

PROJECT PLAN

Level I Water Quality Inventories

Weir Farm NHS, Minute Man NHP, Marsh-Billings NHP
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Introduction

In association with the *Baseline Water Quality Data Inventory and Analysis Program*, the NPS-Water Resources Division has assembled existing water quality data sets collected in most park units throughout the nation. Three small parks in New England (Weir Farm NHS, Minute Man NHP, and Marsh-Billings NHP) were found to have depauperate water quality data bases, thereby requiring Level I water quality inventories. As defined by the NPS Inventory and Monitoring Program, a Level I water quality inventory includes sampling basic water quality parameters for key water bodies within park boundaries. Key water bodies are either those essential to the cultural, historical or natural resources management themes of the park or those that provide habitat for rare plants or animals.

The purpose of this study is to collect water quality data at the three parks to meet the Level I needs. Moreover, this study will identify key water quality management issues at each park, if warranted, and recommend appropriate long-term water quality monitoring strategies.

Study Sites

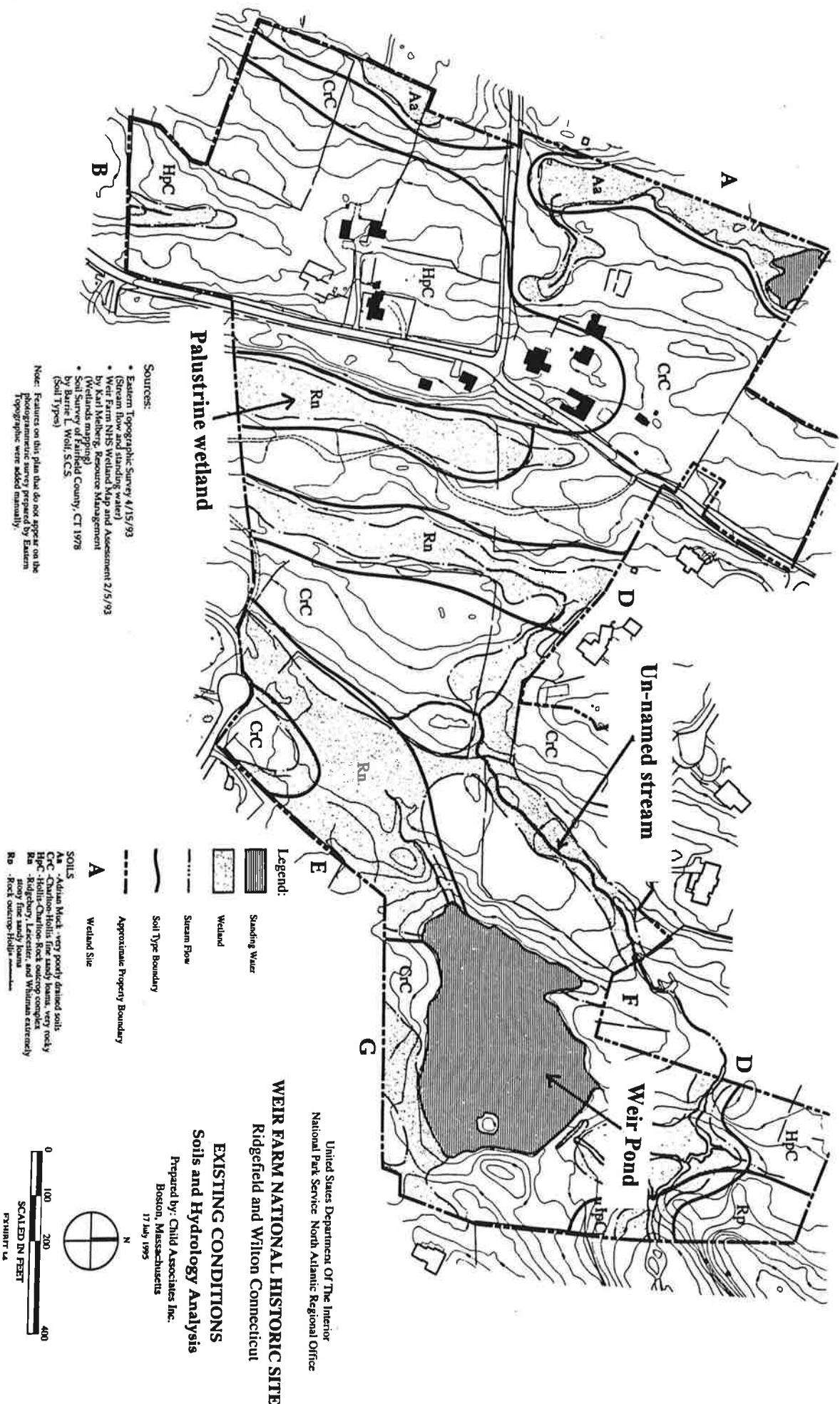
Three parks are participating in this effort -- Weir Farm NHS (WEFA) in Ridgefield and Wilton, CT; Minute Man NHP (MIMA) in Concord, MA; and Marsh-Billings NHP (MABI) in Woodstock, VT. The water resources to be included in the Level I water quality inventory are described below.

Weir Farm NHS

Weir Farm NHS is a historic farmstead and reserve in western Connecticut. Land use adjacent to Weir Farm is residential, serviced by on-site septic systems. Three sites will be sampled: 1) Weir Pond, 2) a palustrine wetland and 3) an un-named stream (Fig. 1).

Weir Pond -- A natural resource evaluation report (USDA, 1995) described Weir Pond as follows: "Weir Pond is approximately 3.68 acres in size, with a watershed of 33.6 acres. The pond has a shoreline of 1,774 feet. Three intermittent streams feed the pond during periods of runoff. Groundwater provides most of the inflow during low runoff periods. A dam that impounds Weir Pond is constructed of boulders. Buttonbush, willow, red maple, marsh fern and royal fern dominate the pond perimeter at elevations between 1-2 feet above the high water line." Land use throughout much of the pond watershed is residential served by on-site individual septic systems, thus, there is concern for nutrient loading from septic systems and lawn maintenance.

Figure 1. Weir Farm NHS



Palustrine wetland -- Numerous permanent and intermittent palustrine wetlands are distributed throughout the Park and have been mapped and described in a natural resource evaluation (USDA 1995). One of these wetlands, a complex of palustrine forested, palustrine scrub-shrub, palustrine emergent and palustrine open water has been identified as an important site for monitoring, and may be representative of the water quality status of wetlands within the park. This wetland receives runoff from a local road and parking area as well as inputs from adjacent residential development. Preliminary plans are also under consideration for placement of the park's new septic system leach field adjacent to this wetland complex.

Un-named stream -- Several small streams flow through associated wetlands within the park. Most of these streams flow year-round, except perhaps during extreme drought periods in the summer. A major concern for water quality in these streams are their response to nutrient loading from residential septic systems and lawn maintenance. Additionally, a planned expansion of a nearby highway could impact hydrology and water quality of this stream and associated wetlands. This representative stream will be sampled to evaluate the impact of these factors.

Minute Man NHP

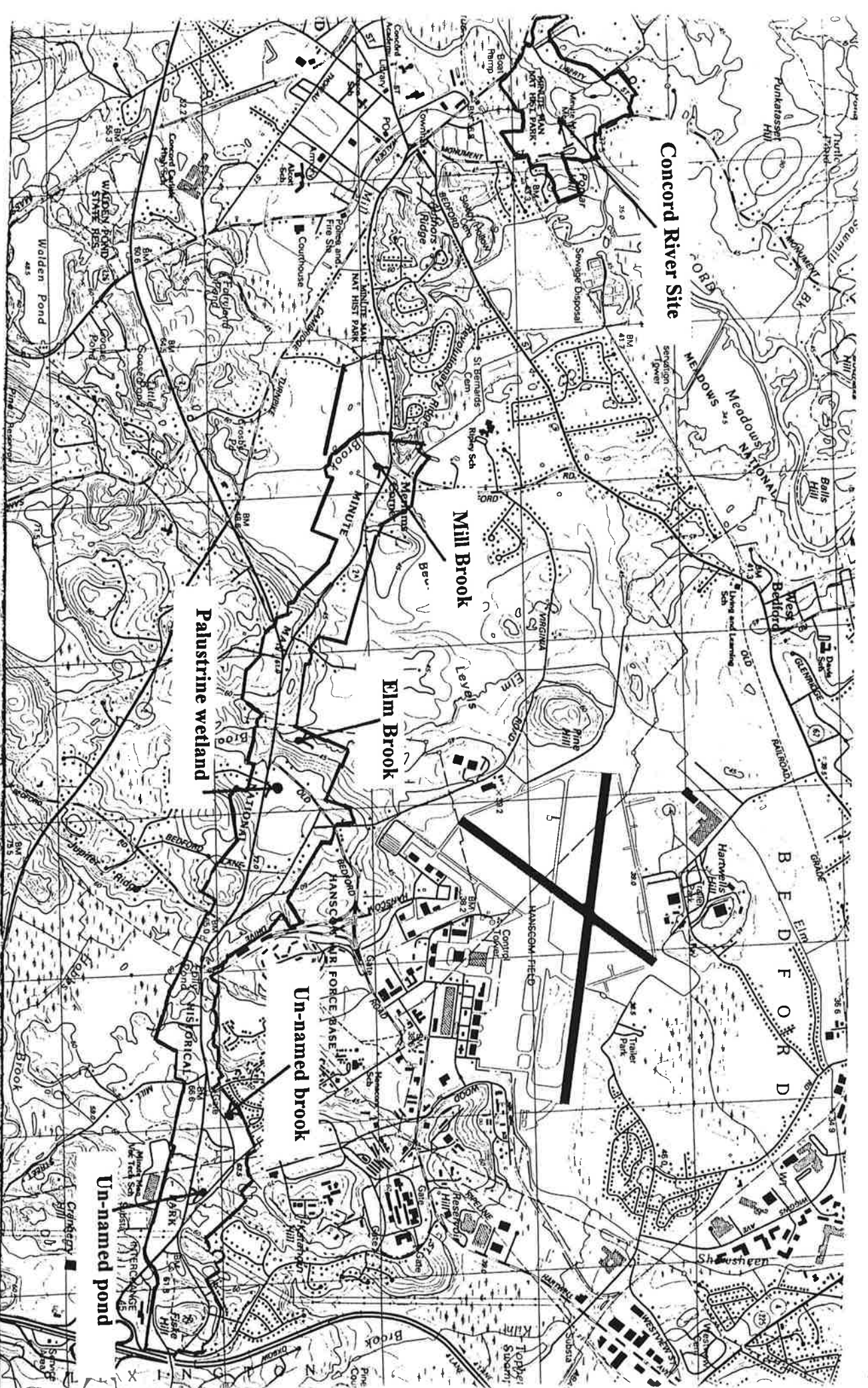
Minute Man NHP is located near Boston, in a highly suburbanized watershed. Six sites will be sampled: 1) the Concord River, 2) Mill Brook, 3) Elm Brook, 4) a palustrine wetland associated with the Elm Brook watershed, 5) an un-named brook and 6) an un-named pond both flowing from Hanscom Air Force Base (Fig. 2). A seventh site, Folly Pond, is presently being monitored as past research showed significant contamination from the old landfill activities at this site. The past and on-going monitoring at this site obviates the need for including this site in the present study.

Concord River at Old North Bridge -- The North Bridge Unit of MIMA is located on the Concord River. Immediately upstream of the park, the Concord River is formed at the confluence of the Sudbury and Assabet Rivers. USGS gauging stations are located on the Sudbury River, several kilometers upstream of the North Bridge, and many kilometers downstream on the Concord River in Lowell (near its' discharge to the Merrimack River). Land use within the Sudbury, Assabet, and upper Concord River watersheds is highly residential/suburban. The Concord River displayed concentrations that exceeded the EPA level of concern for dissolved oxygen, pH, dissolved copper and fecal coliform (NPS Water Resources Division 1996).

Mill Brook -- Mill Brook flows through the Battle Road Unit, is associated with the Concord River basin, and a portion of the Mill Brook headwaters lie within MIMA. Sources of water quality degradation include road runoff and limited agriculture.

Elm Brook -- The headwaters of Elm Brook lie just outside the MIMA boundary. Elm Brook contains some of the parks more extensive wetlands (mostly shrub-forested

Figure 2. Minute Man NHP



wetlands). Sources of water quality degradation include road runoff and limited agriculture.

Palustrine wetland -- This wetland is a red maple/white cedar swamp with a shrub layer of buttonbush and high bush blueberry and various herbaceous species. It is contained within the Elm Brook sub-watershed.

Un-named brook and wetlands -- In addition to Mill Brook and Elm Brook, several small brooks flow through the Battle Road Unit. One of these brooks (un-named) is of concern because it flows from the Hanscom Air Force Base, a highly industrialized area.

Un-named pond -- This basin is an open basin fringed with red maple stands. The shore is cleared of vegetation on the western and southern shoreline. There is a residence for park employees next to the ponds. This pond is partly fed by streams running out of Hanscom Air Force Base.

Marsh-Billings NHP

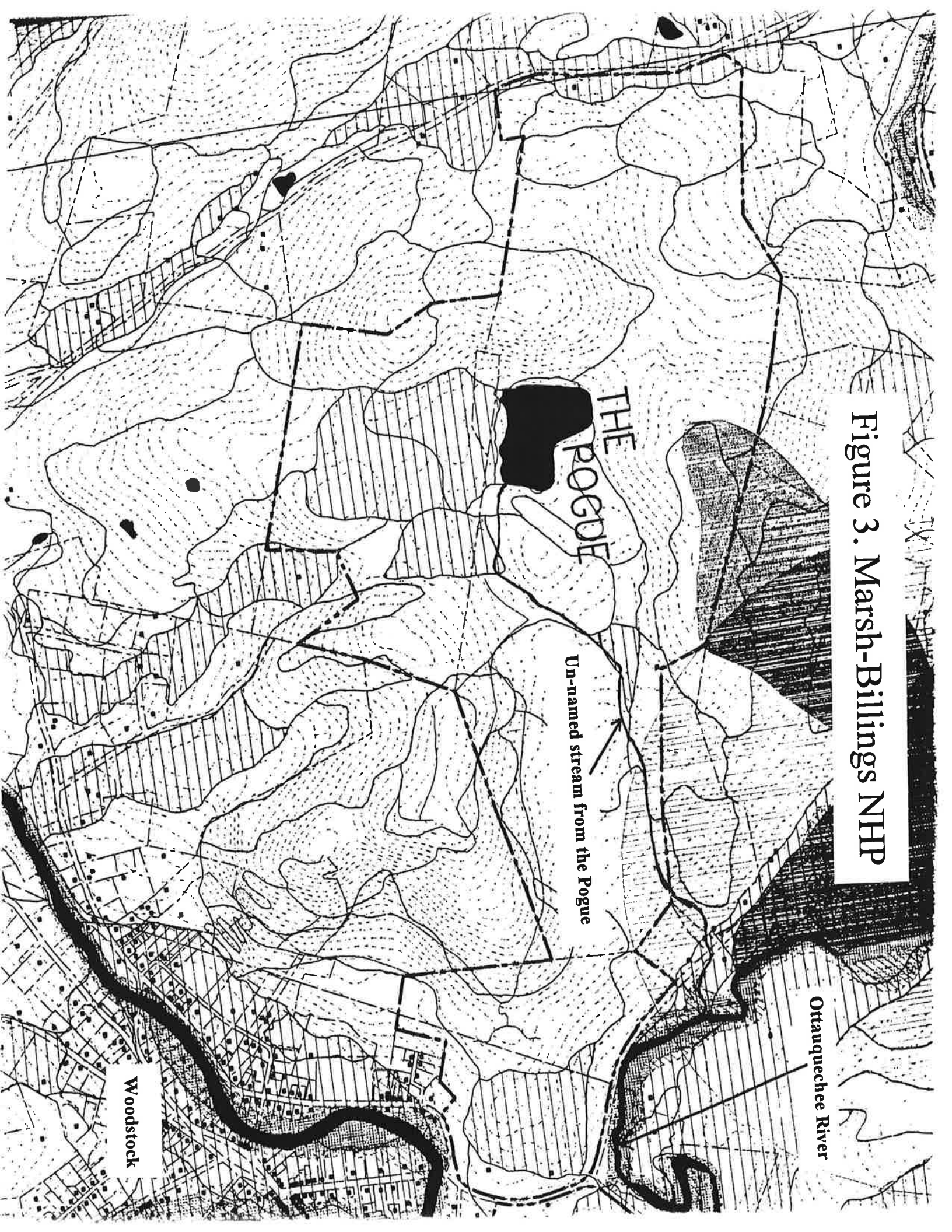
Marsh-Billings NHP is a historic farmstead and estate occupying the slope and base of a mountain in Woodstock, a resort community (Fig. 3). Two sites will be included in the Level I inventory; 1) The Pogue, and 2) un-named stream flowing from The Pogue.

The Pogue -- The Pogue is a 15 acre pond situated at the summit of Mount Tom. The watershed consists of oak and beech forests and the pond has a narrow band of emergent vegetation dominated by sedges and rushes. The Pogue is fed by springs, with input by surface streams. The Pogue's source waters are entirely within Park boundaries; therefore the pond is minimally affected by anthropogenic activities. However, The Pogue is vulnerable to nutrient and chemical loading from atmospheric deposition. Seasonal water quality monitoring would help assess the impact of this loading source.

Un-named stream from The Pogue -- One major stream flows from the Pogue. This stream, a human-made drainage creek, exits the pond via a spillway. The stream passes through a cow pasture before it exits the park and eventually flows into Barnard Brook and the Ottauquechee River. Elevated ammonia and fecal coliform levels have been noted within the stream, probably a result of pasturing of cattle within and adjacent to the stream (NPS Water Resources Division 1997). The park has subsequently restricted access of cattle to the stream. Sampling of the stream, just downstream of the cow pasture, is planned.

The farmstead at the base of the mountain fronts the Ottauquechee River and is a part of the park's protection zone. However, sampling of this major river is not necessary because contributions by the park to its' water quality are better assessed in the stream flowing out of the park into Barnard Brook and the Ottauquechee River.

Figure 3. Marsh-Billings NHP



Principal Investigators

Charles Farris (NESO-Boston) will serve as principal investigator on this project. Krista Lee, chemist at CACO, will perform laboratory analyses except for the volatile organic compounds that will be done at the Barnstable County Department of Health laboratory. The fecal coliform samples that will be analyzed by a laboratory contracted by the Woodstock, VT Department of Public Works. A part-time GS5/7 technician will be hired to facilitate field collections, lab analyses, and data management. For each data collection, it is intended that Dr. Farris and the technician will visit the park and collect the appropriate samples in cooperation with park personnel. Equipment calibration, lab analyses and data management will be performed by Krista Lee and the technician. Charles Farris will be responsible for preparation of the final data reports and recommendation of future monitoring actions.

Sampling plan

The objective of this water quality monitoring program is not to assemble a comprehensive data base, but rather to obtain a baseline of environmental variables. Should degrading trends in these fundamental variables be noted, then management should implement a more comprehensive program to clearly assess the problem.

Once a season, from October 1998 to October 1999, monitoring sites will be chosen at each park. Samples will be collected in the fall (October - November 1998), winter (January - February 1999), spring (March - April 1999) and summer (July - August 1999). Parameters will be sampled at each Park Unit as outlined in Table 1.

Table 1 Sampling parameters for each station

Park Unit	Station	Sampling Parameters
Weir Farm	Weir Pond	Alkalinity, chlorophyll a, conductivity, total and dissolved nutrients, dissolved oxygen, pH, turbidity, temperature, water level
	Palustrine wetland	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, temperature, water level
	Un-named stream	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, temperature, discharge
Minute Man NHP	Concord River	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, temperature, turbidity, copper, VOC
	Mill Brook	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, temperature, discharge

	Elm Brook	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, temperature, discharge
	Palustrine wetland	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, temperature, water level
	Un-named brook	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, temperature, discharge
	Un-named pond	Alkalinity, chlorophyll a, conductivity, total and dissolved nutrients, dissolved oxygen, pH, turbidity, temperature, water level
Marsh-Billings NHP	The Pogue	Alkalinity, chlorophyll a, conductivity, total and dissolved nutrients, dissolved oxygen, pH, turbidity, temperature, water level
	Un-named stream	Alkalinity, conductivity, total and dissolved nutrients, dissolved oxygen, pH, fecal coliform, temperature, discharge

Protocols

Site Access

Pond stations will be sampled from canoe at the middle of the basin. Small streams will be sampled from the shore. Wetland samples will be sampled from the water's edge. The palustrine wetland at MIMA will be sampled from a boardwalk in the middle of the wetland. The Concord River will be sampled from the Old North Bridge. All sampling locations will be identified by GPS coordinates.

Sample collection techniques

For the ponds, surface to bottom profiles will be conducted with a Hydrolab at 0.5 m intervals for dissolved oxygen, pH, temperature, conductivity and turbidity. Discrete water samples will be collected just below the surface (0.25 m), unless the Hydrolab profiles indicate a stratified water column. Then surface, mid-depth and bottom samples will be collected. For streams and the Concord River station and the wetland stations, only surface samples will be collected. Pond samples will be collected with a Kemmerer bottle. Stream and wetland samples will be collected with sample bottles submerged below the surface.

For alkalinity, 60-ml sample bottles will be filled to overflowing, capped without an airspace and placed on ice for transport to the CACO laboratory. A one-liter bottle will

be collected and placed on ice for transport to the CACO laboratory for the chlorophyll a and copper samples. Twenty ml of water will be placed in pre-cleaned test tubes and fixed with potassium persulfate and transported to the CACO laboratory for total nitrogen and phosphorus samples. Sixty-ml sample bottles for dissolved nutrients will be filled with water filtered through 0.4 micrometer Millipore filters, preserved with 2 N hydrochloric acid and iced for transport to CACO. Standardized 60-ml vials will be filled and placed on ice for fecal coliform analysis. All samples will be kept in the dark at 4°C until analysis preparation is completed.

Analytical techniques

Hydrolab parameters to be collected are dissolved oxygen, pH, temperature, conductivity and turbidity. The Hydrolab Mini-Sonde will be calibrated for these parameters at the CACO laboratory according to manufacturers' specifications before each sample trip. Water discharge will be measured by conducting cross-sectional profiles in the field with a Marsh-McBirney Model 201 electromagnetic flowmeter. Water levels will be established and monitored using demarcated staffs.

Discrete samples

Alkalinity: Measurement will be by potentiometric titration using a bromocresol indicator (American Public Health Association 1992).

Chlorophyll a: The water samples will be filtered at the lab through a Whatman GFF filter. The filter will be ground up and extracted with acetone. Then chlorophyll levels in the acetone extract will be measured by on a spectrophotometer (Lorenzen 1966).

Dissolved nutrients: Dissolved inorganic nutrients (nitrate, nitrite, ammonia, and phosphate) will be determine colorimetrically on a Lachat autoanalyzer (American Public Health Association 1992; Lachat Instruments 1993, 1994).

Total nitrogen and phosphorus: Total nitrogen and phosphorus will be determined simultaneously by potassium persulfate digestions followed by colorimetric analysis on the Lachat autoanalyzer (Valderrama 1981).

Copper: Copper concentrations in the water column will be measured by atomic absorption spectrophotometry (Fishman and Downs 1966).

Volatile organic compounds: VOCs will be measured by purge and trap, packed column Gas Chromatography-Mass Spectrophotometry (American Public Health Association 1992).

Fecal coliform: Coliform levels will be determined by the fecal coliform procedure using A-1 EC medium (American Public Health Association 1992)

Data management and Archiving

All collected data will be entered in a central database at CACO maintained by Charles Farris and the GS5/7 technician. This database will be formatted to be compatible with the Environmental Protection Agency's national water quality database, STORET. The database will have measured variable values for each sample. The sampling method, detection limit and information about the filtering method and fraction will be included when necessary. The database will also contain information that will assign a unique station name and have descriptive information and GPS coordinates for each station. After the completion of this database, all data will be added to STORET.

References Cited:

American Public Health Association 1992. Standard methods for the examination of water and wastewater, 17th edition. 1134 pg.

Fishman, M. J. and S. C. Downs 1966. Methods for analysis of selected metals in water by atomic absorption. Geol. Survey Water-Supply paper 1540-C. GPO Wash. DC.

Lachat Instruments 1993. Nitrate in brackish or seawater. QuikChem Method 31-107-04-1-A. Lachat Instruments Milwaukee, WI.

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Lachat Instruments 1994. Ammonia in brackish or seawater. QuikChem Method 31-107-06-1-A. Lachat Instruments Milwaukee, WI.

Lorenzen, C. J. 1966. A method for continuous measurement of *in vivo* chlorophyll concentration. Deep-Sea Res. 13:223-230.

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NPS Water Resources Division 1997. Baseline water quality data inventory and analysis – Marsh-Billings National Historical Park. Water Resources Division and Servicewide Inventory and Monitoring Program.

U.S. Department of Agriculture 1995. The Weir Farm natural resource evaluation project. #IA 1600-3-9001. USDA Natural Resources Conservation Service. 43 pg.

Valderrama, J. C. 1981. The simultaneous analysis of total nitrogen and total phosphorus in natural waters. Marine Chemistry 10: 109-122.

Schedule

Late Summer/Fall 1998	purchase equipment and supplies hire technician
Fall 1998 to Fall 1999	conduct field data collections sample analysis data management
December 1999	submit final report

Budget

	FY98	FY99
<i>Personnel</i>		
C. Farris (0.1 FTE)	NESO match	NESO match
K. Lee (0.1 FTE)	CACO match	CACO match
Technician (GS 5/7, 0.4 FTE)	\$800	\$11,000
<i>Travel</i>		
Technician		\$800
Farris	NESO	
<i>Equipment</i>		
Hydrolab or YSI	\$6,900	
Laptop computer	\$3,000	
<i>CACO Lab Costs</i>		
Start-up (bottles, reagents, etc)	\$300	
Sample analysis		\$2,000
<i>Fecal Coliform Analysis</i> <i>(estimated)</i>		\$400
TOTAL COSTS	\$11,000	\$14,200