackson Estuarine Laboratory
NHCP-New Hampshire Coastal Program
NPDES-National Pollution Discharge Elimination System
NPS-Nonpoint Sources
OSP-Office of State Planning
RCCD-Rockingham County Conservation District
RPC-Rockingham Planning Commission
WWTP-Waste Water Treatment Plant

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A valuable part of this project was working with a steering committee of representatives from watershed towns and local interest groups. The NHCP would like to thank the following for their participation and assistance with the project;

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SUMMARY

Nonpoint sources of pollution are a major cause of water quality problems in New Hampshire coastal waters. Local land use decisions have an important role in controlling these sources of pollution. The objective of this project was to focus on local efforts that address nonpoint pollution in the Exeter/Squamscott Watershed.

Involvement of representatives from communities in the watershed was a key component of the project. The New Hampshire Coastal Program worked with the Rockingham Planning Commission to form a steering committee with members from municipal boards, the county conservation district, NHDES, and other interest groups. Project activities included a review of local land uses and regulations in the watershed, a summary of existing water quality data augmented with additional site specific monitoring, and steering committee meetings to guide project development and develop recommendations.

The following conclusion were made:

- The watershed is rural in character, but land development activities and land use practices have the potential to impact water quality in the area.
- Many towns in the watershed have regulations in place that can control potential nonpoint sources of pollution. As well, there are number of regulations that towns may want to adopt or update to strengthen the effort to prevent nonpoint sources of pollution.
- Maintenance and inspection programs required by land use regulations should be evaluated and strengthened where necessary.
- Nonpoint sources of pollution are a concern in the watershed but point sources of pollution also contribute to documented problems.
- Stormwater runoff in the more urbanized part of the watershed is a major concern.
- Levels of contaminants that exceeded state standards were observed for both dry weather and storm events.
- Elevated bacteria was the most frequent water quality problem observed.
- Although generally at lower levels and with less frequency, bacteria levels that exceeded state standards were observed in the upper part of the watershed. Sites were not as pristine as originally thought.
- Bacteria levels in the lower part of the watershed relate to stormwater runoff, and possibly septic systems and agricultural runoff.

Water quality data indicated there are nonpoint pollution problems in the watershed. Sources in the upper part of the watershed may not be greatly impacting coastal waters at this time, but could be a local concern and should be addressed so larger cumulative impacts do not develop in the future. In the lower part of the watershed a number of samples exceeded state water quality standards and may be contributing to nonpoint concerns in coastal waters.

A number of local land use regulations are in place to address these potential sources of nonpoint

pollution. Still, coverage is incomplete in the watershed, required maintenance and inspection programs are not carried out on a regular basis, and some pollution sources may not be covered by the regulations due to grandfathered sites or size limits. These gaps need to be addressed in order to provide maximum protection from nonpoint pollution in the watershed.

Results were discussed with the Steering Committee and a number of recommendations were suggested for education activities, ways to improve local regulations and implementation, and future monitoring programs.

INTRODUCTION

New Hampshire has solved many water pollution problems in the past twenty years. However, pollution sources still threaten the water quality of our lakes, rivers, and coastal waters. This is evident in New Hampshire's seacoast region where 66% of the shellfish beds in Great Bay are closed due to bacterial pollution (DES, 1994). Previous attempts to control pollution focused on point sources and recent water quality studies suggest that nonpoint sources (NPS) of pollution are the major cause of current water quality problems. In attempt to address nonpoint pollution concerns in coastal NH, this project was conducted in the Exeter/Squamscott Watershed.

What are Nonpoint Sources of Pollution?

Point sources of pollution are relatively easy to identify because they come from a particular point such as a pipe. Industrial discharges and the outfall from a wastewater treatment plant are point sources. Nonpoint pollution, also referred to as polluted runoff, is generated from many scattered sources rather than a single point. It develops when water washes over lawns, parking lots, city streets, farm fields, construction sites, and picks up pollutants such as bacteria , oil, or fertilizers. Polluted runoff may travel to waterways by natural drainage or through a storm drain system.

What is the NH Coastal Nonpoint Pollution Control Program?

The New Hampshire Coastal Program (NHCP) is developing the state Coastal Nonpoint Pollution Control Program (CNPCP). The purpose of the CNPCP is to enhance state and local efforts to control nonpoint pollution that may degrade coastal water quality. For complete details of the State program see the NH Coastal Nonpoint Pollution Control Program (OSP and DES,1995).

Part of the CNPCP includes watershed projects that focus on local efforts to address NPS. A watershed is basically a drainage basin. It is the geographic area in which water, sediments, and dissolved materials drain to a common outlet. Since nonpoint sources of pollution are difficult to locate, problems in a drainage basin may go unnoticed until the cumulative impacts are seen at the downstream outlet. The whole drainage area affects the water quality of the outlet, therefore it is important to evaluate nonpoint pollution on a watershed scale.

How does the Exeter/Squamscott Watershed fit into the Coastal NPCP?

To manage effectively for water quality concerns in the coastal zone, we need to look at the tributaries that flow into the zone. In New Hampshire a large portion of the coastal zone is the Great Bay Estuary; 18 miles of the coastal zone are along the Atlantic Ocean and 132 miles are along the shoreline of the Great Bay Estuary. Great Bay and the Atlantic Ocean are the downstream drainage outlets for many tributaries. To control nonpoint pollution, the NHCP needs to evaluate how the basins that drain into the zone may affect these outlets.

The Exeter/Squamscott River is one of seven major tributaries to Great Bay. Previous studies indicate there are water quality concerns in the river that are the result of nonpoint sources of pollution (see the Water Quality section for more details). Therefore an evaluation of potential pollution sources in the watershed, and current management strategies to control these sources, was initiated to aid the CNPCP.

Local Involvement

Involvement of representatives from communities in the watershed was a key component of the project. To maximize local involvement, the NHCP worked with the Rockingham Planning Commission (RPC) to form a steering committee with members from municipal boards, the Rockingham County Conservation District, and other interest groups. The Steering Committee provided community members an opportunity to learn about the CNPCP, contribute to the development of the program, and direct specific project activities such as site selection for water quality monitoring. The NHCP benefitted by having a forum to review and refine project development and recommendations.

PROJECT OBJECTIVES

The following were the overall objectives of the project:

1.) Help the NHCP define a process to involve local governments and interest groups in the development and implementation of the Coastal Nonpoint Pollution Control Project.

2.) Demonstrate the water quality impacts of existing nonpoint sources of pollution.

3.) Work with a local steering committee to evaluate pollution sources, identify sites for water quality monitoring, and review ability of local land use controls to address nonpoint pollution.

4.) Develop recommendations, for local implementation, to manage sources of nonpoint pollution.

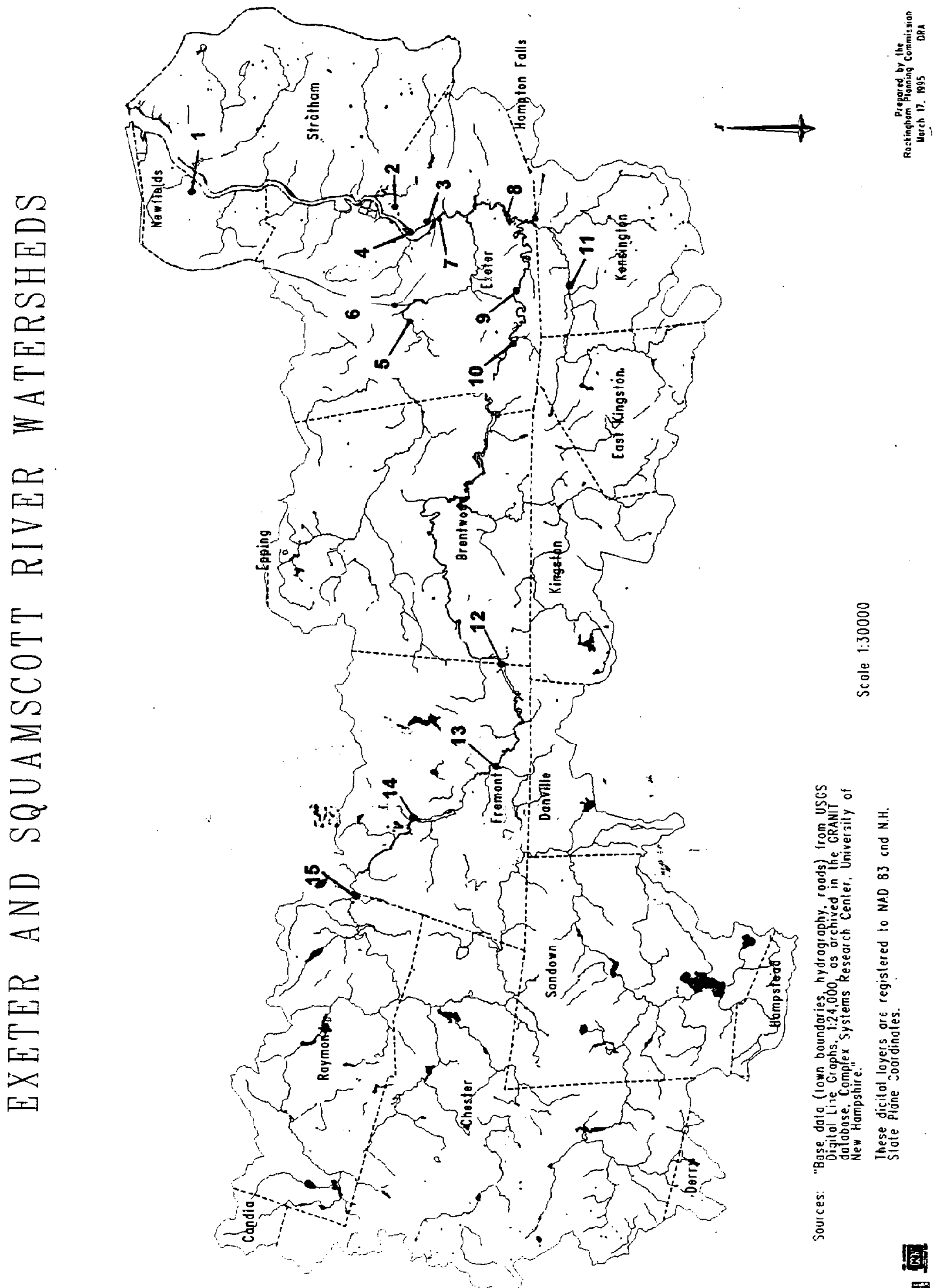
PROJECT ACTIVITIES

Project activities were divided into three major categories:

- Review of land uses and local land use regulations in the watershed.
- A review of existing water quality data augmented with additional site specific monitoring.
- Steering Committee meetings to identify sampling sites, discuss results, and develop recommendations.

The following summarizes methods and results for each major category.

Figure 1: Watershed boundaries and sample sites.



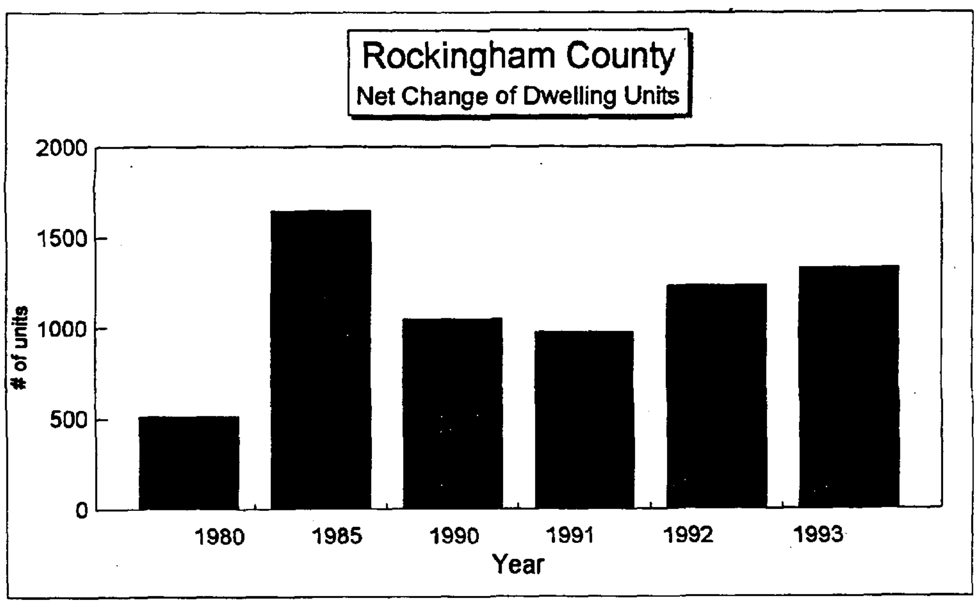
LAND USE AND LOCAL LAND USE REGULATIONS

Land Use in the Watershed

Most of the Exeter/Squamscott watershed is rural in nature. Located in southeastern New Hampshire, the watershed is approximately 127 square miles in size (1993, RPC). The drainage basin covers major portions of 12 towns in the region and minor portions of six additional towns (fig. 1-map). A major portion of the Exeter River is designated as a rural river for the N.H. Rivers Management and Protection Program. Over sixty percent of the watershed is forested and the major land uses are forestry, agriculture, and single family residences (OSP 1993). Some commercial and industrial uses are located in the upper reaches of the watershed but the main urban center is located in the lower part of the watershed in Exeter and Stratham.

Although it has a rural character, the watershed is located in one of the faster growing areas in New Hampshire. Rockingham County experienced a dramatic increase in the number of housing units built between 1980 and 1985. Numbers declined after 1985 but remained higher than the early 1980's (OSP, 1993, fig. 2).

Figure 2: Net change of dwelling units in Rockingham County, 1980-1993.



Source: Current Estimates and Trends in NH Housing Supply, Update 1993, NHOSP.

Land use activities in the watershed are potential sources of nonpoint pollution. Fertilizers and pesticides used on agricultural lands and residential areas can wash off into surface waters if applied in excessive amounts or close to water bodies. As the intensity of development in an area increases, so does the potential to generate nonpoint pollution. Stormwater runoff from urban areas often contains high concentrations of toxic metals, bacteria, and sediments (U.S. EPA, 1983). If stormwater is transported directly to surface waters, and bypasses the natural filtering capacity of soils and vegetation, it can seriously degrade water quality. Parking lots, roads, and other impervious surfaces are normal results of development. Preventing the direct transport of runoff from impervious surfaces to waterways is critical to protect water quality.

Local Land Use Regulations

In New Hampshire, municipalities have the authority to enact local land use regulations that can help reduce NPS. Requiring erosion and sediment controls during construction activities can help retain soil particles on site and lessen the chance they wash away in a rain storm and enter a local stream. Grass swales, vegetated buffer strips, and detention basins are examples of techniques that can be required to slow runoff from impervious areas and allow pollutants to filter out before water enters an important water body.

NHCP staff reviewed a list of local ordinances and regulations for their ability to address sources of nonpoint pollution. The list of municipal regulations was based on federal recommendations that define several nonpoint management measures that the state CNPCP should address. The review included the 12 towns that cover the major part of the watershed. A summary matrix of the review is located in appendix A. For categories where state regulations may apply, the matrix will be blank unless a town has referenced these state regulations or adopted a local regulation. The review was completed from January to April 1995. Additional information was added through Steering Committee meetings, review by RPC circuit riders, along with phone conversations and mailings to local planning boards for towns without representatives on the Steering Committee.

This review was an attempt to summarize key nonpoint regulations for towns in the watershed. Local regulations are continuously changing and developing and any summary has the potential to be quickly outdated. A component of the matrix may have been overlooked for a town because it is not located in a conventional section of the regulations. Still, this summary matrix provides the towns in the watershed an opportunity to examine what regulations are important for reducing nonpoint sources of pollution, how many towns in the watershed incorporate these measures in their regulations, and gaps that towns may want to focus on in the future when updating regulations.

The following summary highlights some important regulatory gaps in the watershed that towns should focus on in the future.

Soil Type Lot Size Regulations

Five towns in the watershed require soil-based lot sizes. In the 1970's the Rockingham County Conservation District developed a system for determining building lot sizes based on the land's capacity to handle the effluent from septic systems. This model has been adopted by many communities in Rockingham County and throughout the state. In early 1990's, a group called the Ad Hoc Committee for Soil-based Lot Size Regulations conducted an extensive review of the soil type lot size regulations and made revisions to make the regulations even more scientifically defensible. The result was the "Model Subdivision regulations for Soil-Based Lot Size", published in June, 1991. All communities with soil type lot size regulations should bring their local regulations into conformance with the standards set forth in the model. Adoption of this model will reduce the likelihood of nonpoint pollution from septic systems placed on inadequate soils types.

Impervious Limits

Impervious surfaces are areas that do not allow rainwater to percolate into the ground, such as rooftops, driveways, parking lots, and highways. Constructed impervious surfaces can reduce the potential for infiltration of precipitation and result in increased runoff, erosion, and greater pollutant loads to surface waters. A twenty percent impervious limit generally allows for house coverage, necessary walkways and driveways, and maintains the natural capability of a site to control NPS (pers. convs. F. Latawiec, OSP). Some advocate impervious limits of 10-15 percent to maintain the quality of sensitive or unique stream areas such as cold-water trout habitat (Schueler, 1991). Vegetated areas control nonpoint pollution by preserving the natural storage capacity and filtering ability of soils and vegetation. Nine towns in the watershed have limits on the portion of a lot that can be impervious, ranging from ten to sixty-five percent.

Excavation Regulations

All towns in the watershed have some form of excavation regulations. RSA 155-E is the state law that regulates excavations in New Hampshire. The law covers permitting procedures, buffer provisions, limits of excavation, operational standards and reclamation standards. The law applies in all communities, regardless of whether they have adopted it's provisions. Communities may adopt versions of the law with increased standards due to local situations. Model excavation regulations are available from the Rockingham Planning Commission and other regional planning agencies. Proper operation and reclamation of excavation sites will reduce the potential for erosion and other nonpoint pollution sources.

Septic Systems

Septic systems are believed to be a major source of bacteria and nutrients in surface waters. Soil-based lot size, discussed previously, reduces some NPS concerns related to septic systems. NHDES regulates the design and installation of new systems. All towns in the watershed reinforce these regulations by inspecting new systems prior to backfilling. Many towns in the watershed have stricter requirements than the state's, such as greater setback requirements from surface waters.

Septic systems require regular inspection and maintenance. No town in the watershed requires owners to inspect tanks annually. All septic tanks need periodic inspections to determine if they are functioning properly or need to be pumped. If homeowners wait until a system shows complete signs of failure, such as surface breakout of wastewater, expensive repairs are required and nonpoint sources of pollution may result. Towns should consider establishing a program focusing on education for septic system owners and creating a septic tank inspection program. Informational brochures about septic system maintenance are available from DES and Cooperative Extension Services (see appendix B).

The Steering Committee debated whether septic system concerns would best be addressed at the local or state level. One suggestion was to focus on substandard systems on a watershed basis, first targeting areas near critical water resources. Major issues that need to be addressed are identifying/locating substandard septic systems and finding ways to help homeowners finance replacement of the system. The NH Coastal Program has plans to form a working group to develop a strategy to remedy failed septic systems statewide, beginning in the coastal area with areas close to surface waters and wellhead protection areas. This group will also study options for financing the repair and replacement of failed systems.

Subdivision and Site Plan Review Regulations

Subdivision regulations apply to the subdivision of land, while site plan review regulations apply to nonresidential and multi-family development. Both types of regulations are important in the effort to provide for the proper treatment of stormwater runoff and the control of nonpoint pollution that may result as land is developed. Various versions of model subdivisions and site plan review regulations have been prepared by a variety of groups. Locally, the Rockingham Planning Commission has recently prepared model regulations for subdivision and site plan review. These models cover everything from application procedures to surety agreements. The provisions that specifically address nonpoint pollution include erosion and sediment control, stormwater management, and control of hazardous materials.

All towns in the watershed have some type of subdivision and site plan review regulations. Nine towns under site plan review and seven towns under subdivision regulations reference a publication from the Rockingham County Conservation District (RCCD) entitled, "Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas of New Hampshire". The handbook is an excellent source of information and contains model erosion and sediment control regulations. It is recommended that towns require applicants to meet the established standards in this guide. (The handbook is available from RCCD-679-2790.)

Ideally these requirements should apply to disturbances of 20,000 square feet or more, construction of roads, subdivisions of three or more building lots, and disturbance of critical areas. Five towns clearly require this under site plan review and subdivision regulations. To ensure these standards are met and implemented may require independent review by a qualified consultant, on-site inspections, and performance bonding. A number of towns in the watershed already carry out some of these activities. Those needing assistance in establishing these regulations should consult the regional planning commission.

Critical Water Resource Areas: wetlands, shoreland, floodplains, aquifers, wellhead areas
The Office of State Planning supports an integrated approach to planning and zoning for management and protection of critical water resources including shorelands, floodplains, aquifers, wetlands and wellhead areas. A technical bulletin prepared by OSP (see appendix C) lists a number of provisions to prevent nonpoint pollution that could be included in a water resources protection district such as a wetlands conservation district. Every town in the watershed has either a wetland, shoreland, or aquifer district. Six towns include regulations for all three resource areas and come close to addressing all the nonpoint provisions outlined. Other towns should consider augmenting their existing regulations in place, or adopting a model ordinance to protect critical water resource areas.

Maintenance and Inspection
An informal set of questions was discussed with municipal officials, planning commission circuit riders, and steering committee members, regarding maintenance and inspection programs. The objective was to determine how towns ensure standards and maintenance practices required in regulations are carried out. Do they have inspections during construction to ensure erosion and sediment controls are in place and functioning? Are stormwater structures such as catch basins inspected and cleaned on a regular basis? The conclusion was that many towns are limited by a lack of people and dollar resources and maintenance and inspection are not happening on a regular basis. The town of Raymond promotes cross training of town employees to develop a greater pool of people to cover inspections. Towns may also want to review a bonding system to assure that maintenance and inpsections are carried out.

For towns that want to pursue any gaps in their regulations in regard to NPS control, the following references are helpful for additional information on NPS and techniques to prevent it:

- **A Guide to Controlling Nonpoint Pollution through Municipal Programs. Technical bulletin #11, N.H. Office of State Planning, 1995.**

  This technical bulletin focuses on nonpoint sources of special concern to coastal waters. It provides guidance on improving the effectiveness of local ordinances and regulations and other municipal programs. This guide is included in appendix C.

- **Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials. NHDES-WSPCD-94-2.**

  This guide describes what causes NPS and best management practices (BMPs) to prevent it.

- **Local Land Use Management Techniques for Water Resource Protection and**

Geographic Inventory Procedures. NHOSP, 1992.

Explains municipal regulatory and non-regulatory measures that can be use to protect water resources.

CONCLUSIONS DRAWN FROM THE LAND USE AND REGULATORY REVIEW

- The watershed is rural in character, but land development activities and land use practices have the potential to impact water quality in the area.
- Many towns in the watershed have regulations in place that can control potential nonpoint sources of pollution. As well, there are number of regulations that towns may want to adopt or update to strengthen the effort to prevent nonpoint sources of pollution.
- Maintenance and inspection programs required by land use regulations should be evaluated and strengthened where necessary.

WATER QUALITY INFORMATION

The following sources of water quality data were reviewed to assess existing sources of nonpoint pollution in the watershed and aid in developing a site-specific monitoring program:

Point Sources

Information available for wastewater treatment plants (WWTP) and other point discharges in the watershed were reviewed to assess their impact as possible pollution sources. Most studies suggest recent reductions in point sources of pollution in NH leave nonpoint sources as the leading cause of water quality problems. Point sources were evaluated to assess whether this theory holds in the study area.

There are five NPDES permit holders in the watershed. The National Pollution and Discharge Elimination System (NPDES) is a permit process established to track large-scale discharges to surface waters. The system covers discharges from municipal WWTP and industrial operations. Dischargers are classified as major or minor. Four of the dischargers are minor and one is major.

All of the permits were reviewed with the NHDES environmental inspector in charge of the records. Two of the minor permits are for non-contact cooling water. These permits require testing discharges for temperature, pH , and flow and these sites have not displayed any water quality concerns. The other minor permit holders are for wastewater treatment systems for the town of Newfields and the County Complex in Brentwood. Newfields WWTP consistently met its required bacteria discharge level, but had an infrequent, seasonal, total suspended solids violation due to algal blooms in the lagoon system. The County Complex in Brentwood had no recent water quality violations.

The major discharge permit in the watershed is for the WWTP for the town of Exeter. They have a permit limit for bacteria of 70 total coliform/100ml. In 1994, ten bacterial violations were recorded. Adjustments were made at the plant and bacterial violations ceased. The plant also was cited for occasional total suspended solids violations. NHDES feels this is due to a seasonal buildup of algae in the lagoon system at the plant.

Previously Exeter held a permit for the storm water holding pond located near the Exeter Mill Apartment Complex. The town completed a storm and sewer separation project in 1992 and requested that the State eliminate the requirement for a NPDES permit for the holding pond. The Town has not been testing the water quality at the holding pond since that time. The pond occasionally receives combined sewer overflow during heavy storm events. In April 1995, the town of Exeter researched upgrading a pump station to reduce the chance of sanitary sewer overflow into the stormwater holding pond. The town was recently issued a new NPDES permit that requires water quality testing at the holding pond again, starting in October 1995. (personal communications with Mike Ma[illegible]n, Exeter Water and Sewer Superintendent).

Rockingham Planning Commission
A pollution source identification report produced by the Rockingham Planning Commission (RPC, 1992, 1993), was reviewed. For this project, RPC identified and mapped a number of pollution threats in Rockingham County. A variety of threats were identified, but two sources in particular were recommended for further review: temporary salt piles and stormwater runoff. A list of potential threats in the watershed was consulted when sites for further monitoring were selected.

Great Bay Watch
Great Bay Watch is a volunteer water quality monitoring group sponsored by Sea Grant Extension at the University of New Hampshire. In 1994, volunteers began sampling the Squamscott River at the Exeter town dock. The site was sampled twice a month from April to November at both high and low tide. Fecal coliform bacteria counts were consistently high for both high (mean= 122.4) and low tide (mean= 184.5).

NH Department of Environmental Services
The most recent studies conducted by New Hampshire Department of Environmental Services (NHDES) indicate there are water quality concerns in the Exeter/Squamscott Watershed:

- In 1991 a sanitary survey of the Squamscott River was completed (NHDES-WSPCD-92-10). Samples were collected and tested for bacteria at sites between the Franklin Street crossing on the Exeter River and the mouth of the Squamscott River. High bacteria levels were found and evidence indicated they were not due to the wastewater treatment plants on the river but seemed to originate upstream of the tidal dam. The study recommended further investigations be targeted at the Exeter and Little rivers.

- A 1992 report (NHDES-WSPCD-92-14) listed one mile of the Exeter River as not supporting its designated use due to bacterial violations.

- According to the 1994 water quality Report to Congress prepared by NHDES, 1.2 miles of the Squamscott River did not meet class B standards due to bacterial violations. (See page 16 for class B definition).

- DES conducts monthly (as long as surface waters are not frozen), testing for E. coli levels at a number of sites throughout the seacoast area. One sample site is at Great Brook, a tributary to the Exeter River. Results were recently obtained for five samples collected between July, 1994 and May 1995. Bacteria levels were variable but relatively high and the geometric mean of these sample exceeds the state limits (geomean= 228, n=5, whereas the state standard is not greater than 126 E. coli/100 ml).

DES also concludes that most point sources are meeting water quality standards and the remaining water quality problems are primarily due to nonpoint sources. DES listed the Piscataqua River watershed as top priority for future water quality protection efforts. The Exeter/Squamscott watershed is a sub-basin of the Piscataqua River.

Jackson Estuarine Laboratory

Jackson Estuarine Laboratory (JEL) at the University of New Hampshire recently published two reports that include water quality data for part of the Exeter/Squamscott watershed. One report is the result of a two year coordinated sampling effort in the Great Bay and associated tributaries as part of the N.H. Coastal Nonpoint Pollution Control Program (CNPCP). Three sample sites are located in the Exeter/Squamscott River: 1.) the mouth of the Squamscott River at the railroad crossing between Newfields and Stratham; 2.) the Route 108 bridge crossing of the Exeter River in downtown Exeter; and 3.) the Pickpocket Dam on the Exeter/Brentwood town line.

The following conclusions were reached;

- Bacterial contaminants from terrestrial and freshwater sources appear to be major contributions to tidal water contamination.
- For the Exeter/Squamscott tributary, high nutrient levels at the mouth of the Squamscott are due to point and nonpoint sources in the tidal portion of the river and not from sources in the Exeter River. (This conclusion was not known at the time preliminary results were presented to the Steering Committee)
- For bacterial contaminants, the freshwater sources are a significant contribution.
- Bacteria levels were significantly higher after rain events. Nutrient levels were

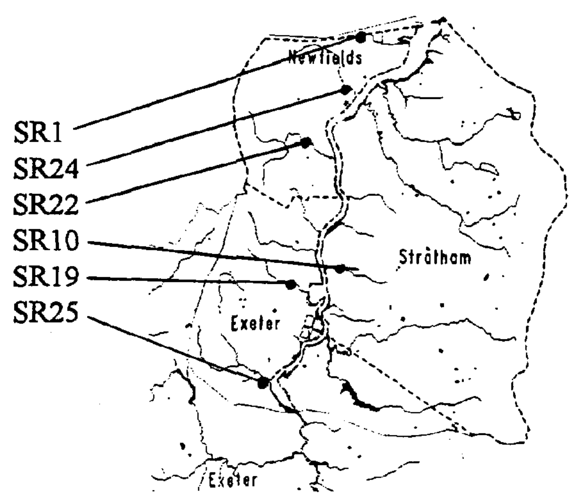
not significantly higher following rain events. (Higher nitrate levels were observed following rain events but not statistically significant possibly due to the small data base and variability.)

- Levels at Pickpocket Dam were much lower than downtown Exeter and did not violate state standards for swimming (for State standards see page 16). This suggests stormwater runoff in the more urbanized section of the watershed is a major source of bacterial contamination.

The second study conducted by JEL (Jones and Langan, 1995) focused on the Squamscott River with the objective of developing strategies for assessing nonpoint pollution impacts. This included sampling in the Exeter river and preliminary data was presented to the Steering Committee in March to help focus additional monitoring efforts. The final report concluded the Exeter River and tributaries near Exeter are a source of bacteria to the tidal river. Loading estimates for bacteria and nutrients were calculated for most of the tributaries to the Squamscott River. The following sites were listed as having the largest potential to negatively impact river water quality:

SR25-bacteria & nutrients-Norris Brook, mouth-downtown Exeter
SR24-bacteria and ammonium-Cobby Brook, Newfields
SR22-phosphate-Parting Brook, Rte. 85 crossing, Newfields
SR1-nitrate and phosphate-(stream in Newfields near Golf course)
SR19-ammonium-Rocky Hill Brook, Rte 85 crossing, Exeter
SR10 -bacteria- stream crossing, Middle Road , Stratham.

Figure 3: Sites identified by JEL with potential to negativley impact the Squamscott River.



Bacteria levels at these sites frequently exceeded state standards. (See appendix D for a data table of values and page 16 for state standards.)

WHAT DOES THE BACKGROUND WATER QUALITY INFORMATION TELL US?

- Nonpoint sources of pollution are a concern in the watershed but point sources of pollution also contribute to documented problems.
- Bacteria and nutrients are water quality concerns in the watershed.
- Data above Pickpocket Dam is limited, but historic data indicate water flowing over the dam generally does violate state water quality standards.
- Stormwater runoff in the more urbanized part of the watershed is a major concern.

Site Specific Sampling

Available water quality data for the watershed was summarized and presented to the Steering Committee to help focus further monitoring. The Committee discussed what parameters to focus on and the number of samples that could be collected within the budget available. Due to the lack of data above Pickpocket Dam in Exeter, it was decided sites in the upper watershed would be valuable to include for baseline data. The Committee chose fifteen sample sites, five in the upper part of the watershed and ten in the more urban part of the lower watershed. Sample sites included outlets from storm drains, drainage swales, detention basins, along with stream sites in the main branch and tributaries of the Exeter River that flowed through agricultural and residential sections of the watershed. Since stormwater runoff was documented to negatively impact the water quality in the watershed, sampling focused on storm events. Due to time constraints and sampling logistics, a combination of storm events and dry weather samples were collected.

Sample Collection and Analyses

Samples were grab samples collected in polyethylene bottles that are acid-washed and prepared at NHDES and Jackson Lab at UNH. Bottles used for nutrient and metal analyses contained an acid preservative. For smaller streams and accessible storm drains, a sample was collected directly into the sample bottle. A clean bucket, rinsed twice with local water before collecting a sample, was used to collect from sites difficult to access, such as the outlet for the Exeter stormwater holding pond.

All samples were held on ice and transported to the appropriate lab for analysis. Nutrients, metals and bacteria tests were conducted at DES, Total suspended solids and percent organic matter at JEL. Field instruments were used to measure pH, dissolved oxygen, conductivity, and temperature. Results were recorded on field data sheets.

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note: Technically, E. coli results should be less than fecal coliform since it is a subset of this group. DES uses different techniques to analyze for the two indicators (i.e.-incubation times, culture media) and at times E. coli counts are higher than fecal coliform for the same sample. DES feels the E. coli technique is more accurate and when this indicates higher numbers than the fecal coliform test, the higher number is probably more accurate.

Temperature, Conductivity, Dissolved Oxygen and pH
These are the parameters that are measured in the field. Extreme values can be quick indicators of pollution problems.

Temperature-Runoff from paved areas can increase stream temperatures. Temperature can affect other water quality characteristics such as dissolved oxygen. The state standard is "no increase that would appreciably interfere with the designated uses".
Specific Conductivity is a measure of the ability of water to conduct an electric current and is an indicator of the dissolved ionic matter present in water. High conductivity measurements may indicate pollution sources such as salt or nutrients from runoff. The unit of measure is micromhos (μmhos). There is no state standard for conductivity but most clean surface waters of New England have very low conductivity levels (Spang, 1988).
Dissolved Oxygen-Dissolved oxygen (DO) in water is required to support aquatic life. Stormwater runoff with high levels of organic matter can consume oxygen as it decays. The state standard is not less than 75% saturation or generally not less than 6.0 mg/L. Low DO is stressful to aquatic life.
pH- This is a measure of the acidity of water. The pH scale ranges from 1 to 14, seven being neutral with values below this indicating increasingly acidic conditions and values above indicating more basic conditions. Extreme values or changes may indicate biological activity or pollution sources. The state standard for class B waters is 6.5 to 8.0 or as naturally occurs.

Total Suspended Solids (TSS)- This is a measure of fine materials suspended in the water column. High levels of suspended sediments can reduce light penetration and may have attached nutrients and other adsorbed pollutants that affect stream life. High levels may indicate erosion or runoff problems. An average value for unpolluted surface waters in the Northeast is 10 mg/L.

Percent Organic Matter (% Org)-is the percentage of the TSS that is organic matter. In general, percent organic matter may be high but the overall amount of TSS is low. High TSS levels that are mostly organic matter (therefore the % organic matter is high), may indicate excess nutrient sources are stimulating algal growth.

Nutrients
Phosphorus and nitrogen are important plant and animal nutrients and generally found at very low concentrations in streams. Nutrients may enter streams from leaking septic systems, runoff from agricultural areas or fertilized lawns, or via sediments from eroding areas. Increased nutrient levels can stimulate algal production and are toxic to aquatic life at very high levels.

The state standard for phosphorus is "no phosphorus in such concentrations that would impair any usage assigned to the specific class involved, unless naturally occurring". Naturally occurring levels of phosphorous in NH rivers are generally less than .035mg/L (NHDES, 1993). The state standard for nitrate is not to exceed 10 mg/L, based on protection of human health. In general unpolluted, well oxygenated surface water concentrations are less than 1 mg/L (Goldman and Horne, 1983). USEPA also sets the drinking water standard at 10mg/L.
The state standard for ammonia in freshwater is 29 mg/L, based on acute toxicity for aquatic life. Levels for unpolluted surface waters are generally less than 0.1 mg/L (Goldman and Horne, 1983)

Metals
Metals are a concern because they are commonly contained in urban runoff. The Nationwide Urban Runoff Program (EPA 1983) found elevated levels of Cu, Pb, Zn in at least 91% of the sample collected. Metals may be toxic to aquatic life and have the potential to bioaccumulate in the food chain.
The state uses the following USEPA acute toxicity standards designed to protect aquatic organisms. (DES and EPA are reviewing metals standards.)

Aluminum (Al)	0.75 mg/L
Copper (Cu)	0.0048 mg/L
Zinc (Zn)	0.036 mg/L
Cadmium (Cd)	0.0082 mg/L

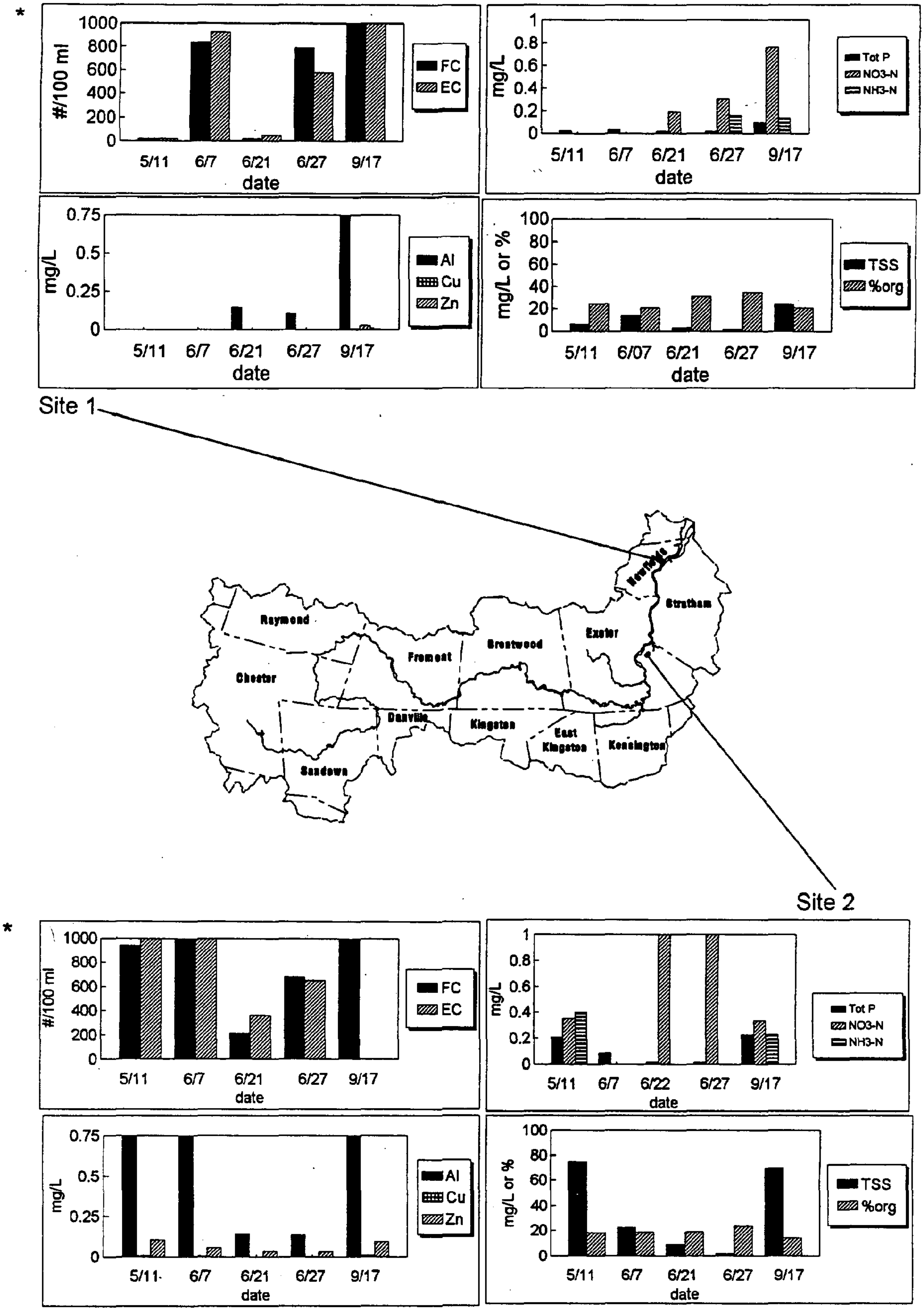
SAMPLING RESULTS

Samples were collected on five separate dates. The first two sample dates were during or shortly after a rain storm. On 5/11/95 a rainstorm began in the evening. Three samples were collected within the first hour of the storm at sites 2,7, and 9. The remaining samples were collected the next day. A total of .44 inches of rain was recorded at the Durham observation station and .93 inches in Greenland. (This demonstrates the variability in the amount of rainfall in the watershed and observation locations only give a relative indication of rainfall for the sample sites.) For the second storm sample (6/7/95), .30 inches of rain were recorded at Durham and .38 inches in Greenland. Sampling began within the first hour of the beginning of the storm. By the time samples were collected in the upper part of the watershed (sites 11-15), the rain was very light or had ended. A dry event was sample on 6/21/95. No rain was recorded for four days prior to this date. Another dry event was sampled on 6/27/95. Scattered thunderstorms occurred two days before on 6/25/95. A total of .60 inches of rain was recorded in Durham but no measurable rainfall was recorded in Greenland. Possible effects of this storm on the sample date are discussed with site descriptions that follow. A significant storm event was sampled at 10 sites on 9/17/95. 1.15 inches of rain were recorded in Durham and Greenland.

Reading the Graphs
A few things should be kept in mind when reviewing the following graphs. Results for bacteria, nutrients, metals, and total suspended solids were graphed for each sample site. A complete database for all parameters measured is in appendix E. Graph scales were kept consistent to allow for relative comparison between sites. Therefore data bars that reached the top of the graph may indicates values higher than shown and appendix D should be referenced for exact values. Only parameters that were detected were graphed. This accounts for some of the variablity between graph legends. If a parameter is listed in the legend but not visible on the graph, it may be due to a low value that is not visible with the scale utilized.

Sample Sites
Site 1-Cobby Brook, Route 85, Newfields-sampled downstream side of road.
This site was selected for concerns about development in the area.
Temperature, pH, and dissolved oxygen all follow normal trends at this site. Percent saturation levels for dissolved oxygen were low for the 6/27/95 sample date and just under the 6.0 mg/L state standard. Many sample sites had a decline in DO levels for this date and may relate to low stream flow at this time of the year and did not seem to be related to storm events. Conductivity ranged from 280-365 umhos. Nutrient levels were within the range of clean running waters, except total phosphorus for the last storm date (.102 mg/L). The only metal detected for four of the five sample dates was aluminum. After the one inch rainfall, Al, Cu, and Zn were all detected. Al and Cu exceeded state limits for this date. TSS level were normal for most samples, but slightly elevated after the heaviest rain event (9/17/95, 24 mg/L). Bacteria levels were variable but well over 500/100ml for E. coli and Fecal coliform for three sample dates. The geomean for all five sample dates also exceeds the state limit (E. coli, 255cts/100ml).

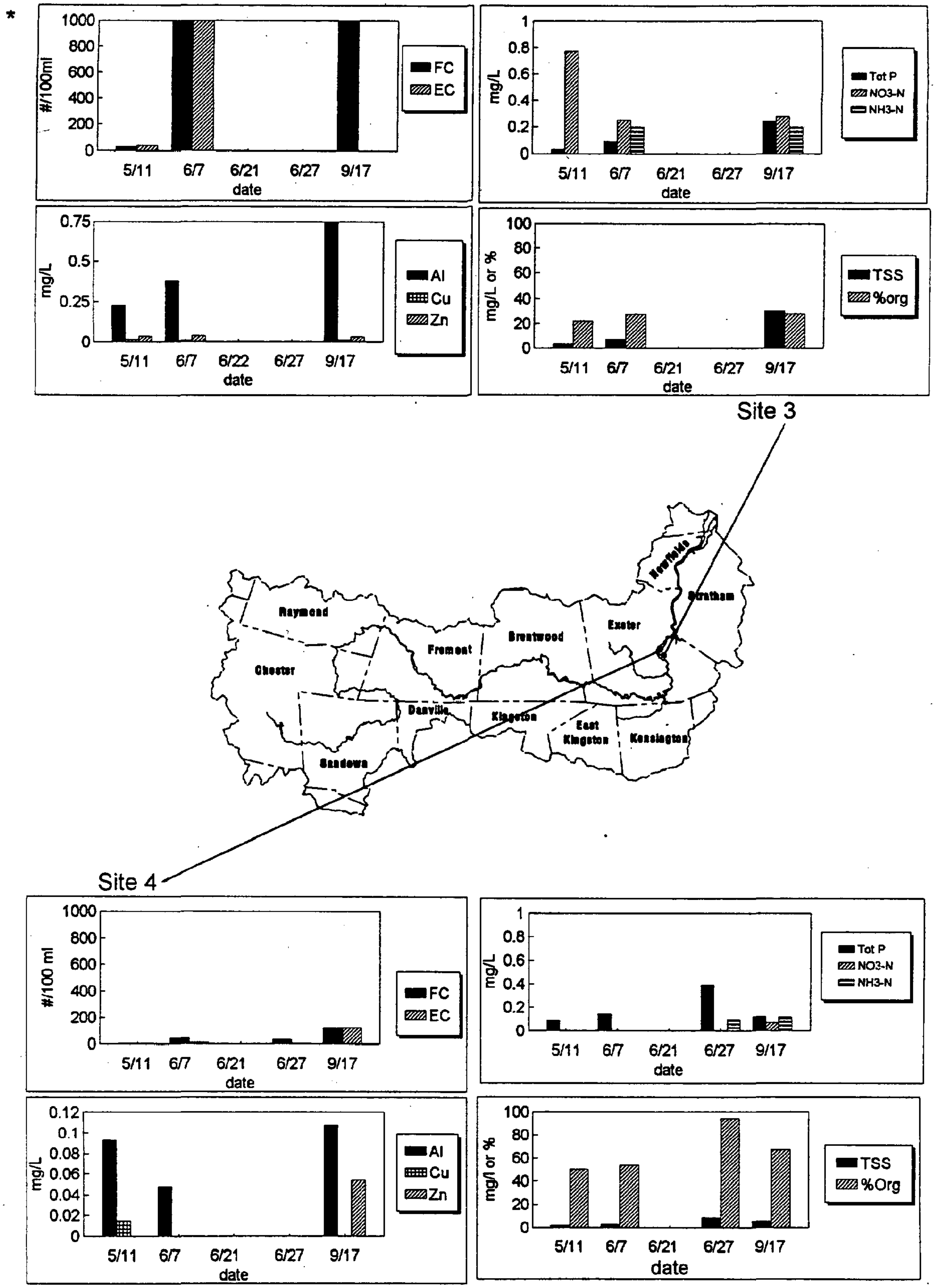
Site 2-Wheelwright Creek, Exeter-access from Jady Hill, sampled south side of road. Wheelwright Creek receives stormwater runoff from a number of businesses located on Portsmouth Avenue in Exeter. Bacteria levels were consistently over the state standard. Bacteria levels were higher on storm dates than dry dates. Total phosphorous levels were elevated on storm sample days whereas nitrate levels were elevated for two dry days. This combination of high bacteria and nutrients, during both storm and dry events, could be the result of stormwater runoff and septic systems influences. One side of the creek is bordered by single family residences. This area is within the sewer district but all homes may not be hooked up to the system. TSS levels were elevated for storm sample dates, especially on 5/11/95 and 9/17/95. Aluminum, zinc, and copper levels exceeded state limits for storm samples. Conductivity levels ranged from 89-700 umhos. All other parameters followed normal trends.



* data bars that reach top of graph indicate values higher than shown-see data table for exact values

Site 3-Exeter Mill Apartment Complex, Exeter-sampled storm drain that discharges into the Squamscott River.
Samples were collected at the storm drain outlet and therefore only collected on storm dates. Bacteria levels exceeded state standards on 6/7 and 9/17. Copper levels were also exceeded on three dates. Nutrient levels were generally within acceptable ranges, except Total Phosphorus levels on 6/7/95 (.089 mg/L) and 9/17/95 (.241 mg/L) were more indicative of an urban impacted area.

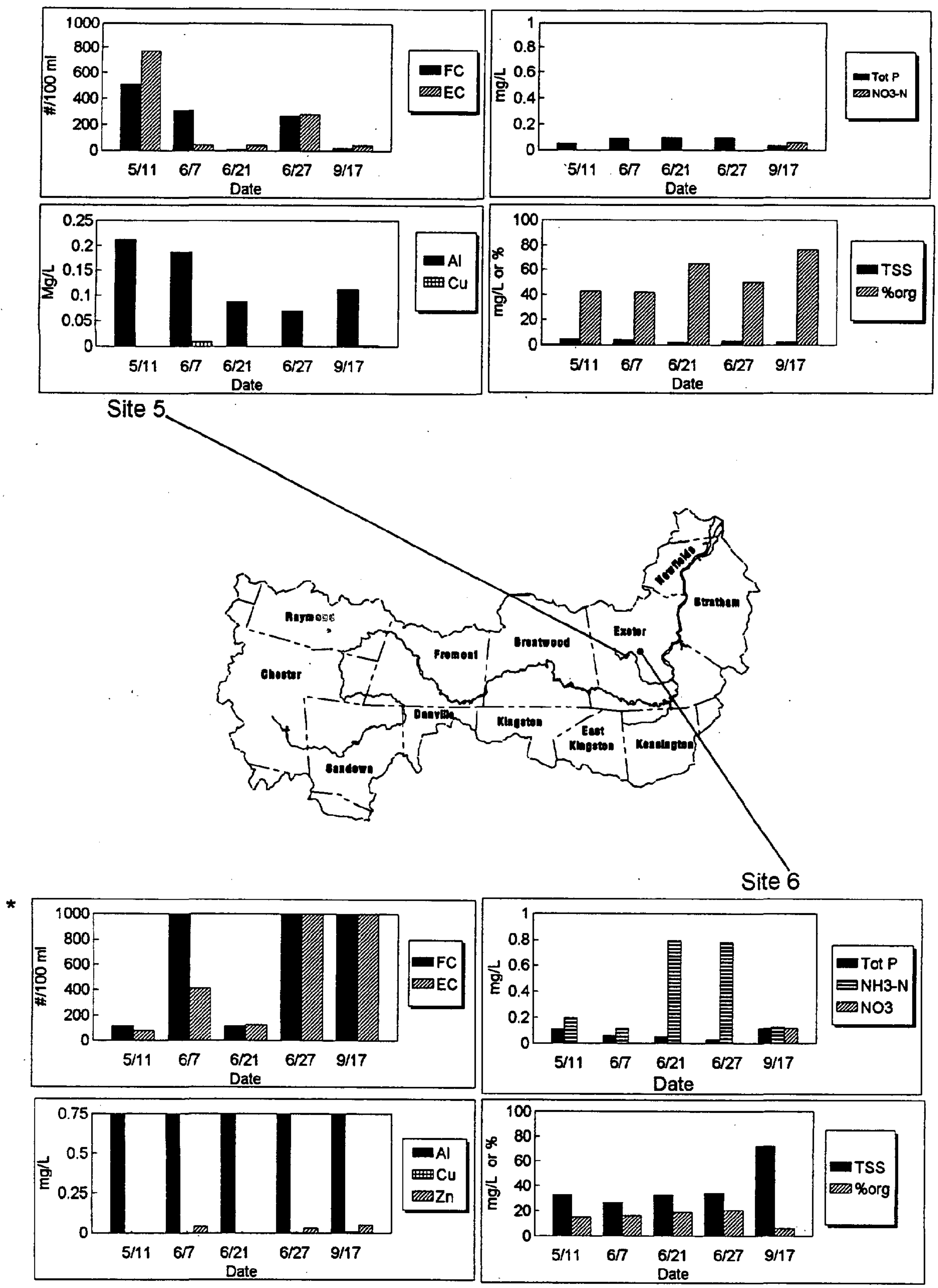
Site 4-Exeter Stormwater Holding Pond, Exeter-sampled at outflow into Squamscott River. This site was sampled due to concerns about combined sewer overflows influencing the holding pond discharge. This site was more characteristic of a pond than running water. DO levels were some of the lowest sampled, ranging from 4 to 8.6 mg/L. Total phosphorous levels were high (.094-.39 mg/L) and probably contribute to the high algal growth in the pond. But the pond discharges to tidal waters where phosphorous is not a limiting factor and therefore is not as great a concern as in freshwater sites. Bacteria and other nutrient levels were low for most sample dates, perhaps an indicator the wetland/holding pond was removing most of these constituents from the water column. Bacteria levels were elevated for the last sample date (rainfall recorded at Durham = 1.15 inches). E. coli levels were below state standards (120 cts/100mls), but for fecal coliform levels exceeded state standards (120 cts/100mls).



* data bars that reach top of graph indicate values higher than shown-see the data table for exact values

Site 5-Little River, Garrison Lane crossing, Exeter-sampled upstream side of bridge.
This site was chosen to determine if the watershed above this point was impacted by nonpoint sources of pollution. Bacteria levels were variable but exceeded state standards at times. E. coli levels exceeded the state limit for a one-time sample on 5/11/95 (770cts/100mls) and were high on 6/27/95 (280cts/100ml). The geometric mean for all five sample dates was within state limits (107cts/100ml). Total phosphorous levels ranged from .052-.096; more characteristic of agriculturally impacted waters than clean surface waters. All other parameters followed normal trends.

Site 6-Epping Road, Exeter, Trucking station detention pond outflow-access from Allard St.
This site was selected due to concerns about visible water quality changes in the stream receiving the discharge from the trucking station detention pond. The rust color precipitate in the water is characteristic of iron bacteria found naturally in many soils and waters. For further explanation of iron bacteria in surface waters see the DES Fact Sheet in appendix G. Iron bacteria are not a human health threat, but do present aesthetic problems. Other concerns at this site were high bacteria levels and TSS. These did not consistently relate to storm events. Bacteria violations occurred on two storm dates (6/7/95, E. coli 1410cts/100 ml, 9/17/95 E. coli >2000 cts/100mls). Levels were also high on 6/27/95 (E. coli 1400 cts/100 ml). This date was dry but levels may be the result of rain that occurred on 6/25/95 (.6 inches of rain- measured in Durham). The detention pond is tied into the channelization of the stream that took place when the site upstream was developed. This would explain why flow is observed during dry weather. TSS levels were high, ranging from 27-72 mg/L Flow rates at this site are relatively low, so overall impacts of the discharge may not be significant.



* data bars that reach top of graph indicate values higher than shown-see data table for exact values

Site 7- Storm drain outflow to the Exeter River, Long Block, Exeter.
This site drains a number of catch basins from a down town section of Exeter. A storm sample within the first hour of the beginning of the storm was collected on 5/11/95. This sample had elevated levels of sediments, total phosphorous, and metals. A visible plume of sediments was evident on this date. Aluminum and zinc were above state standards for acute toxicity. For other sample dates, parameters concentrations were variable. Pollutants may be quickly delivered and flushed at this site. That would explain elevated levels when this "first flush" was captured on 5/11/95. Subsequent samples were collected as at different storm stages. Bacteria levels were higher for storm events, especially after the last storm sample on 9/17/95.

Site 8- Exeter River-sampled at end of Lary Lane, Exeter.
This site is on the main branch of the Exeter River. Temperature, pH, DO, and conductivity followed normal trends at this site. DO levels were at 40 percent saturation for the 6/27/95 sample date. Again this may be a normal seasonal depression for the river under low flow conditions. The river is very slow moving at Lary Lane and water levels were low by the end of July. Total phosphorous levels were acceptable but on the high end of the range (.026-.04 mg/L). Bacteria levels were elevated on three sample dates but the geometric mean fell below the limit at 114 cts/100mls.

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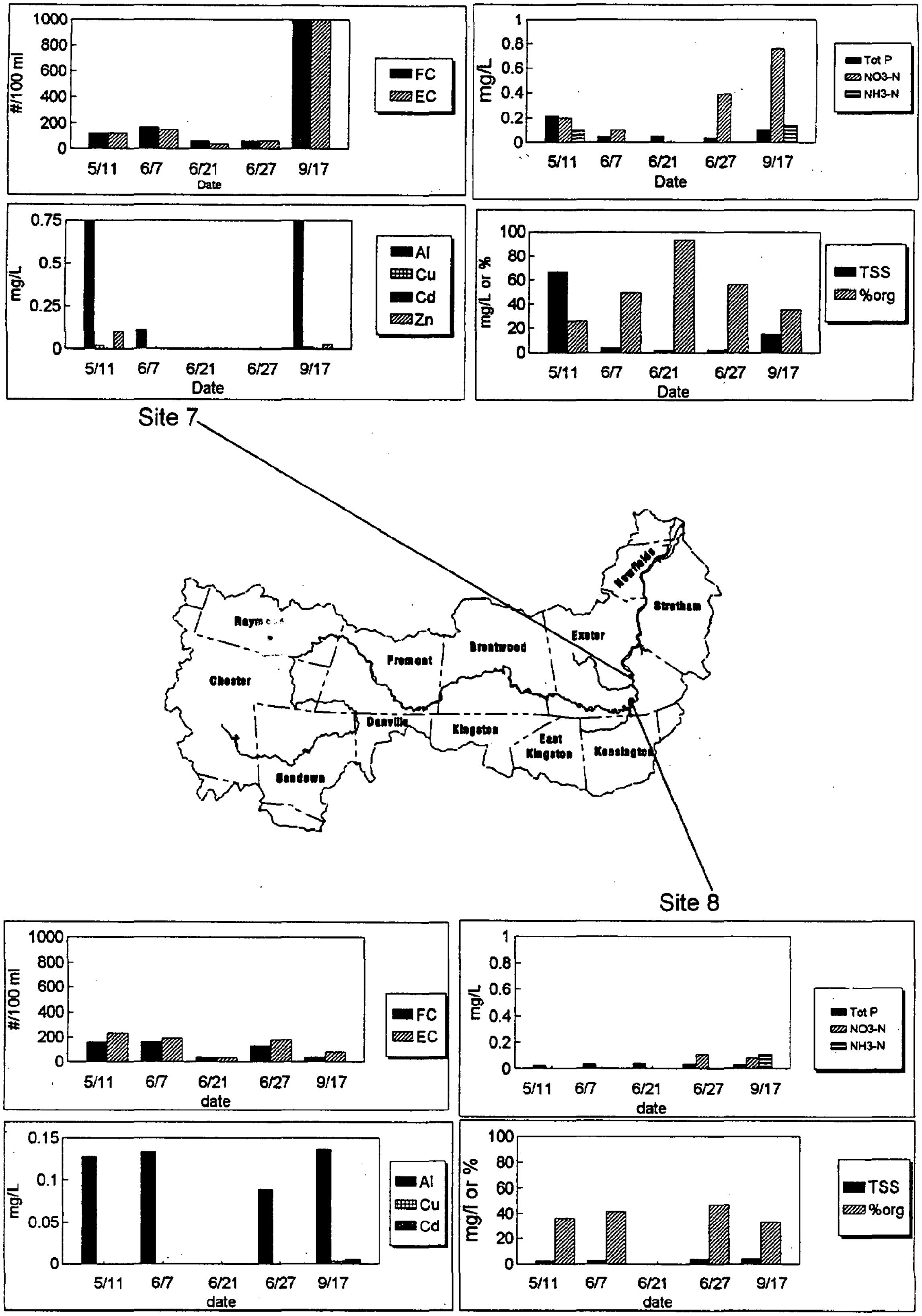
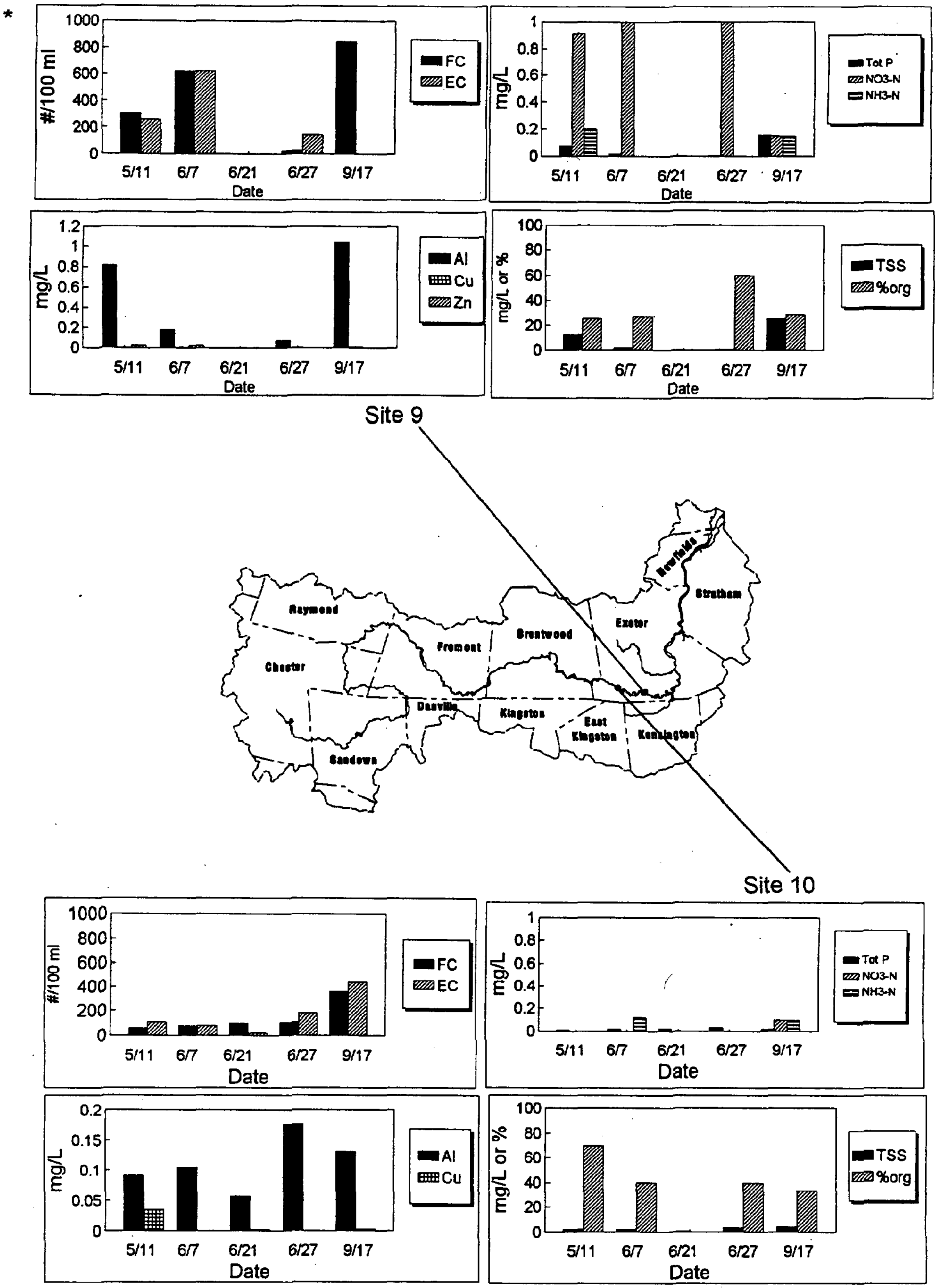


* data bars that reach top of graph indicate values higher than shown-see data table for exact values

Site 9-Storm drain outflow to the Exeter River from Linden St.-sampled at pipe, north side of river, bridge crossing near Sherwood Forest mobile home park.
This sample was collected at a drain outlet discharging into the Exeter River. The drain collects runoff from Linden Street. Temperatures at this site were lower than most other sites (10-15.7C). Discharge was also collected on a dry date. This indicates the drain may be more than just stormwater runoff from the street. Nitrate levels were high, especially on 6/27/95 (2.14 mg/L). Total phosphorus was higher on the dates with greater rainfall (5/11/95 and 9/17/95). Bacteria levels were higher for storm samples.

Site 10-Exeter River, bridge crossing at Route 111 and Powder Mill Road intersection-sampled downstream of bridge.
This site was sampled due to concerns about erosion resulting from DOT road maintenance near the Exeter River. Sediment bars are present in the stream due to destabilization of the vegetation in the area. Parameters tested did not consistently show elevated levels as a result of the erosion, although bacteria levels were high after the larger rainfall event sampled on 9/17/95. Sediment bars in the stream degrade the stream habitat, can smother nesting areas for fish and other aquatic life, and if not stabilized may generate additional nonpoint sources of pollution. This site is clearly marked as a drinking water source. Road maintenance practices at the local and state level need to be improved in order to prevent streamside erosion problems and subsequent introduction of nonpoint pollutants. Bacteria levels exceeded the state standard for a single sample after the rain event sampled on 9/17/95 (E. coli, 440 cts/100 mls).



* data bars that reach top of graph indicate values higher than shown-see the data table for exact values

Site 11-Great Brook, Kensington-sampled at Route 108 culvert, sampled upstream side of road. Bacteria and nutrient levels were elevated at this site. Bacteria levels were the highest of all the sites tested and exceeded state limits (E. coli , 400-9800 cts/100ml). Total phosphorous and ammonia were in the range for urban or agriculturally impacted surface waters. Aluminum and copper were detected but at levels below the limit for acute toxicity.

Site 12- Exeter River Impoundment at Brentwood/Fremont town line, Route 107-sampled upstream side of bridge.
No evidence of NPS impacts were observed at this site. Temperatures were slightly elevated compared to other locations, but would be expected due to the impoundment. The impoundment may also reduce bacteria levels from upstream sources. Impoundments in other areas have reduced bacteria levels by slowing the water and allowing sediments and bacteria to settle out.

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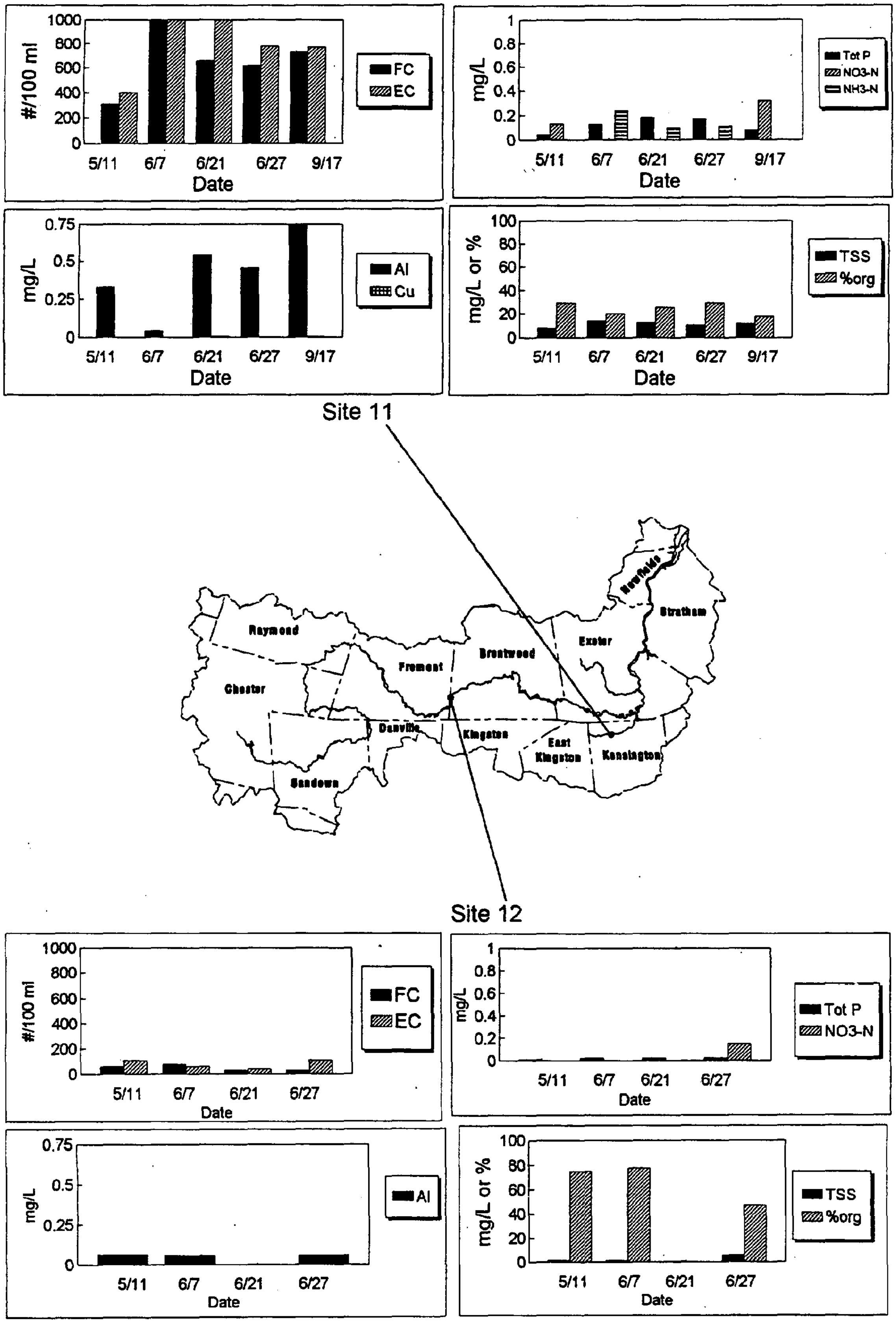
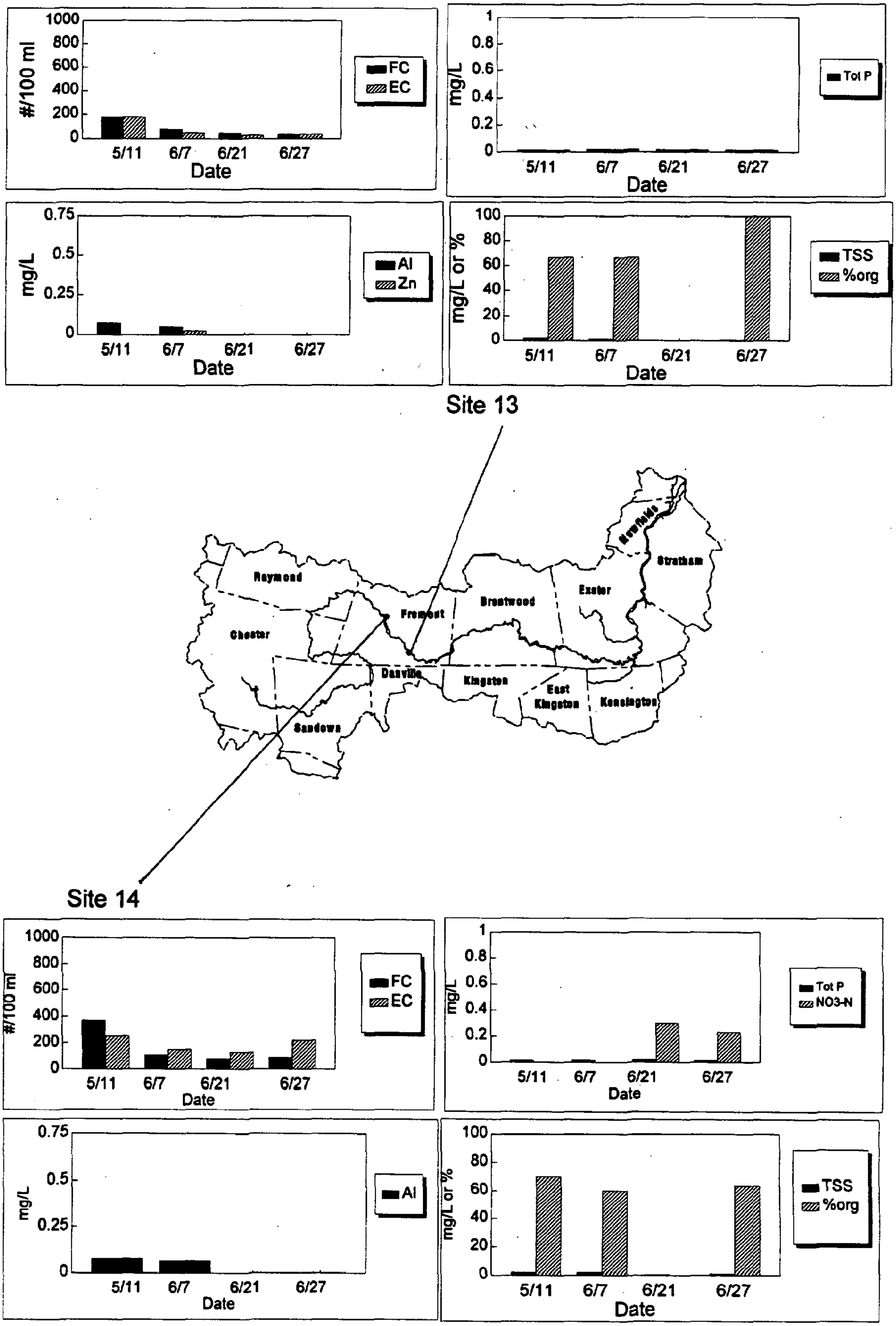


* data bars that reach top of graph indicate values higher than shown-see data table for exact values

Site 13-Exeter River, junction of Redbrook Road and Route 111a, Fremont-sampled just downstream from Exeter River Campground.
Parameters at this site were mostly indicative of clean surface waters. Bacteria levels on the first storm date were moderately high (E. coli, 180 cts/100 ml) but the geomean for both sample dates was below state standards (94 cts/100ml). On dry dates bacteria levels were well below state limits (E. coli, 30-40 cts/100ml). More storm samples during heavy storms may be required before concluding there is no storm related bacteria inputs to the river at this site.

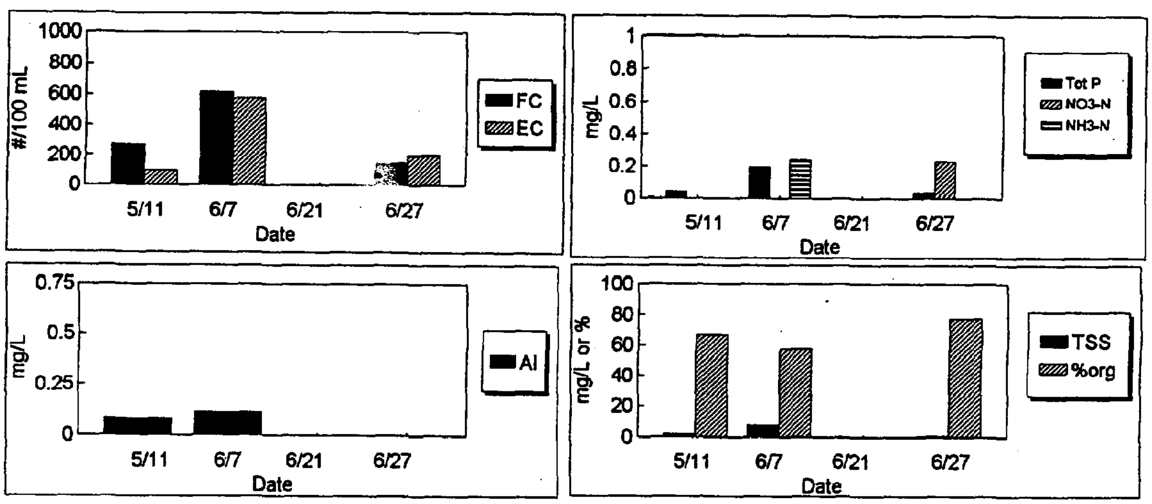
Site 14-Exeter River, downtown Fremont-sampled where Route 107 meets the river, south of downtown Fremont.
Bacteria levels were somewhat elevated at this site for both storm samples and dry samples. E. coli ranged from 130 to 250 cts/100ml, with a geometric mean of 180 cts/100ml. This is slightly over the state limit 126 cts/100ml. All other parameters were within acceptable ranges.

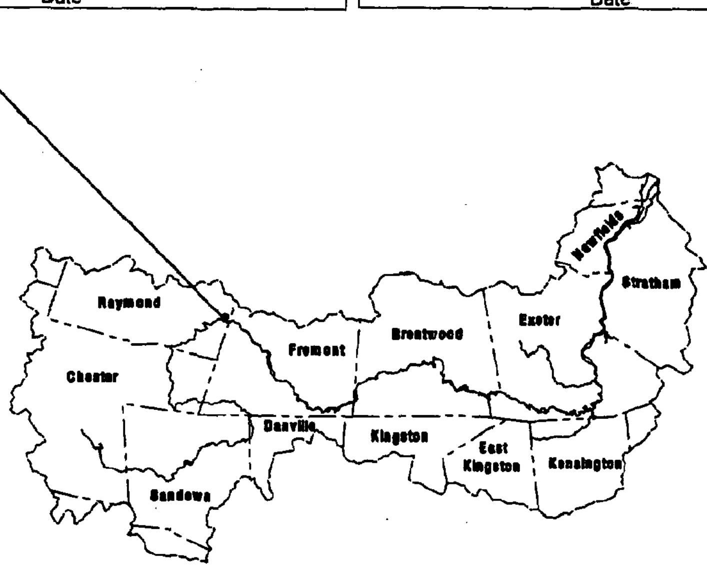


#/100 ml
1000
800
600
400
200
0
5/11
6/7
6/21
6/27
Date
FC
EC
mg/L
Tot P
mg/L
Al
Zn
mg/L or %
TSS
%org
Site 13
Raymond
Chester
Fremont
Brentwood
Exeter
Newfields
Stratham
Danville
Kingston
East Kingston
Kensington
Sandown
Site 14
#/100 ml
FC
EC
mg/L
Tot P
NO3-N
mg/L
Al
mg/L or %
TSS
%org

Site 15-Drainage swale, Raymond/Fremont town line-drainage swale leading from subdivision to Exeter River.

There was no flow at this site on dry dates. A sample was taken from the Exeter River on 6/27/95 near the drainage swale outlet. Bacteria levels were variable. E. coli levels on 6/7/95 were above the state limit (580 cts/100ml) but flow on this day was almost insignificant. Bacteria levels for the river sample collected on 6/27/9 were lower (200 cts/100ml) and below the state standard for a one time sample. Total phosphorus ranged from .032 to .196 mg/L; slightly elevated compared to other clean water sites. All other parameters were within acceptable ranges.





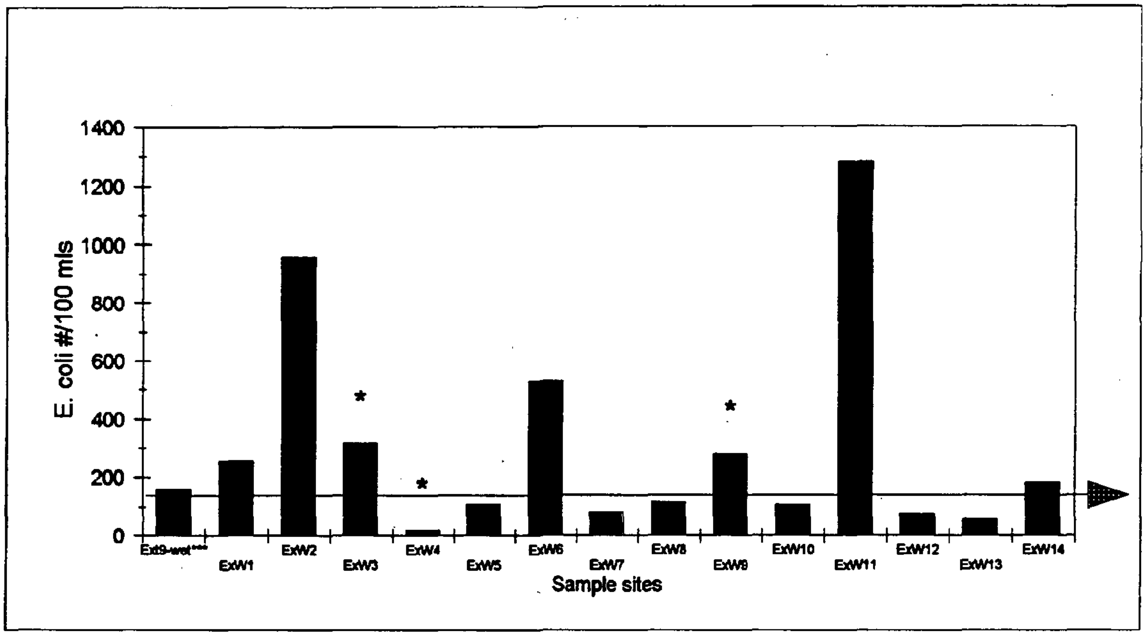
Elevated bacteria levels were the most common water quality problem observed during the site-specific water quality sampling. Geometric means for E. coli and fecal coliform were calculated and graphed (figure 4). The objective was to see how sample sites compared on a relative scale. It should be noted these geometric means are for samples from dry weather and storm events. Also flow rates were not measured so loading rates could not be calculated. Data for rainfall conditions measured above the dam in downtown Exeter (site Ext9) are from the study conducted by Jackson Estuarine Laboratory (UNH) and included for a downstream value. Under rainfall conditions bacteria levels exceeded state standards at the tidal dam (E. coli geomean=160 cts./100 mls, n=18 fecal coliform geomean=193 cts./100 mls, n=18). A number of sites sample for this study were above the State limit set for E. coli in class B waters. Two sites, ExW2 and ExW11 with very high E. coli levels may also have high loading rates and should be investigated further.

As stated before, fecal coliform is not the state standard for freshwater but is the indicator for classifying shellfish waters. Measuring fecal coliform in freshwater identifies potential upstream bacteria sources that influence tidal waters. State bacteria limits are much lower for shellfish standards (shellfishing is prohibited when fecal coliform >88 cts./100 mls, mean of 30 samples). Sites 2 and 11 may be significant contributors of fecal coliform to tidal waters. Site 6 greatly exceeded state standards but flow is very low at this site therefore the overall contribution may be insignificant. Site 3 may be a concern for shellfish standards. Fecal coliform levels were high and this site drains directly into the tidal portion of the Squamscott River.

GENERAL CONCLUSIONS FOR SITE-SPECIFIC WATER QUALITY SAMPLING

- Levels of contaminants that exceeded state standards were observed for both dry weather and storm events.
- Elevated bacteria was the most frequent water quality problem observed.
- Although generally at lower levels and with less frequency, bacteria levels that exceeded state standards were observed in the upper part of the watershed. Sites were not as pristine as originally thought.
- Bacteria levels in the lower part of the watershed relate to stormwater runoff, and possibly septic systems and agricultural runoff.

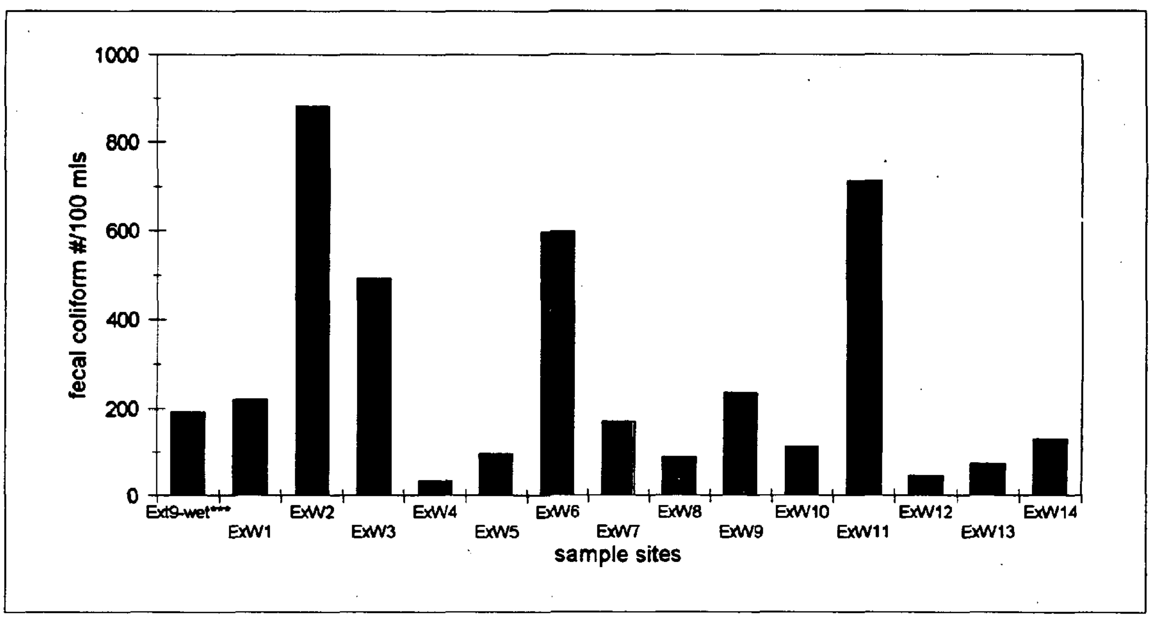
Figure 4: Geometric means for bacterial indicators for each sample site.



State limit for class B waters, 126cts/100 mls is noted.

* less than 4 samples were collected

** site 15 not included due to location changes-see site description



*** geomean for bacterial indicators measured during rainfall conditions for 1993-1995 by JEL (Jones and Langan, 1995).

DISCUSSION AND RECOMMENDATIONS

Water quality data, both current and historic, indicate there are nonpoint pollution problems in the Exeter/Squamscott watershed. Sources in the upper part of the watershed may not be greatly impacting coastal waters at this time, but could be a local concern and should be addressed so larger cumulative impacts do not develop in the future. In the lower part of the watershed a number of samples exceeded state water quality standards and may be contributing to nonpoint concerns in coastal waters.

The major suspected sources of nonpoint pollution for the State are stormwater runoff from urban areas and impervious surfaces, septic systems, shoreline development, and agricultural runoff (OSP and DES, 1995). The Steering Committee developed a list of concerns that included the above categories as well as gravel operations, poor road maintenance practices, landfills and land spreading operations. Site specific sampling conducted did not include gravel operations, landfills or land spreading operations. Site specific sampling did provide evidence that sources of nonpoint pollution in the watershed are the result of stormwater runoff and possibly runoff from agricultural areas and septic systems.

A number of local land use regulations are in place to address these potential sources of nonpoint pollution. Still, coverage is incomplete in the watershed, required maintenance and inspection programs are not carried out on a regular basis, and some sources may not be covered by the regulations due to grandfathered sites or size limits. These gaps need to be addressed in order to provide maximum protection from nonpoint pollution in the watershed.

All of these results were discussed with the Steering Committee and the following recommendations were suggested.

<u>Education</u>
People may be familiar with nonpoint issues but it is important to make sure they know it is a local concern and local actions can be important for its control.

Activities to consider:
The NHCP should distribute final reports to towns in the watershed and schedule an informational session to discuss report findings and recommendations with local land use boards. Ideally this should happen during regularly scheduled board meetings.

The NHCP should work with the NHDES Nonpoint Program to further investigate sources and provide technical assistance to resolve problems.

RCCD and RPC should develop a NPS lecture for the ongoing natural resource lecture series they sponsor.

Towns should be made aware of the stormwater demonstration site at the RCCD in Brentwood, and attend training workshops for local officials. Contact RCCD for information, 679-2790.

Develop fact sheets about nonpoint pollution, or use existing materials, for distribution through mailings or as part of established newsletters.

<u>Improve local regulations and implementation</u>.

Activities to consider:
Local boards should plan a work session to assess local regulations and review implementation practices.

Towns should budget and plan for regular maintenance activities, for example cleaning catch basins, street sweeping, and maintenance of vegetated buffer strips.

Towns needing assistance with adopting model ordinances or updating regulations should contact the Rockingham Planning Commission.

<u>Future monitoring and management</u>
NHDES should review sampling results and determine if further sampling should be incorporated into state monitoring programs.

Towns may consider establishing a water quality monitoring program to track water quality. NHDES can provide assistance to establish a program. (see appendix F for project budget).

The final report should be presented to the committee nominated to work on the Exeter River Management Plan as part of the State Rivers Management and Protection Program.

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Appendix A

Exeter-Squamscott Watershed Project, **Checklist for evaluation of municipal ordinances & regulations, as of 4/95**

Please note: A "Y" indicates a town has some type of regulation for the listed category. For categories where state regulations may apply, the summary matrix will be blank unless a town has referenced these state regulations or adopted a local regulation.

Abbreviations used:

- Aq.PD-aquifer protection district
- BMP-best managment practices
- ESC- erosion and sediment control
- HO-health officer
- RCCD-Rockingham County Conservation District
- SDR-subdivision regulations
- SPA-shoreland protection act
- SPD-shoreland protection district
- SPR-site plan review
- TSS-total suspended solids

Zoning												
	Exeter	Brentw.	Kingston	E.King.	Fremont	Newfields	Kensingt.	Raymond	Sandown	Stratham	Danville	Chester
lot sizes	5,000sq. ft/- 2ac.	soil based- w/ septic	80,000 sq.ft. 3 ac. in AqPD	2-3ac.	2ac.	2-3ac less in sewer distr.	1ac. min & soil based	20,000- 87,120sq. ft.	resident. .-min 40,000 SDR soil based	SDR soil based	2ac. min. or soil based	.5-2ac.
impervious limits	10-75%	20-40%	65% Industrial zone		30%	25%+	60% Commerc / industrial zones	50% open in PRCD		20-40%	15% Commer / industrial zones	
building setbacks *surface water, wetlands*	Y-SDR 50' wetlands SPD 100'-150'				50'+	50'/75' type A/B hydric soil 150' conserv. district				wetlands SPA Floodpl.	75' wetlands	50' from water, very& poorly drained soils
agriculture regulated *erosion/sed/soil consv., run-off control/mgmt, nutrients, pesticides, grazing, State BMP Manual referenced?*			Y-SPA cite RCCD	Y- wetland district		Y				general requir.		

Gravel Excavation												
erosion and sediment controls	Y			Y	Y	Y	Y	Y	Y		cite155E	aquifer restric.
exposure limit/phasing requirements	excav. by special exception	Y(4)	Y	Y	Y		Y(7)	Y	Y	limit in aquif. zone	excav.- spec. except. (refs155-E)	
reclamation requirements	Y	Y(5)	Y	Y	Y	Y	Y	Y	Y	Y	Y	cite155-E
equipm. maintenance restricted						Y		Y				
permit time limit	2yr	1yr.	1yr.		Y	1yr.	1yr	1yr	3yr	2yr		1yr
Septic Systems - Zoning and Health Ordinance/Regulation												
	Exeter	Brentw.	Kingston	E.King.	Fremont	Newfields	Kensingt.	Raymond	Sandown	Stratham	Danville	Chester
setbacks > 75 ft.								cite state stds.			200' public water	
from wetlands(12)	75'/ 50'	75'/ 50'	100'	75'	100'	75'/ 50'	75'			Y(10)	75'	75'
from surface water	150'/ 100'	75'	100'	100'						100'	75'	75-100'
distance above seasonal high water table	2'	1'	2'	2'	2' in Aq. protec.	2'	18"		cite state std.	2' SDR	2' SDR	2'
review of Design & construction applications	con.com. plan.board	Y	Y		°			HO reviews		Y	HO reviews	Y-build. insp.
inspection of new systems	Y	Y	Y	Y	Y	Y	Y	Y-HO	Y	Y	Y-HO	Y
annual inspection												
operating guidelines								Y				
inspection, upgrade required for expansion, conversion	Y-for expansion	Y-for condo convers	Y	Y	Y	upgrade for exspans.	Y	Y		Y	Y	Y
slope restrictions		>/= 15% limit		25%	20%					>/= 15% limit	SDR 15% limit	>20%
sept./sludge requaltions				Y								

Site Plan Review Regulations	Exeter	Brentw.	Kingst.	E.King.	Fremont	Newfields	Kensing.	Raymond	Sandown	Stratham	Danville	Chester
minimize disturbance *avoid development of sensitive areas* *preserve riparian areas* *site roads etc. to preserve natural drainage features* *limit impervious area,* *limit land disturbance, cut & fill*	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
erosion/sedeiment control(ESC) *1.ESC plans required pre-construction?* 2.what size areas?(13) 3.outside review agency? *4.performance std. (80% TSS)* *5.design stds* *6.guidance manual*(14)	1.Y 2.OK 3. 4.Y(1) 5. 6.RCCD	OK Y RCCD	>2unit Y	Y Y(1) RCCD	Y	Y OK Y Y(1) Y RCCD	Y Y(1) RCCD	Y all Y(1) RCCD	Y Y RCCD	OK RCCd	Y Y Y(1) RCCD	
permanent stormwater treatment *1.performance stds (80% TSS, pre-dev't runoff rates)* *2.design stds* *3.guidance manual*	1.Y(1) 2.Y 3.Y(2)		Y-no specific #'s	Y(1)	Y(2)	cite RCCD		Y(1) cite DOT	cite RCCD	Y-list stds.& meet SDR	Y(1)	shall meet requir. in SDR
additional studiesmay be requir.	Y	Y			Y			Y	Y	Y	Y	Y
chemical control		Y										
Subdivision Regulations												
minimize disturbance *avoid dev'elopment of sensitive areas* *preserve riparian areas* *site roads etc. to preserve natural drainage features* *limit impervious area,* *limit land disturbance, cut & fill*	Y	y-for road desg.	Y	y-in wetland district	Y	Y	rev. by conserv. comm.	Y	Y	Y	Y	Y
erosion & sediment control *1.ESC plans required pre-construction?* 2.what size areas?(13) 3.outside review agency? *4.performance std. (80% TSS)* *5.design stds* *6.guidance manual*	1.Y 2.OK 3. 4. 5.Y 6.RCCD	Y OK Y RCCD	2+lots Plan. board Conser. comm. inpsect	may require review by RCCD	requir. if Plan. board determ. necs.	cite SPR	Y all RCCD	Y all DOT	Y discr. of PB Y RCCD	Y OK Y(priv. eng.) RCCD	Y->2 or more lots Y RCCD	gen ref

Subdivison regulations(cont.)	Exeter	Brentw.	Kingston	E. King.	Fremont	Newfields	Kensing.	Raymond	Sandown	Stratham	Danville	Chester
permanent stormwater treatment *performance stds (80% TSS, pre-dev't runoff rates)* *design stds* *guidance manual* *maint.-runs with deed*	Y(1) Y Y	Y Y	cite street requir.	Y(1) no guid. manual			Y(8)	Y(1) DOT	Y(1)	Y	Y(1) Y	road req.
additional studies performance bonds	Y Y	Y	Y	Y	Y	Y	Y	Y	Y	Y Y	Y Y	Y Y
Riparian/Shoreland Areas												
shorelands protected: depth of shoreland (depends on body of water- major tribs. vs perennial stream)	300'/ 150'	300'/ 150'	300'/ 150'		150'/ 100'	150'/ 100'		75'/50'		150'/ 100		
salt storage, junk yards, solid waste prohibited	Y	Y	Y		Y			y		Y		
land alteration requires Erosion &sediment control s	y		Y									
septic setbacks > 75'	150' 100'		150' 100'					75'/50'				
setback for primary structures	150' 100'	150' 100'	150' 100'			no primary building allowed					FEMA requir.	
vegetated buffer- depth	75'	75'	75'			75' 50'				75' 50'		
50% tree cutting limit	30% 1/10yrs	30% 1/10yrs	50% 20yrs 25% on slope >15%			50% 1/20yrs				50% 1/20yrs		
impervious limits	20%	20%	20%									
non-sewered lot size					2acres					soil - based		
agriculture exemption requires BMP's	Y	Y	Y RCCD			Y				Y		

	Exeter	Brentw.	Kingston	E.King.	Fremont	Newfields	Kensing.	Raymond	Sandown	Stratham	Danville	Chester
Wetland Protection												
septic setbacks(12)	75' 50'	75' 50'	100' discr. Hoff.	plan. board may requir.	100'	75' 50'	75' (9)		75'	75' 50'	75'	75' poorly or very poorly drained soils
buffer protection/building setback(12)		100' 50'	100' discrect. of Plan. board	plan. board may requ.		75' 50'		50'		SDR- may req50'	75'	
Roads, Parking Lots *deicing chemicals* *maint. of stormwater structures*						limit Aquifer zone						
Aquifer/Groundwater Protection												
overlay district	Y	Y	Y		Y	Y		Y		Y		
impervious limits	10%	20%R 35%I	20% 35%		10%	25%		50%		20% (11))		
land use restrictions	Y	Y	Y		Y	Y		Y		Y		
larger lots	Y 3ac	Y	Y 3ac	Y 3ac	Y(3) 3ac	Y 3ac 2if sewer district				may require soil- based lot		
Hazardous Materials					Y in general	restricted Aquifer zone		in aquifer Y		prohib. Aquifer zone		
storage regulated	Y	Y	Y									
UST's regulated		Y	Y									
household hazmat		Y	Y									
Miscellaneous												
pooper scooper law	Y											
turf management												
cluster development	Y	Y	Y	Y(6)				Y			Y	Y

Marinas												
	Exeter	Brentw.	Kingst.	E.King.	Fremont	Newfields	Kensingt.	Raymond	Sandown	Stratham	Danville	Chester
siting restricted	Y					requires special except. permit- conserv. distr.						
design review *authority broad or limited*												
sewage pumpouts or sanitary facilities req'd	Y											
hazardous material regulated												
waste disposal												

(1)-pre-post development requirement does not include 80% TSS reduction-require measures to control sediments
(2)-quidance manual for stormwater-USDA-SCS Guide for calculating drainage
(3)-larger lots may be required, decided on a case by case basis
(4)-in phased manner to minimize erosion-no specifics listed
(5)-meet minimum requirements of 155-E
(6)-requirements for setbacks from poorly drained and v. poorly drained soils of 50'/100'
(7)-limits slope,debris removal required
(8)-design standards- NH Dept. of Public Works
(9)-buffer from soils type 5 or 6 (ID by HI map)
(10)-2 sets of setbacks- SDR-100'/50' type A/B hydric soils, Wetland Conservation District 75'/50'
(11)-exception if submit stormwater plan
(12)-if two setbacks listed-relates to type A/B hydric soils
(13)-OK for "what size area?" means they regulate for disturbances of >20,000 sq. ft.
(14)-RCCD indicates they reference the Stormwater Management and Erosion and Sediment Control handbook for Urban and Developing Areas in NH

UNIVERSITY OF NEW HAMPSHIRE
COOPERATIVE EXTENSION

GRANITE STATE DESIGNERS & INSTALLERS

Lake Sunapee Protective Association

NEW HAMPSHIRE LAKES LAY MONITORING PROGRAM

THE NORTH COUNTRY
RESOURCE CONSERVATION AND DEVELOPMENT AREA

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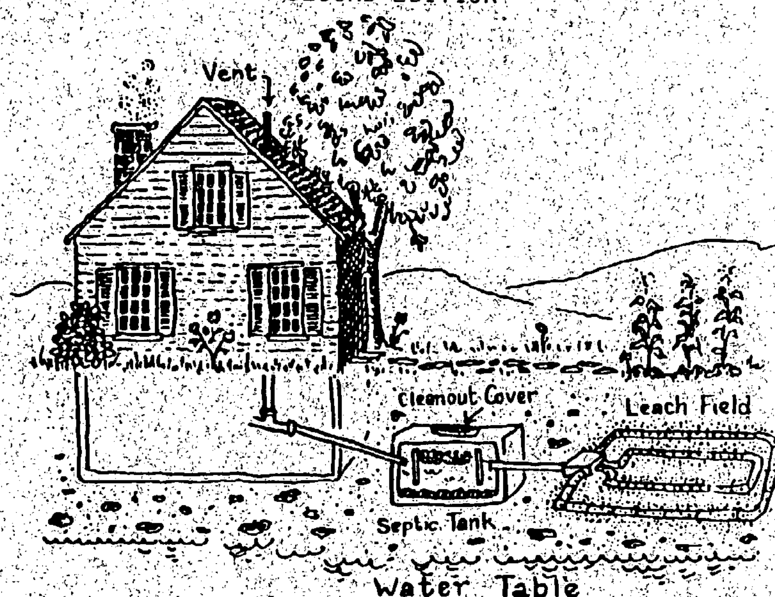
Septic Systems

How They Work & How To Keep Them Working

SECOND EDITION



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Lake Sunapee Protective Association
New Hampshire Lakes Lay Monitoring Program
The North Country Resource Conservation and Development Area

Contents

A special thanks to Nancy Browne and Russ Lanoie for their expertise and help with this brochure.

TO GET YOUR TANK PUMPED

See the Yellow Pages under: Septic Tanks and Systems – Cleaning

INSPECTION, PUMPING SCHEDULE AND RECORD

Date Installed ______________ Installer ______________

Dates of Inspection/Cleanout:	By Whom:

This booklet is a joint effort of UNH Cooperative Extension, "Helping You Put Knowledge and Research To Work," Pettee Hall, Durham, N.H., 03824, and Granite State Designers and Installers, Box 1567, Concord, N.H. 03301

Glossary

Effluent: Liquid which flows out of the septic tank and into the leaching system.

High Groundwater Table: A condition in which the natural soil water is at or near the surface of the ground due to wet weather or the natural lay of the land.

Percolate: To seep through the soil and disperse into the ground.

Sewage: The liquid wastewater discharged through the soil pipe of a household which contains "black water" from the toilet and "grey water" from sinks, showers, baths, and washing machines.

Sludge: Solids that accumulate after bacterial action has ceased. Accumulation is normal and must be removed periodically.

Scum: Floating material that also accumulates normally, requiring periodic removal for proper maintenance of the system.

WHO TO CALL

LOCAL: Your health officer, building inspector or selectman.

COUNTY: UNH Cooperative Extension or USDA Soil Conservation Service

STATE: Department of Environmental Services, Water Supply and Pollution Control Division, 6 Hazen Drive, Box 95, Concord, N.H. 03301
Phone: 271–3503

For the name of a septic system designer or installer who may be able to help you with a specific problem or question contact: GRANITE STATE DESIGNERS & INSTALLERS, Box 1567, Concord, N.H. 03301
Phone: 224–9929

A complete copy of the rules governing septic systems in New Hampshire is available for $5 from the Department of Environmental Services, Box 95, Concord, N.H. 03301. Ask for the "Blue Book".

Introduction

A new residential septic system can cost anywhere from $3,000 to more than $20,000* to install. If it is not taken care of it will become clogged and will overflow on the ground or cause wastewater to backup into the house. Rebuilding the system to put it back into operation may cost several thousand dollars and create a tremendous nuisance.

System failure is cheaper and easier to prevent than it is to correct. By keeping harmful materials out of the system, and by having the septic tank pumped out regularly (at least every three years), homeowners can help protect their system against premature failure. The $75–$150* cost of having the tank pumped is wise insurance to protect a substantial investment.

This booklet outlines the principles of septic system operation and explains the maintenance procedures necessary to lengthen the life of a system. If properly operated and maintained, the septic system can provide many years of trouble–free service. If neglected, however, the septic system is likely to fail, leaving the homeowner with unsanitary back–ups, over–flows and expensive repairs.

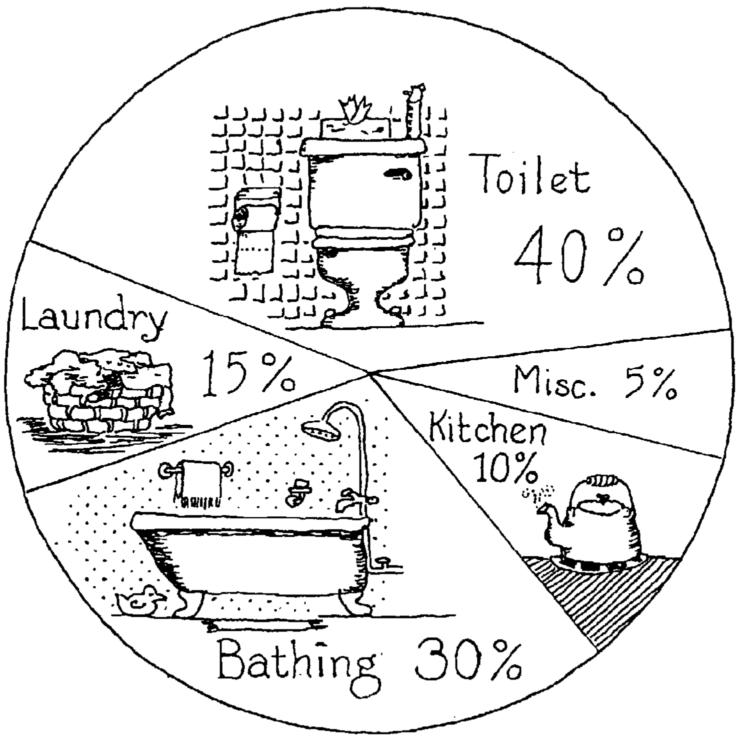
Many homeowners have been under the misconception that once a septic system is installed it will work forever without maintenance. This is not so.

***1989 costs**

This publication is based upon work supported by U.S.D.A. Extension Service under project #90-EWQI-1-9257.

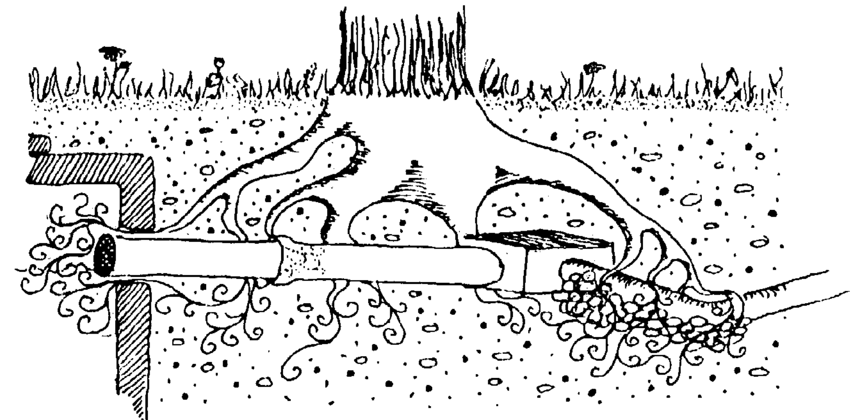
Household Sewage

Household sewage is a combination of wastewater from several sources, including sinks, toilets, showers, washing machines, and dishwashers. As shown below, the largest source of household sewage is the toilet. The actual quantity and composition of household sewage may vary depending upon the number of residents and water-using appliances within the home. Organic matter comes mostly from toilets, while sinks, showers and washing machines contribute large amounts of wastewater containing only small amounts of soap and dirt (including grease, detergents, lint and vegetable matter).



ROOTS

The roots of trees and bushes, as shown below, planted over the leaching area or near tanks can sometimes enter and block pipes. Such plants should be removed.



If Repairs Are Needed

If, through neglect, overuse or misuse, or simply old age, the leaching area becomes clogged to the point a new leaching area must be installed:

1. Don't automatically dig up the existing leaching system unless there's no room to install a new system or expand the present one. A clogged leaching system will often recover, given sufficient time.

2. Check with the town health officer, building inspector or selectmen to determine if local codes are more strict than the state's. New Hampshire allows failed systems for private residences to be repaired "in kind" without submission to the Water Supply and Pollution Control Division in certain instances. Since replacement requires destroying part of a system that may be able to recover, it may be wise to submit a plan to the state for the addition of new leaching area. This may be made by the homeowner, but with the complex nature of today's regulations it might be best to seek the help of a licensed designer familiar with the process.

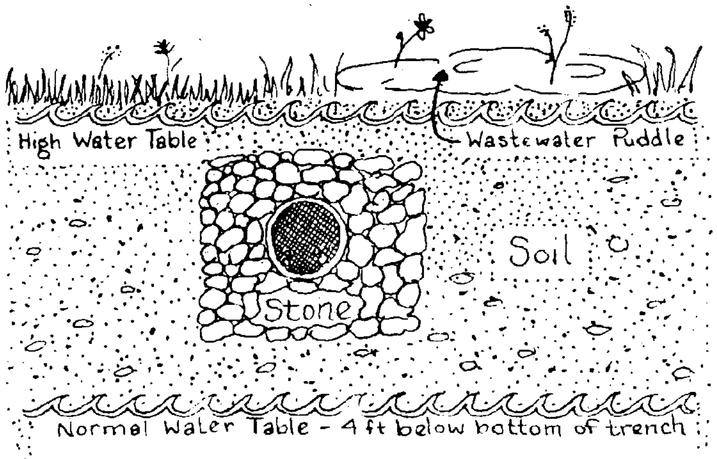
3. If there's enough room and regulations permit, install a new leaching system with an alternating valve which allows you to switch back and forth between leaching areas. Let the old system dry out at least a year, then alternate between systems yearly and have the septic tank cleaned regularly.

4. All work must be done either by the homeowner or by a state licensed installer.

HIGH WATER TABLE

During wet seasons, the ground water table rises. If the water table rises into the leaching system, sewage may be forced up toward the ground surface as shown by vertical arrows in the illustration below. This problem is the result of improper leaching system siting.

Although it may be possible to install drains to lower the ground water level, generally this problem can only be corrected by relocating the leaching system to a site where at least four feet of soil exist between the bottom of the trench and the maximum high water table as is required by N.H. regulations.

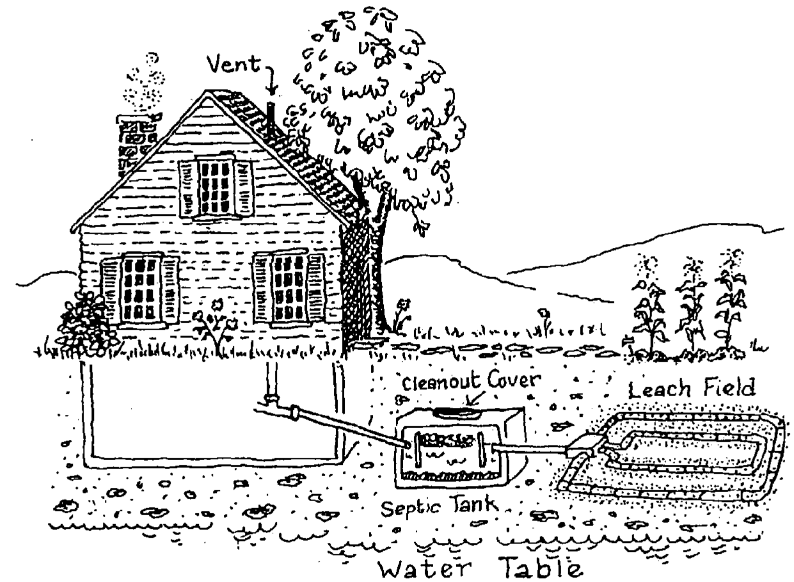


SOIL CLOGGING

If sludge or scum from the septic tank overflows into the leaching area, the soil will quickly become clogged with organic matter. This situation can often be corrected by allowing the system to rest for 6-12 months. This may mean a new leaching system must be installed. The chance of this problem occurring can be significantly reduced by inspecting the septic tank at least every three years and pumping out its contents if needed.

If the soil in the leaching area is continuously flooded or wet, due either to a high water table or excessive sewage flows, mineral deposits, which clog the soil, tend to form. Such soil clogging can often be corrected by allowing the leaching area to dry out and rest 6-12 months. Reducing the volume of sewage flowing from the home can help prevent this type of failure. Water use in the home can be greatly reduced by using the methods mentioned on page 12.

The Septic System



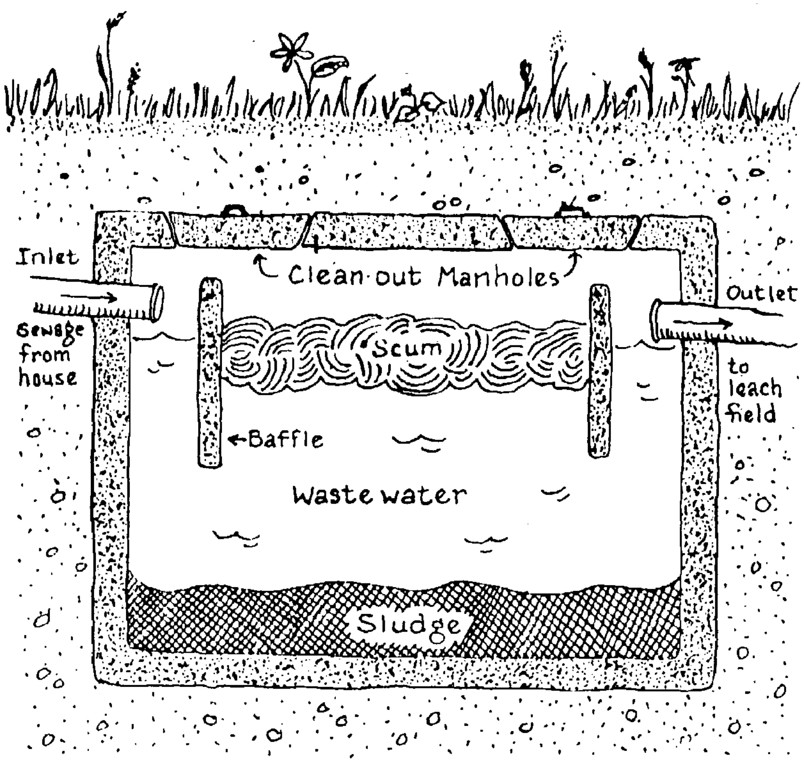
The septic system is a two–part sewage treatment and disposal system buried in the ground, composed of a septic tank and a leaching system. The sewage generally flows by gravity; first into the septic tank where the larger particles are removed and some decomposition takes place and, then, into the leaching system where it soaks into the ground.

NOTE: Older homes and seasonal dwellings often had only a single stone, block, or wood lined pit similar to the dry well shown on the bottom of page 5. All wastes entered this pit and untreated wastewater was absorbed into the soil through the walls and bottom of the pit. These early systems were called CESSPOOLS, and, although they are no longer installed, many remain in use today.

The Septic Tank

Untreated household sewage will quickly clog all but the most porous gravel if applied directly to the soil. The function of the septic tank is to condition the sewage so that it can percolate into the ground without clogging the soil. Within the tank, illustrated below, three important processes take place:

1. The heavier, solid particles in the sewage settle to the bottom of the tank forming a layer of sludge. Lighter materials, including fat and grease, float to the surface forming a scum layer.



2. Bacteria living in the septic tank break down some of the organic solids into liquid components, helping to reduce the build–up of sludge in the tank.

3. Sludge and scum are stored within the septic tank rather than being allowed to flow out into the leaching system where they would quickly clog the soil.

PROTECTING LEACHING SYSTEM

The leaching system is a delicate structure.

DO	DON'T
DO insist on proper location and construction of a new leaching system.	**DON'T** install a poorly thought out system (see "Who To Call").
DO keep deep rooted trees and bushes away from the leaching system.	**DON'T** allow vehicles to travel over system.

•Vehicles can compact the soil, crush pipes and break the septic tank and, thus, result in costly repairs.

Septic System Failure

SYMPTOMS OF SYSTEM FAILURE

Septic systems generally give little warning that they are about to fail. However, the following symptoms often indicate that the leaching system is becoming clogged:

1. Sewage odor near the septic tank or leaching area.
2. Slowly running drains and toilets.
3. Sewage on the ground over the leaching area.

If any of these symptoms develop, inspect the tank to see if it needs pumping.

If for some reason the effluent from the leaching system cannot soak into the soil, sewage may back up in the system and overflow onto the surface of the ground. There are three major causes of this problem.

REDUCING WATER USE

Be conservative with your use of water.

DO

DO use water reducing fixtures on sinks, toilets, showers.

DO dump cleaning water outside instead of in the toilet.

DO load your washing machine completely before use.

DO fix leaky faucets and toilets promptly.

DO place plastic baffles in your toilet tank.

DO limit shower time.

DO take larger, back–to–school or after–vacation laundry loads to the laundromat.

DON'T

DON'T flush the toilet unnecessarily.

DON'T overfill your bathtub.

DON'T empty roof drains, basement sumps or foundation curtain drains into the septic system.

KEEPING THE SYSTEM'S BACTERIA WORKING

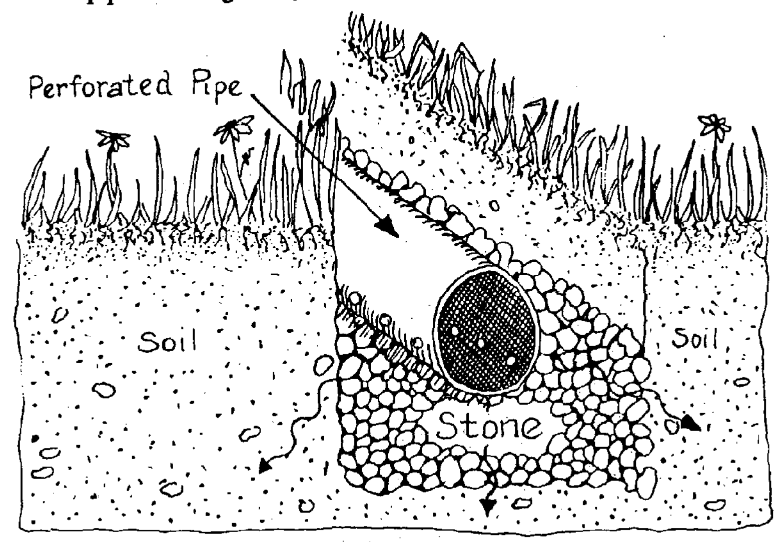
Remember your septic tank and leaching system are full of living organisms that make the system work.

DO use caution in what goes down drain.

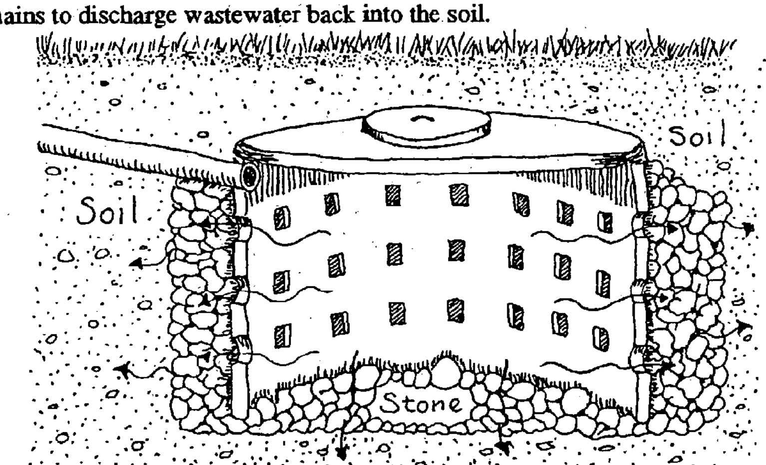
DON'T put pesticides, disinfectants, acids, medicines, paint, paint thinner, or other materials which can kill bacteria in the septic system.

Leaching System

After being conditioned in the septic tank, the effluent flows into the leaching system where it runs out through perforations into the graded or crushed stone and into the surrounding soil. The leaching system usually consists of either a network of perforated pipes laid in graded, stone–filled trenches or leach beds, as in the first



illustration, or of a loosely stacked concrete block, stone, brick, precast concrete or even a wooden dry well often surrounded with crushed stone similar to that shown below, or a configuration of chambers, either plastic or concrete. Their function remains to discharge wastewater back into the soil.



Finding Your Septic System

In order to take proper care of a septic system, the homeowner must know where it is located. If the access holes are at ground level, there is no problem. Unfortunately, they are often buried somewhere under the lawn. To locate the tank, go into the basement and find where, and in what direction, the sewer pipe goes out through the basement wall.

Check the lawn in that area for places where the grass looks different or for areas that are slightly depressed or mounded. In the winter, look for an area in the lawn where the snow melts or where there is a depression in the snow. In the spring, the snow may melt first over the septic tank and leaching system. Any likely spot can be probed with a thin metal rod.

If this doesn't work, ask someone who may have seen the tank installed or pumped – a neighbor, the builder, or the previous owner. When purchasing a home, a sketch showing tank and leaching system location should be requested from the realtor or previous owner.

For recently installed or repaired systems (if your town has adopted local health regulations covering septic tank leaching system installation), the town clerk, selectmen, or health officer should have a plan that shows the location of the system and access holes.

If you have purchased property with a septic system built after Aug. 30, 1977, the seller must transfer a copy of approved plans and specifications to the buyer. The buyer must transfer this at next sale.

If all else fails, turn the problem over to your local septic tank pumper. Once you find your septic system, be sure to make a map. You may also want to have the hole extended up to just below ground level, and marked permanently with a stake or other object.

Electronic devices are also available to help you find a lost system.

REDUCING SLUDGE BUILD-UP

Keep all solid materials possible out of your sewage.

DO	DON'T
DO have your tank inspected every three years.	**DON'T** wait for signs of failure.
DO keep a schedule and record of past and future inspections and pumping (see Inspection and Pumping Schedule and Record).	**DON'T** use a garbage grinder.•
DO have your tank pumped as needed.	**DON'T** put automotive oil, cooking oil, or grease in the septic system.
DO compost garbage or put it in the trash.	**DON'T** empty large quantities of water from items such as hot tubs or whirlpools, particulary if they are chlorinated.
DO keep a can for grease near the stove.	

• Waste from garbage grinders will not only fill your septic tank rapidly and require more frequent pumping, but will also float and increase the scum blanket thickness. This can eventually spill into the effluent pipe and clog the leaching system. It is now recommended that the septic tank be 50 percent larger if a garbage disposal is used.

Septic Tank Pumping

Do not wait until your system shows signs of failure to have your septic tank pumped out. Waiting can mean complete clogging and an expensive repair bill. Call a pumper to inspect the system AT LEAST ONCE EVERY THREE YEARS and pump if needed. For a list of operators in your community, consult the yellow pages under "Septic Tanks and Systems – Cleaning". If the access holes are at ground level or are clearly marked or mapped, the job should be quick and simple.

While your tank is being pumped, ask the operator to examine the inlet and outlet baffles or tees. If either is broken, have repairs done immediately. The inlet should also be checked to see if wastewater is continuously flowing into the tank from previously undetected plumbing leaks.

It is not necessary to leave any of the sludge in the tank as "seed." Incoming sewage contains all the bacteria needed for proper operation. Acids or bleaches should not be used to clean the tank.

The use of enzymes or other "miracle" septic system additives has not been shown to be of any value. While their use may not harm your system, they do not take the place of regular pumping.

Preventing System Failure

To help protect a septic system against premature failure, the homeowner can follow a few simple procedures for (1) reducing sludge build–up, (2) reducing water usage, (3) keeping the system's bacteria working, and (4) protecting the leaching system.

Septic Tank Mapping

SAMPLE

1. Below, make a rough sketch of your house, the septic tank cover, leaching system and other permanent reference points like trees or rocks.

2. Measure and record distances to the cover of your septic tank and to the corner of your leaching system. As long as the distances are correct, do not be concerned about whether or not your drawing is to scale.

MAP YOUR OWN SEPTIC TANK ON THIS PAGE.

Septic System Maintenance

Most septic systems are poorly maintained as they are out of sight and, therefore, out of mind. Solids separated from liquids in septic tanks are reduced in volume approximately 50 percent. Remaining solids must periodically be removed. The need for cleaning varies according to use. Garbage disposals, as an example, increase accumulation of solids significantly. Failure of systems is due to poor design, installation and maintenance or combination of these.

SEPTIC SYSTEM TROUBLES

Neglecting to inspect and clean the septic tank is a frequent cause of failure of a disposal system.

When the tank is not cleaned at appropriate intervals, solids will build up to such a high level that they will be carried from the tank to the leaching system.

Eventually, the sewage solids will clog the soil openings or pores thus blocking the flow of liquid into the soil. When this happens, the leaching system will be ineffective and may have to be rebuilt.

A septic tank is supposed to be full of water, but not full of scum and solids.

PERIODIC INSPECTION

Periodic inspection and cleaning of a septic tank will prevent unnecessary expense and inconvenience. A septic tank should be inspected every 2 to 4 years (more often if there is a garbage grinder) but the frequency of cleaning depends primarily on the size of the tank and the use it is given. Some tanks require cleaning every 3 or 4 years; others will operate satisfactorily for a much longer period.

Clogging of the absorption field is the most common trouble with septic tank systems. This may be due to improper use or neglect of necessary servicing. A tank that is too small, overloaded or improperly proportioned, or that agitates or short–circuits the sewage flow is likely to allow excessive amounts of small sewage particles to carry over to the absorption area where they clog the pores of the soil. Neglect of cleaning produces the same effect. If the absorption area is in an unsuitable soil or is too small, overloaded, or poorly constructed, the small amount of sewage particles normally in the effluent may lead to early clogging of the soil pores.

A septic tank has three distinct layers of material: a top layer of scum, a liquid layer in the middle and a bottom layer of sludge.

A septic tank cleaning schedule is based on the thickness of these 3 layers. A tank should be cleaned when the bottom of the scum is within 3 to 4 inches of the lower end of the inlet baffle or the outlet device or when the depth of the sludge is equal to or more than one–third of the existing liquid depth. Another way to determine when a tank needs to be cleaned is when the total depth of the scum and the sludge reaches one–third of the liquid depth of the tank. Either method may be used. The first is probably better in that the layers are treated individually.

Septic tanks are ordinarily pumped out by contractors who are approved by a health department for cleaning tanks and disposing of the contents. The material removed from the tank must be disposed of by a method approved by local and state government.

NHCP technical bulletin 11
1995

A GUIDE TO CONTROLLING NONPOINT POLLUTION THROUGH MUNICIPAL PROGRAMS

INTRODUCTION

Nonpoint source pollution is water pollution that comes from diffuse sources and is carried to surface water by rainfall, snowmelt, or groundwater movement. The New Hampshire Coastal Program is developing a Coastal Nonpoint Pollution Control Program (CNPCP) to enhance state and local efforts to manage land use activities that may contribute to nonpoint source pollution. As part of the program, this technical bulletin was developed for municipal officials and other citizens interested in preventing nonpoint source pollution.

This is a companion guide to a booklet published by the N.H. Department of Environmental Services, *Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials* (1994). While the DES *Guide* describes the causes of nonpoint pollution and what can be done to prevent it, this *Technical Bulletin* focuses on nonpoint sources of special concern to coastal waters. It further provides guidance on improving the effectiveness of local ordinances and regulations and other municipal programs.

Use of the information in this Technical Bulletin need not be limited to coastal communities. Many of the recommendations apply equally to inland freshwater lakes and streams.

Water quality monitoring studies show that nonpoint sources are a significant problem in N.H. coastal waters and tributaries. Indicators of pollution in surface waters increase following storm events - especially nutrients and suspended solids. Ammonia increased dramatically during storms (as compared to dry weather) sampled by the Department of Environmental Services and the Coastal Program in 1994. Bacterial contamination, the chief cause of shellfish bed closures, also dramatically increases following precipitation events. Nonpoint sources are believed to be the principal origin of those pollutants.

In New Hampshire, municipalities have the authority to enact local land use controls and therefore play a key role in preventing nonpoint pollution. State and federal agencies have a number of programs in place to address various aspects of nonpoint pollution. However, potential nonpoint sources are too numerous for these agencies to monitor statewide.

Comprehensive planning is the first step. An up-to-date Master Plan, including a Local Water Resources Management and Protection Plan, should provide the basis for land use ordinances and regulations. If a review of ordinances and regulations indicates the need for an update, the proposed amendments should be supported by scientific and technical documentation clearly articulated in the municipal Master Plan.

This *Technical Bulletin* covers five categories of nonpoint pollution: stormwater runoff, subsurface wastewater disposal systems, road maintenance and construction, agricultural activities, and marinas and boatyards. This *Technical Bulletin* is designed for use as a checklist to identify where gaps in local regulatory efforts can be improved. Prior to

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local adoption of amendments to address nonpoint pollution, consult with your town planner, regional planning commission, or the N.H. Office of State Planning, and refer to the DES *Guide* for more information. Always have any proposal for local land use controls reviewed by Town Counsel prior to adoption.

STORMWATER RUNOFF FROM DEVELOPED AND DISTURBED AREAS

This is a major category of nonpoint pollution in N.H. coastal waters. Storm runoff from disturbed areas carries sediment and associated nutrients. Runoff from paved areas often carries bacteria, sediment, heavy metals, and other pollutants. The Department of Environmental Services' Alteration of Terrain (Site Specific) program regulates site development where at least 100,000 square feet (50,000 square feet in the protected shoreland area) of land is disturbed. However, many smaller sites can contribute to nonpoint pollution as well. DES also regulates activities in the protected shoreland adjacent to public waters (where municipalities have not adopted ordinances that have been certified by OSP as being at least as stringent as the Comprehensive Shoreland Protection Act). However, only streams of the fourth order or higher are covered by the program (See the DES Fact Sheet on this program for more information). In both cases, cities and towns can help fill in the gaps. Model ordinances and regulations are available from the Office of State Planning and your regional planning commission. If your municipality already has some controls in place, check to see if they achieve the following:

Water Resources Protection Zoning

The Office of State Planning supports an integrated approach to planning and zoning for management and protection of critical water resources, including shorelands, floodplains, aquifers, wetlands, and wellhead areas. The following provisions could be part of a water resources protection district, or they could be implemented as general provisions in a zoning ordinance. Some of these provisions are included in the Comprehensive Shoreland Protection Act (RSA 483-B); others are additional water resource protection measures recommended by OSP.

- Establishment of an overlay district which includes lands within 250 feet of public waters (be sure to clearly define where the high water line is to be drawn).
- Prohibition of certain uses, and restrictions on other uses, in the protected shoreland (see RSA 483-B or OSP's model ordinance).
- Minimum standards for new septic systems: DES approval of new lots, lot size determined by soil type (see *Model Subdivision Regulations*), and increased setbacks for septic systems in sensitive shoreland areas.
- Temporary and permanent stormwater management controls for <u>all</u> development activities in the protected shoreland (refer to the *Stormwater Handbook* cited in the next section).
- Protection of a natural vegetated buffer within 150 feet of the high water line.
- Minimum shoreland frontage of 150 feet for lots with on-site water and septic systems.
- Building setbacks from surface waters of 50 feet or more for primary structures.
- Limit of 20 percent impervious area for each lot.
- Performance or design standards for water-dependent uses such as marinas.
- Performance or design standards for cluster developments in the protected shoreland.
- Performance or design standards for waterfront parcels used for shared access to the water.
- Limits on impervious area, particularly over aquifer recharge areas and near surface waters.

Subdivision Regulations and Site Plan Review Regulations

Subdivision regulations apply to the subdivision of land, while site plan review regulations apply to nonresidential and multi-family development. Both types of regulations should provide for proper treatment of stormwater runoff.

- Require temporary and permanent erosion and sedimentation control (stormwater management) plans and ongoing maintenance schedules to be included in the final plan.
- Specify performance standards and/or a reference manual for stormwater management

measures. See the *Stormwater Management* handbook.

- Apply stormwater management requirements to disturbances of 20,000 square feet or more, construction of roads, subdivisions of three or more building lots, and disturbance of critical areas.
- Utilize the Planning Board's statutory authority (under RSA 676:4 I.(g)) to require that the applicant provide special investigative studies.
- Require bonding of stormwater management measures, as well as inspection and maintenance.
- Require inspection and maintenance (with documentation) of stormwater structures.
- Encourage retaining natural vegetation, minimizing disturbed area, and retaining sediment within the project area.
- Minimize cutting and filling, development of sensitive areas such as riparian areas, and impacts to natural drainage features.
- Require proper storage and handling of hazardous materials.

Local Excavation Regulations under RSA 155-E

- Condition final approval on compliance with state Alteration of Terrain rules (RSA 485-A:17 and Ws-Env 415).
- Require stormwater management plans - including maintenance and revegetation plans.
- Before ground is broken, require bonds for erosion and sedimentation control measures, implementation of reclamation plans, and inspection.
- Include reclamation standards consistent with state statute.
- Include reclamation schedules in all permits.
- Require vegetated buffer strips between disturbed areas and surface water courses.
- Require equipment maintenance to be done off site.
- Require methods to prevent tracking mud onto roadways.
- Periodic review and inspection of the operation by the planning board or its consultant.
- Periodic renewal of the permit.

SUBSURFACE WASTEWATER DISPOSAL SYSTEMS

These are believed to be a major source of bacteria and nutrients in coastal waters, particularly of concern near shellfish-growing areas. The N.H. DES regulates the design and installation of septic systems. Municipalities can adopt a local health ordinance to reinforce those rules by doing the following:

- Have the local Health Officer review and approve plans for new and replacement systems prior to construction, and inspect systems prior to backfilling.
- Provide educational materials to homeowners and renters regarding proper use and maintenance of septic systems, emphasizing the avoidance of repair or replacement costs. Sources of educational materials include DES and Granite State Designers and Installers.
- Require owners to inspect septic tanks annually. (This is already required by state rules Env-Ws 1023.01(a).)
- Require owners to have tanks pumped out every few years or as needed according to state rules (Env-Ws 1023.01(b) - when sludge plus scum equals one-third of tank depth) to prevent clogging of the leach field by sludge or scum.
- Conduct periodic inspections in areas of concern.
- Prohibit disposal of greasy or bulky wastes, excessive amounts of solids, and toxic or hazardous materials.
- Prohibit paving over or placing heavy objects on leach fields to avoid damage.
- Require inspection when indicators of failure are observed, such as ponding, or when expansion or conversion of a building is proposed
- Make it clear that the Health Officer is empowered by statute to require repairs.
- Establish a clear procedure for notifying owners of violations and requiring repair or replacement.
- Establish programs to help owners finance repairs and replacements.

- Using the Health Officer's statutory authority to remove nuisances, perform repairs and recover costs from septic system owners.

Contact OSP for a copy of *Model Ordinance to Regulate Subsurface Disposal Systems and Establish Local Enforcement Procedures* (1992).

ROAD MAINTENANCE AND CONSTRUCTION PRACTICES

Subdivision and Site Plan Review Regulations cover road construction by private developers; this section refers to road construction and maintenance by municipal highway departments. These activities can be responsible for significant pollutant loads to surface waters. Sediments from road runoff carry with them a wide array of pollutants, including nutrients, bacteria, oxygen-demanding substances, toxic metals, and hydrocarbons. Road maintenance and construction practices should consider:

- Proper design *and maintenance* of stormwater handling structures is important for the control of pollutants from paved areas.
- Snow disposal should take place where salt runoff will not contaminate drinking water supplies and away from surface waters so that sand and debris will not enter surface water.

For recommended management practices, see the DES *Guide* and *A Series of Quick Guides for New Hampshire Towns*, available from UNH Cooperative Extension and the Rockingham County Conservation District.

AGRICULTURAL ACTIVITIES

Agricultural activities can result in the addition of nutrients, bacteria, sediment and sometimes agricultural chemicals to surface runoff. The Department of Agriculture's Pesticide program and Manure Management program have made many positive efforts to address commercial farms. However, the many small-scale hobby farmers and keepers of livestock, such as a horse or two, are believed to represent a significant source of nonpoint pollution. Several approaches are possible:

- Encourage farmers and owners of horses and other livestock to work with the County Conservation District to develop approved farm management plans and become active cooperators who utilize best management practices.
- Distribute information about proper grazing and manure management. Information is available from OSP, County Conservation Districts, and UNH Cooperative Extension.
- Conservation Commissions can work with the County Conservation District to identify farms with highly erodible soils and to develop farm management plans to prevent nonpoint pollution.
- Require compliance with requirements of the N.H. Department of Agriculture (RSA 431:33-35, the agricultural BMP manual, and Code of Administrative Rules Pes 100-1000).

MARINAS AND BOATYARDS

These can cause habitat destruction from dredging and water pollution resulting from sewage discharge, hull washing, boat maintenance, and leaching of metals from bottom paints. Local laws may cover the following:

- Site plan review regulations should apply to marina and boatyard construction *and expansion*.
- Take into account the impact of marina design on shellfish beds and other habitat, tidal flushing, and water quality.
- Require collection and treatment of stormwater runoff in parking lots and areas where boats are maintained, especially where hulls are scraped and painted.
- Require sewage pumpouts, dump stations, and/or restroom facilities.
- Require fueling stations to be designed for prevention and ease in cleanup of spills.
- Require proper operating practices at marinas and boatyards. The N.H. DES is currently preparing a manual of voluntary Best Management Practices (BMP's) for marinas. Such BMP's include waste disposal, prevention of fuel spills, and boat cleaning practices. The DES manual could also serve as guide for local ordinances and regulations or for local education efforts. Contact the DES Limnology Bureau for a copy. With encouragement from local officials, marina and boatyard operators may implement BMP's voluntarily.

INFORMATION RESOURCES

A Series of Quick Guides for New Hampshire Towns, N.H. Association of Conservation Districts, UNH Technology Transfer Center, U.S.D.A. Natural Resources Conservation Service, North Country Resource Conservation and Development Area, and UNH Cooperative Extension.

Comprehensive Shoreland Protection Act, RSA 483-B, N.H. Department of Environmental Services Technical Bulletin NHDES-CO-1994-2.

Formulating a Water Resources Management and Protection Plan, N.H. Office of State Planning Technical Bulletin 9, Winter 1992.

Manual of Best Management Practices for Agriculture in New Hampshire, N.H. Department of Agriculture, June 1993.

Model Shoreland Protection Ordinance, N.H. Office of State Planning, July 1994.

Model Subdivision Regulations for Soil-Based Lot Size, Ad Hoc Committee for Soil-Based Lot Size Regulations, June 1991, available from Rockingham County Conservation District, Brentwood.

Pollution Control for Horse Stables and Backyard Livestock, Fact Sheet, 1994, U.S. EPA Region VI and Terrene Institute.

Stormwater Management and Erosion and Sediment Control Handbook for Urban and Developing Areas in New Hampshire, 1992, available from Rockingham County Conservation District.

Many more resources are listed
in DES's
Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials (NHDES-WSPCD-94-2).

NOAA

NH OFFICE OF STATE PLANNING COASTAL PROGRAM

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Text by Paul Susca, NH OSP

Appendix D

Source: Jones, S. H. and R. Langan. 1995. Strategies for assessing nonpoint source pollution impacts on coastal watersheds. A final report to NH Coastal Program, OSP.

Table 6. Concentrations (per 100 ml) of bacterial indicators at sites in tributaries to the Squamscott River.

Fecal Coliforms

Site	1	3	4	5	6	9	10	11	14	19	20	21	22	24	25	GB 7
7/19/94	98	38		114	233	1300		303	93		685		456			33
8/2/94	123	18		165	110	7100		110	91		2490		75			25
8/16/94	50	0		300	103	400		65	268		1100		18			16
9/12/94		0		93	53	2100		65	105		355		9			38
10/20/94	34	43		8	74	0		230	124		20		28			28
11/15/94	80	61		9	11	545		30	28		15		40			37
4/19/95	26	166		31	9	27		72	116		20		56			
4/26/95	8	143		11	12	5		43	68		6		4			
5/25/95	19	1740	140	69	49				83	26			83			
6/1/95	5	1100		18	63	1150	300	335	110	9	15	50	10	70	600	41
6/7/95	165	540		280	235	6480	2100	220	140	283	1700	900	130	350	6100	98
Geo. Mean	**37**	**51**	**140**	**49**	**53**	**265**	**794**	**108**	**98**	**40**	**120**	**212**	**36**	**157**	**1913**	**35**

E. coli

Site	1	3	4	5	6	9	10	11	14	19	20	21	22	24	25	GB 7
7/19/94	85	27		105	161	4300		247	80		669		416			30
8/2/94	120	14		163	95	7100		105	86		2310		75			25
8/16/94	50	0		243	88	400		63	223		800		20			15
9/12/94		0		23	35	2100		18	53		145		23			4
10/20/94	32	43		2	32	0		190	108		20		27			26
11/15/94	80	57		8	11	540		28	28		15		40			37
4/19/95	16	159		30	6	27		45	75		20		55			
4/26/95	3	118		10	6	5		40	50		3		4			
5/25/95	19	1153	28	69	49				60	25			65			
6/1/95	0	1100		18	63	1040	250	190	70	6	5	0	10	30	100	15
6/7/95	165	540		270	225	6220	1900	220	110	259	1565	610	130	350	5740	84
Geo. Mean	**24**	**46**	**28**	**36**	**40**	**294**	**689**	**80**	**75**	**34**	**87**	**16**	**39**	**102**	**758**	**22**

Table 6. Concentrations (per 100 ml) of bacterial indicators at sites in tributaries to the Squamscott River.

Enteroccocci

Site	1	3	4	5	6	9	10	11	14	19	20	21	22	24	25	GB 7
7/19/94	109	231		148	660	1300			43		510		294			34
8/2/94	135	248		258	1100	6400		0	15		925		185			9
8/16/94	288			2015	610	7500			231		7400		485			
9/12/94		0		1100	210	1900		0	0		0		0			3
10/20/94	137	3		0	18	26		33	8		10		10			7
11/15/94	19	15		35	34	175		15	5		0		95			8
4/19/95	10	4		2	29	11		11			26		6			
4/26/95	2	17		2	4	3		8	5		3		10			
5/25/95	75	90	288	81	149	408	690		40	88	250	250	54	49	1390	
6/1/95	5	430		25	430	740	180	50	15	14	75	50		6	200	13
6/7/95	265	880		840	2350	3760	2540	88	140	612	1545	220	400	192	2960	59
Geo. Mean	**43**	**35**	**288**	**50**	**150**	**368**	**681**	**9**	**16**	**91**	**54**	**140**	**41**	**38**	**937**	**12**

Table 7. Concentrations of nutrients at sites in tributaries to the Squamscott River.

Ammonium (µm)

Site	1	3	4	5	6	9	10	11	14	19	20	21	22	24	25	GB 7
7/19/94	4.16	68.90		4.99	7.06	5.51		15.33	4.80		4.26		4.43			9.57
8/2/94	4.36	0.44		7.42	5.73	7.77		0.20	4.86		6.11		4.75			2.59
8/16/94	12.15	1.21		5.19	5.90	5.49		3.74	4.88		5.01		1.81			2.08
9/12/94	1.32	4.89		1.49	1.28	1.60		0.86	0.76		1.51		1.71			2.72
10/20/94	1.01	29.64		0.19	0.75	0.22		13.87	0.91		19.82		0.06			6.89
11/15/94	0.80	5.66		0.97	1.97	1.91		5.07	3.22		1.62		1.55			3.25
4/19/95	9.68	5.08		3.55	2.62	1.39		14.34	1.75		1.48		1.64			
4/26/95	1.81	7.57		1.77	2.29	1.98		9.33	3.84		1.58		2.00			
5/25/95	2.04	14.38	2.31	1.91	1.53	1.94	3.26		17.20	50.37	30.21	1.19	1.49	2.46	4.60	
6/1/95	1.41	7.50		1.69	7.81	4.65	4.23	5.88	14.01	43.68	1.75	1.94	3.64	4.51	5.66	8.47
6/7/95	10.93	25.84		1.60	3.21	13.17	8.42	17.92	130.94	35.35	18.89	50.74	5.86	24.17	28.33	
Average	**4.52**	**15.55**	**2.31**	**2.80**	**3.65**	**4.15**	**5.30**	**8.65**	**17.02**	**43.13**	**8.39**	**17.96**	**2.63**	**10.38**	**12.86**	**5.08**

Table 7. Concentrations of nutrients at sites in tributaries to the Squamscott River.

Nitrate (µm)

Site	1	3	4	5	6	9	10	11	14	19	20	21	22	24	25	GB 7
7/19/94	215.93	8.03		50.38	56.05	206.13		4.87	0.28		9.79		4.36			3.62
8/2/94	235.36	0.30		48.09	61.17	35.98		1.54	0.00		12.77		5.81			0.40
8/16/94	228.17	2.74		41.24	75.72	220.78		1.35	0.14		9.18		5.91			1.31
9/12/94	244.21	4.09		48.03	69.61	122.92		1.71	0.51		10.23		4.11			1.98
10/20/94	231.71	14.40		69.46	25.78	146.14		22.08	8.91		8.29		6.02			20.03
11/15/94	259.11	10.74		75.45	35.09	162.34		20.34	4.59		7.23		8.17			4.76
4/19/95	179.01	12.43		37.84	25.72	95.29		7.65	3.66		16.30		5.32			
4/26/95	201.67	14.04		29.85	18.67	90.95		7.62	4.88		9.60		4.80			
5/25/95	222.26	19.91	6.38	14.79	10.13	59.89	4.37		5.58	2.50	5.31	1.14	2.48	4.05	14.20	
6/1/95	248.48	6.61		27.33	23.20	135.31	13.36	7.96	6.75	3.93	15.16	5.91	4.95	12.55	33.54	6.32
6/7/95	200.11	10.07		18.23	18.50	59.80	10.27	12.23	5.58	2.70	1.68	6.74	6.42	10.45	27.49	
Average	**224.18**	**9.40**	**6.38**	**41.88**	**38.15**	**121.41**	**9.34**	**8.73**	**3.72**	**3.04**	**9.59**	**4.60**	**5.30**	**9.02**	**25.08**	**5.49**

Phosphate (µm)

Site	1	3	4	5	6	9	10	11	14	19	20	21	22	24	25	GB 7
7/19/94	0.27	0.35		0.28	0.39	0.45		3.59	0.32		0.63		0.23			1.19
8/2/94	0.26	0.17		0.18	0.31	0.26		0.03	0.38		0.86		0.28			0.22
8/16/94	0.15	0.02		0.11	0.17	0.15		2.54	0.10		0.65		0.03			0.97
9/12/94	0.32	1.22		0.28	0.24	0.28		0.78	0.19		0.84		0.23			2.26
10/20/94	0.37	0.72		0.17	0.15	0.14		3.98	0.35		0.48		0.25			2.61
11/15/94	0.30	1.46		0.17	0.17	0.07		1.63	0.38		0.59		0.39			1.23
4/19/95	0.16	0.17		0.03	0.07	0.08		0.33	1.16		0.08		0.09			0.08
4/26/95	0.24	0.48		0.10	0.10	0.38		0.87	0.15		0.19		0.14			
5/25/95	0.47	0.73	0.95	0.26	0.22	0.56	0.78		0.38	0.41	0.50	0.47	0.47	0.24	0.46	
6/1/95	0.37	0.71		0.37	0.33	0.70	0.69	1.55	0.50	0.45	0.53	0.64	0.68	0.42	0.60	1.48
6/7/95	0.50	0.77		0.38	0.39	0.69	0.71	1.68	0.50	0.38	0.48	0.54	0.49	0.31	0.57	
Average	**0.31**	**0.62**	**0.95**	**0.21**	**0.23**	**0.34**	**0.72**	**1.70**	**0.40**	**0.41**	**0.53**	**0.55**	**0.30**	**0.32**	**0.54**	**1.26**

Appendix E

Exeter/Squamscott Watershed CNPCP sampling results															
blanks and "ns" indicates no sample was collected, "nd" means no detection															
xxx-indicates no results due to testing problems															
pH															
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	6.81	6.87	7.03	9.15	6.79	6.75	6	6.76	5.57	5.78	6.79	6.76	6.81	6.68	6.7
60795	7.05	6.69	6.8	6.76	6.99	6.66	6.75	6.82	7.18	7.09	6.73	6.75	6.82	7.05	6.87
62195	6.6	6.88	ns	ns	6.49	6.2	6.38	6.39	ns	6.49	6.35	nd	6.46	6.25	ns
62795	7.01	7.22	ns	6.84	6.9	6.37	6.43	6.44	6.82	6.75	6.52	6.54	6.62	6.62	6.61
91795	6.6	7.11	7.11	7.03	7.01	6.6	7.06	7.09	6.93	6.92	7.1	ns	ns	ns	ns
MEDIAN	6.81	6.88	6.80	6.84	6.90	6.60	6.43	6.76	6.82	6.75	6.73	6.65	6.72	6.65	6.66
TSS mg/L															
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	5.8	75.33	3.6	2	4.2	33	66.5	2.2	12.6	2	8.2	1.6	1.8	2	1.8
60795	13.4	22.4	7.2	2.6	3.8	27.2	3.6	2.4	2.2	2	13.75	1.8	1.2	2	8
62195	2.9	9.4	ns	ns	1.7	33	1.88	ns	ns	0.4	12.6	0.6	0	0.5	ns
62795	2	1.89	ns	8.29	3	34.33	2.3	3.6	1	3.47	10.17	5.67	0.33	1.1	0.9
91795	24	70	30.2	5.75	2.12	72.33	15.2	4.13	25.5	4.5	11.33	ns	ns	ns	ns
%org															
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	24.14	18.14	22.22	50	42.86	15.15	25.56	36.36	25.4	70	29.27	75	66.67	70	66.67
60795	20.9	18.75	27.78	53.85	42.11	16.18	50	41.67	27.27	40	20	77.78	66.67	60	57.5
62195	31.03	19.15	ns	ns	64.71	19.19	93.33	ns	ns	0	25.4	0	0	0	ns
62795	35	23.53	ns	94.83	50	20.39	56.52	47.22	60	39.39	29.51	47.06	100	63.64	77.78
91795	20.83	14.29	27.81	67.39	76.47	5.99	35.53	33.33	28.76	33.33	17.65	ns	ns	ns	ns
Tot P mg/L								totp							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	0.027	0.206	0.031	0.094	0.052	0.111	0.215	0.026	0.074	0.013	0.044	0.011	0.015	0.019	0.036
60795	0.036	0.086	0.089	0.146	0.089	0.061	0.045	0.034	0.016	0.022	0.127	0.022	0.02	0.021	0.196
62195	0.023	0.018	ns	ns	0.096	0.053	0.049	0.04	ns	0.023	0.183	0.025	0.017	0.022	ns
62795	0.021	0.014	ns	0.39	0.096	0.03	0.039	0.037	0.003	0.031	0.172	0.025	0.016	0.017	0.032
91795	0.102	0.227	0.241	0.123	0.033	0.12	0.13	0.029	0.156	0.021	0.078				
NO3-NO2-N	mg/L							NO3-NO2							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	nd	0.35	0.77	nd	nd	nd	0.2	nd	0.91	nd	0.13	nd	nd	nd	nd
60795	nd	nd	0.25	nd	nd	nd	0.1	nd	1.67	nd	nd	nd	nd	nd	nd
62195	0.19	1.69	ns	ns	nd	nd	nd	nd	ns	nd	nd	nd	nd	0.3	ns
62795	0.3	4.05	ns	nd	nd	nd	0.39	0.11	2.14	nd	nd	0.15	nd	0.23	0.23
91795	0.76	0.33	0.28	0.07	0.06	0.12	0.14	0.08	0.15	0.1	0.32				
NH3-N	mg/L							NH3-N							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	nd	0.4	nd	nd	nd	0.2	0.1	nd	0.2	nd	nd	nd	nd	nd	nd
60795	nd	nd	0.2	nd	nd	0.12	nd	nd	nd	0.12	0.24	nd	nd	nd	0.24
62195	nd	nd	ns	ns	nd	0.8	nd	nd	ns	nd	0.1	nd	nd	nd	ns
62795	0.16	nd	ns	0.1	nd	0.78	nd	nd	nd	nd	0.11	nd	nd	nd	nd
91795	0.14	0.23	0.2	0.12	nd	0.13	0.17	0.11	0.15	0.1	nd				
Fecal	cts/100ml							FECAL							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	20	940	30	<10	510	120	120	160	300	60	310	60	180	370	270
60795	840	>2000	>2000	40	310	1550	170	160	620	80	>2000	80	80	110	620
62195	20	210	ns	ns	10	120	60	40	ns	100	660	30	50	80	ns
62795	790	680	ns	30	270	1700	60	130	20	110	620	30	40	90	150
91795	>2000	>2000	>2000	120	20	>2000	>2000	40	840	360	730				
E.Coli	cts/100ml														
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	20	>2000	40	<10	770	80	120	230	250	110	400	110	180	250	100
60795	930	1800	2500	10	40	1410	150	190	620	80	9800	60	50	150	580
62195	50	360	ns	ns	40	130	40	31	ns	20	1450	40	30	130	ns
62795	580	650	ns	<10	280	1400	60	180	140	180	780	110	40	220	200
91795	>2000	xxx	xxx	120	40	>2000	xxx	80	xxx	440	770				

Cu	mg/L							Cu							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	ns	0.008	0.016	0.015	nd	nd	0.02	nd	nd	0.035	nd	nd	nd	nd	nd
60795	nd	0.0068	0.0068	nd	0.008	nd	nd	nd	0.0058	nd	nd	nd	nd	nd	nd
62195	nd	nd	ns	ns	nd	nd	nd	nd	ns	0.0026	0.0044	nd	nd	nd	ns
62795	nd	nd	ns	nd	nd	0.0029	nd	nd	nd	nd	nd	nd	nd	nd	nd
91795	0.0085	0.0115	0.0105	nd	0.003	0.0095	0.0175	0.003	0.0125	0.003	0.004				
Cd	mg/L							Cd							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	ns	nd	nd	nd	nd	nd	0.0005	nd	nd	nd	nd	nd	nd	nd	nd
60795	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
62195	nd	nd	ns	ns	nd	nd	nd	nd	ns	nd	nd	nd	nd	nd	ns
62795	nd	nd	ns	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd -	nd
91795	nd	nd	nd	nd	nd	nd	nd	0.0005	nd	nd	nd				
Zn	mg/L							Zn							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	ns	0.105	0.034	nd	nd	nd	0.099	nd	0.026	nd	nd	nd	nd	nd	nd
60795	nd	0.058	0.037	nd	nd	0.044	nd	nd	0.025	nd	nd	nd	0.025	nd	nd
62195	nd	0.036	ns	ns	nd	nd	nd	nd	ns	nd	nd	nd	nd	nd	ns
62795	nd	0.033	ns	nd	nd	0.03	nd	nd	nd	nd	nd	nd	nd	nd	nd
91795	0.026	0.094	0.031	0.054	nd	0.051	0.048	nd	nd	nd	nd				
Al	mg/L							Al							
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	ns	1.73	0.228	0.093	0.212	1.36	1.67	0.128	0.82	0.091	0.334	0.062	0.077	0.078	0.083
60795	0	1.04	0.376	0.048	0.187	1.01	0.111	0.134	0.183	0.104	0.043	0.057	0.051	0.063	0.113
62195	0.146	0.142	ns	ns	0.088	1.35	nd	nd	ns	0.058	0.542	nd	nd	nd	ns
62795	0.103	0.135	ns	nd	0.07	1.51	nd	0.089	0.076	0.176	0.458	0.055	nd	nd	nd
91795	1.57	3.29	1.03	0.108	0.113	4.29	0.459	0.137	1.04	0.131	0.759				
temp	°C														
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	13.2	10.6	9.4	12.1	10.8	9.5	9.9	12	10	12.5	11.1	12.4	13.1	12.5	12.7
60795	18.6	19.1	19.1	21.2	20	19.5	21	20.4	15.7	19.7	18.6	20.8	19.9	19.2	17.8
62195	19.5	15.5	ns	ns	20.7	18.9	22	22.7	ns	20.8	19.5	24	22.9	22	ns
62795	17.6	14.8	ns	20.2	21.5	20.9	20.6	20.2	15.3	19.6	18.6	21.9	21.8	20.4	19.7
91795	14.5	18.8	17.8	18	15.6	16.8	17.6	16.9	16.8	14.7	15.8				
cond.	umhos														
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	280	150	200	410	110	160	110	110	30	100	120	90	100	80	320
60795	290	89	79	700	120	259	130	140	190	125	170	120	120	125	375
62195	330	700			135	430	150	150		140	175	130	135	145	
62795	365	700		1200	130	430	150	145	220	135	180	130	135	140	140
91795	300	90	85	5500	150	85	15	110	20	215	185				
DO	mg/L														
Date	ExW1	ExW2	ExW3	ExW4	ExW5	ExW6	ExW7	ExW8	ExW9	ExW10	ExW11	ExW12	ExW13	ExW14	ExW15
51195	8.4	9.8	10	8.6	9.4	10.2	10.2	8.2	10.5	10.2	9	8.1	9	8.8	8.9
%sat	80	88	87	80	85	89	90	76	93	93	81	80	85	83	84
60795	7.2	7.5	7.5	4	6.6	7.1	5.6	5.4	9.4	7.7	5.2	7	6.7	7.1	6.2
%sat	77	82	81	45	75	77	63	59	95	85	56	79	74	77	66
62195	5.9	8.6	ns	ns	6	3.7	6.1	8.6	ns	7.4	3.8	6.5	5.5	5.9	ns
%sat	64	87			67	40	70	101		84	41	77	65	68	ns
62795	5.9		ns	4.4	6.3	2	3.8	3.6	9.2	7.4	3.4	6.3	5.2	6.4	4.9
%sat	62		ns	48	72	22	43	40	92	81	37	72	60	71	54
91795	7.7	8.4	8.9	6.9	8.5	8.4	8.8	6.2	9.0	7.8	6.7				
%sat	75	90	95	73	86	87	93	65	94	77	68				

Appendix F

EXETER/SQUAMSCOTT NPS PROJECT
WQ MONITORING BUDGET (1995)

This budget is included for reference. TSS/% organic analyses were completed at UNH.
All other anlayses were completed at NHDES.

	UNIT	15 SITES
TEST	COST	4 STORMS
FECAL	7	420
E COLI	7	420
COPPER	6	360
ZINC	6	360
ALUM.	6	360
CADMIUM	6	360
T PHOS.	8	480
NH3-N	9	540
NO3-NO2-N	7	420
TSS/%ORG	10	600
TOTAL		**3900**

Appendix G

ENVIRONMENTAL Fact Sheet

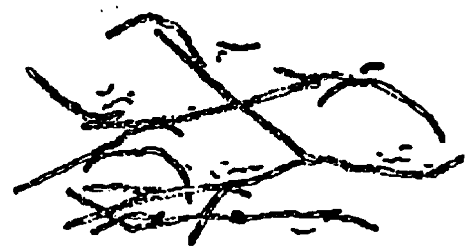
NEW HAMPSHIRE DEPARTMENT OF
Environmental Services
6 Hazen Drive, Concord, NH 03301

NHDES Technical Bulletin WSPCD-BB-1993-2

Iron Bacteria In Surface Water

What are iron bacteria?

Iron bacteria are bacteria that 'feed' on iron. Unlike most bacteria, which feed on organic matter, iron fullfill their energy requirements by oxidizing ferrous iron into ferric iron. When ferrous iron is converted to ferric iron, it becomes insoluble and precipitates out of the water as a rust-colored deposit. This process can occur simply by exposing iron-rich groundwater to the atmosphere. However, if the deposit is slimey and clumpy, it is probably caused by iron bacteria.



Are iron bacteria harmful?

Iron bacteria are of no threat to human health. They are found naturally in soils and water. However, the orange slime in the water or leaching from the shore is often considered to be an aesthetic problem. The oily sheens created by the decomposing bacteria cells are often mistaken for petroleum sheens.

What causes iron bacteria?

Iron is a common element in New Hampshire soils. Consequently, iron-fixing bacteria have existed in our natural waters for over a million years. Iron-rich fill material or bedrock can create an iron bacteria problem whenever it is located near water. In general, wherever there is oxygen, water and iron there is the potential for an iron bacteria problem.

How can we identify iron bacteria?

Orange or brown slime (precipitate) and oily sheens are often the first indication that these bacteria are present. Unlike petroleum sheens the iron bacteria sheens break apart when they are disturbed. The orange or brown slime may be collected in a jar and analyzed microscopically at DES to identify the bacteria type.

What can we do about iron bacteria?

The best treatment for an iron bacteria problem is prevention. To thwart these obnoxious bacteria, have all fill material analyzed for iron content before using or exposing it. Unfortunately, once established, iron bacteria problems are difficult, if not impossible to correct. Sometimes iron-rich fill can be replaced by fill with a lower iron content. However, this may be extremely costly and have other environmental impacts. Since iron bacteria are not harmful, sometimes the only feasible thing that people can do is simply to accept it for the natural occurrence that it is.

For further information: For more information on iron bacteria, please contact DES' Biology Bureau 603-271-3503.