Vermont

Lake Champlain Basin Watersheds
Section 319
National Monitoring Program Project

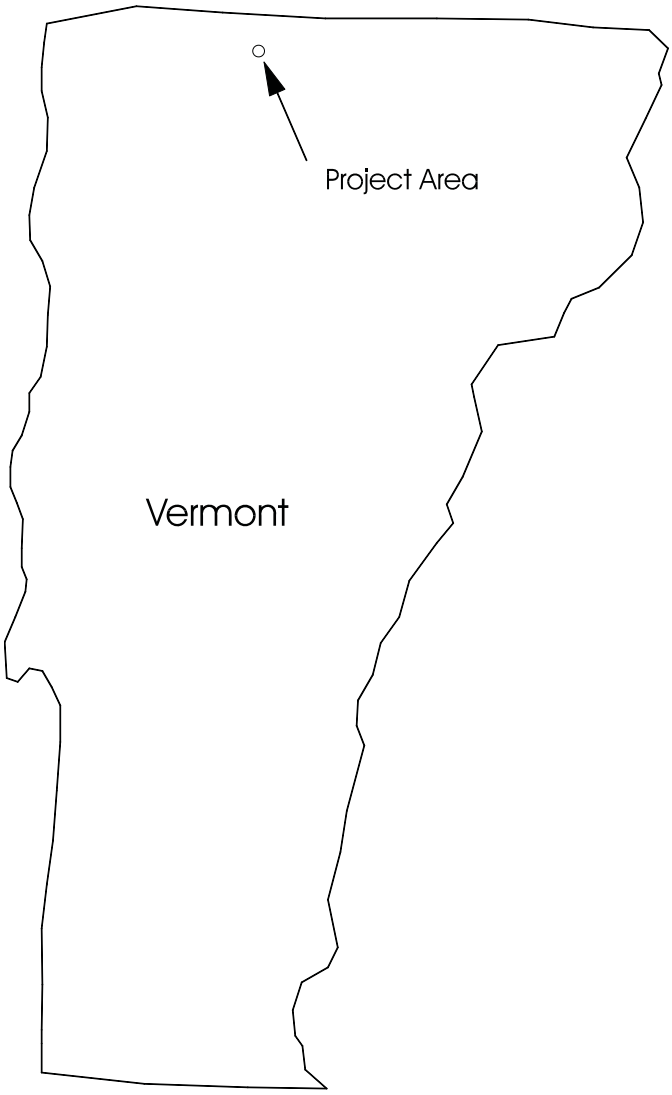

Figure 50: Lake Champlain Basin (Vermont) Watersheds Project Location

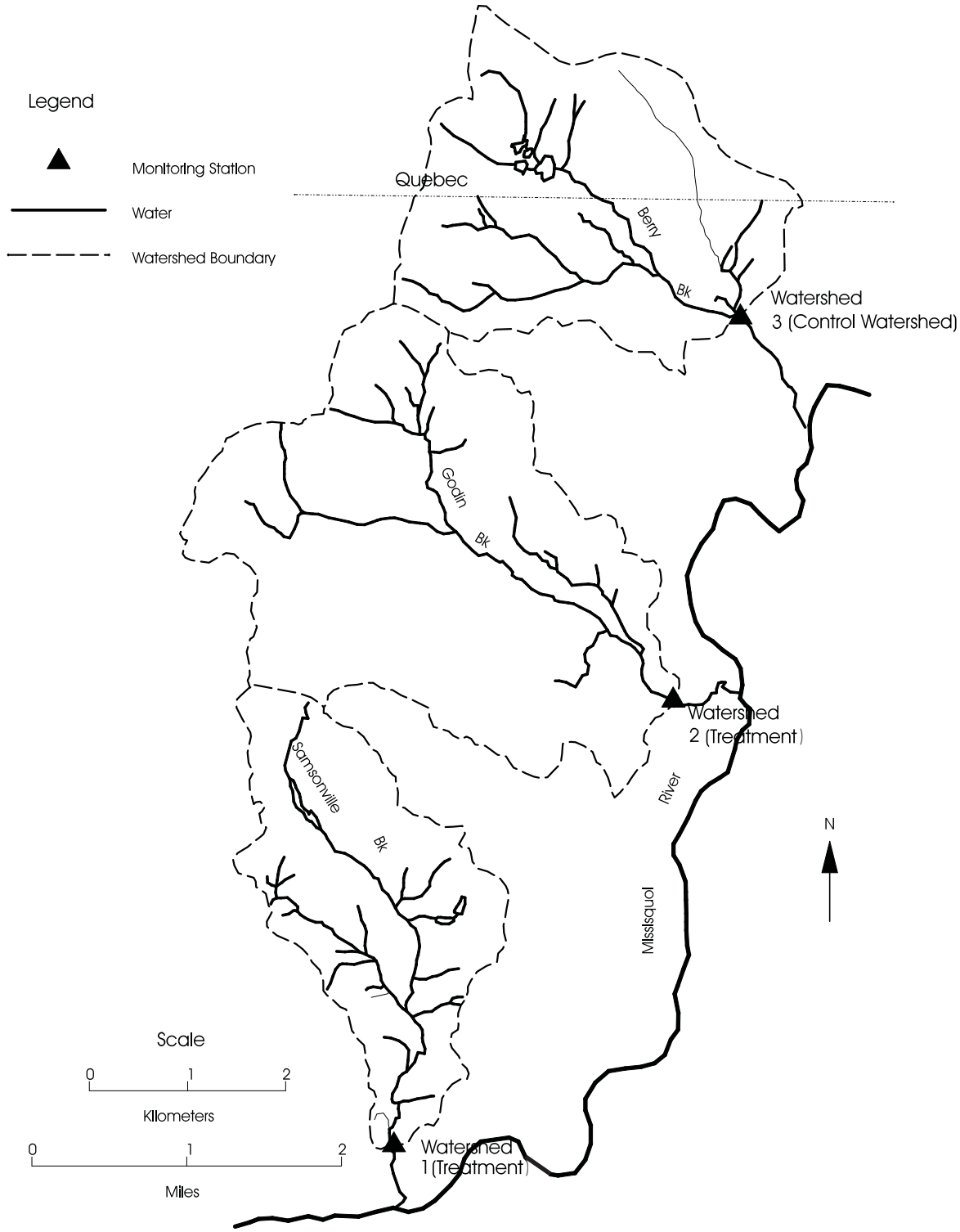

Figure 51: Water Quality Monitoring Stations for Lake Champlain Basin (Vermont) Watersheds

PROJECT OVERVIEW

The Lake Champlain Basin Watersheds Section 319 National Monitoring Program project (also known as the Lake Champlain Agricultural Watersheds Best Management Practice Implementation and Effectiveness Monitoring Project) is located in northcentral Vermont in an area of transition between the lowlands of the Champlain Valley and the foothills of the Green Mountains (Figure 50). Agricultural activity, primarily dairy farming, is the major land use in this area of Vermont.

The streams in these project watersheds drain into the Missisquoi River, a major tributary of Lake Champlain. The designated uses of many of the streams in this region are impaired by agricultural nonpoint source pollution. The pollutants responsible for the water quality impairment are nutrients, particularly phosphorus, *E. coli*, fecal streptococcus, fecal coliform bacteria, and organic matter. The source of most of the agricultural nonpoint source pollution is the manure generated from area dairy farms, livestock activity within streams and riparian areas, and crop production. The Missisquoi River has the second largest discharge of water and contributes the greatest nonpoint source load of phosphorus to Lake Champlain.

The Lake Champlain Basin Watersheds 319 National Monitoring Program project was designed to evaluate a set of treatments to control the pollutants generated by agricultural activities, focusing on grazing management and riparian restoration. A system of best management practices (BMPs) has been implemented to exclude livestock from selected critical areas of streams and to protect stream crossings, streambanks, and riparian zones. Individual BMPs included fencing, minimization of livestock crossing areas in streams, strengthening of necessary crossings, watering systems, and streambank stabilization through bioengineering techniques.

The water quality monitoring program was based on a three-way paired design: one control watershed and two treatment watersheds receiving similar BMP systems at different intensities (Figure 51). The watersheds have been monitored during a three-year calibration period prior to BMP implementation. Implementation has occurred and post-treatment monitoring continued for three years.

Biological, chemical, and covariates were monitored during all three monitoring phases. Fish, macroinvertebrates, fecal streptococcus, fecal coliform, and *E. coli* bacteria are the monitored biological parameters. The chemical parameters monitored were total phosphorus, total Kjeldahl nitrogen, total suspended solids, dissolved oxygen, conductivity, and temperature. Two covariates, precipitation and continuous discharge, were also monitored.

Nutrients and suspended sediment were monitored in a flow-proportional weekly composite sample. Bacteria grab samples were collected twice weekly, with concurrent in-situ measurements of temperature, dissolved oxygen, and conductivity. Macroinvertebrate and fish communities were sampled annually. Invertebrate and fish monitoring were also conducted at an unimpaired local reference site. The project has been completed, with the Final Report dated June 2001.

PROJECT BACKGROUND

Project Area

1705 ac (WS 1) + 3513 ac (WS 2) + 2358 ac (WS 3) = 7576 ac

Relevant Hydrologic, Geologic, and Meteorologic Factors

The project area is in northcentral Vermont (Franklin County) in an area of transition between the lowlands of the Champlain Valley and the foothills of the Green Mountains. Average annual precipitation is about 41 inches; average annual temperature is about 42^{o}F. Frost-free growing season averages 118 days.

Most of the watershed soils are till soils, loamy soils of widely variable drainage characteristics. There are significant areas of somewhat poorly drained silt/clay soils in the lower portions of the watersheds.

Land Use

The three watersheds are generally similar in land use:

	WS1		WS2		WS3	
Land Use	Acres	%	Acres	%	Acres	%
Corn/hay	275	16	824	24	443	19
Pasture/ hay-pasture	137	8	530	15	231	10
Forest	1153	68	1908	54	1443	61
Other	140	8	250	7	242	10

Source: 2000 FSA aerial photography, farmer interviews, ground-truthing

Water Resource Type and Size

The study streams are small second- or third-order permanent streams that drain to the Missisquoi River, a major tributary of Lake Champlain. The streams are generally 10-15 feet wide at the monitoring stations. Historical stream flow data do not exist for these streams; discharge has ranged from 0.1 to over 300 cubic feet per second (cfs) since May, 1994.

Water Uses and Impairments

These particular small watersheds were selected to represent agricultural watersheds in the Lake Champlain Basin, where streams often violate state water quality criteria (Clausen and Meals, 1989; Meals, 1990; Vermont RCWP Coordinating Committee, 1991) and contribute nutrient concentrations and areal loads that generally exceed average values reported from across the United States (Omernik, 1977) and in the Great Lakes Region (PLUARG, 1978).

Because of their size, the study streams themselves are subject to very limited use for agricultural purposes (livestock watering) and recreation (swimming and fishing). No historical data exist to document support or nonsupport of these or other uses. Project data indicate that Vermont water quality (bacteriological) criteria for body contact recreation are consistently violated in these streams. Biological data for fish and macroinvertebrates indicate moderate to severe impact by nutrients and organic matter.

The receiving waters for these streams—the Missisquoi River and Lake Champlain—have very high recreational use that is being impaired by agricultural runoff (Vermont Agency of Natural Resources, 1994). The Missisquoi River is the second largest tributary to Lake Champlain in terms of discharge (mean flow =1450 cfs) and contributes the highest annual nonpoint source phosphorus load to Lake Champlain among the major tributary watersheds (75.1 mt/yr) (VT and NY Departments of Environmental Conservation, 1994). Lake Champlain currently fails to meet state water quality

standards for phosphorus, primarily due to excessive nonpoint source loads (Vermont Agency of Natural Resources, 1994). About 66% of the nonpoint source phosphorus load to Lake Champlain is attributed to agricultural land (Meals and Budd, 1998).

Pollutant Sources

Nonpoint sources of pollutants are streambanks, degraded riparian zones, and dairy-related agricultural activities, such as field-spread and pasture-deposited manure and livestock access. Some agricultural point sources such as milkhouse waste or corn silage leachate are thought to exist.

Pre-Project Water Quality

No historical physical/chemical data exist for the study streams. Pretreatment monitoring data showed the following ranges:

E. coli (#/100 ml)	Fecal Coliform (#/100 ml)	Fecal Strep. (#/100 ml)
1 – 108,000	2 – 122,000	2 – 110,000

TP (mg/l)	TKN (mg/l)	TSS (mg/l)
0.02 – 1.57	< 0.20 – 3.59	1 – 585

Water Quality Objectives

The overall goal of the project is a quantitative assessment of the effectiveness of livestock/grazing management practices focused on the riparian zone in reducing concentrations and loads of nutrients, bacteria, and sediment from small agricultural watersheds. Major water quality objectives are to 1) document changes in sediment, nutrient, and bacteria concentrations and loads due to treatment at the watershed outlets and 2) evaluate response of stream biota to treatment.

Project Time Frame

September 1993 to November 2000

PROJECT DESIGN

Nonpoint Source Control Strategy

The project tested a suite of practices that treat and protect the stream and riparian zone. In both treatment watersheds, work concentrated on selective exclusion of livestock from the streams, creation of a protected riparian zone, improvement or elimination of heavily used livestock stream crossings, and revegetation of degraded streambanks. The treatment required fencing, watering systems, reducing the number of livestock crossing areas, bridging or strengthening necessary crossing areas, and streambank erosion control through willow planting and other bioengineering techniques.

During the pretreatment monitoring period, treatment needs were assessed, specific plans and specifications developed, and agreements with landowners pursued. The project and/or its partners provided 100% cost support for cooperating landowners. Agricultural management activity—both routine and treatment implementation—is monitored by farmer record-keeping and annual interviews.

Some work was done, as necessary, on agricultural point sources when such pollutant sources were identified.

Project Schedule

Site	Pre-BMP	BMP Implementation	Post-BMP
WS-1	5/94-5/97	6/97-11/97	11/97-11/00
WS-2	5/94-5/97	6/97-11/97	11/97-11/00
WS-3	5/94-5/97	N/A	11/97-11/00

Water Quality Monitoring

The study was based on a paired-watershed design, with a control watershed and two treatment watersheds (Figure 44). The design called for three years of calibration monitoring, one year of implementation monitoring, and three years of post-treatment monitoring.

Variables Measured

Biological

E. coli bacteria (EC)
Fecal coliform bacteria (FC)
Fecal streptococcus bacteria (FS)
Macroinvertebrates
Fish

Chemical and Other

Total phosphorus (TP)
Total Kjeldahl nitrogen (TKN)
Total suspended solids (TSS)
Dissolved oxygen (DO)
Conductivity
Temperature

Covariates

Precipitation (continuous)
Discharge (continuous)

Sampling Scheme

Automated sampling stations were located at three watershed outlets for continuous recording of streamflow, automatic flow-proportional sampling, and weekly composite samples for sediment and nutrients. Twice-weekly grab samples for bacteria were collected. Concurrent in-stream measurement of temperature, dissolved oxygen, and conductivity occurred at grab samples collection. Three precipitation gauges were installed. All monitoring systems operated year-round.

The macroinvertebrate community at each site and a fourth “background reference” site were sampled annually using a kick net/timed effort technique. Methods and analysis followed USEPA’s Rapid Bioassessment Protocols (Protocol III). Fish were sampled annually by electroshocking and evaluated according to Rapid Bioassessment Protocols Protocol V.

Physical habitat assessments were performed during each sampling run.

Monitoring Scheme for the Lake Champlain Basin Watersheds Section 319 National Monitoring Program Project

Design	Site or Activities	Primary Parameters	Covariates	Frequency of WQ Sampling	Frequency of Biological Assessment	Duration
Three-way paired watershed	WS1-Samsonville Brook[T] WS2-Godin Brook[T] WS3-Berry Brook[C]	E Coli FC FS Macroinvertebrates Fish survey TP TKN TSS DO Conductivity Temperature	Precipitation Discharge (continuous)	TP, TKN, TSS—weekly composite from continuous flow-proportional sampling. Bacteria, temperature, DO and conductivity—twice weekly	Fish and Macroinverte-brates sampled once per year	3 yrs pre-BMP 1 yr BMP 3 yrs post-BMP

[T]Treatment watershed
[C]Control watershed

Land Treatment Monitoring

Land use monitoring included farmer record-keeping, annual farmer interviews, and examination of annual FSA crop compliance aerial photography. Land treatment tracking was accomplished by at least weekly inspections of installed treatments. Additional details were included in the Project Final Report (2001).

Modifications Since Project Started

Problems with funding and personnel shifts delayed the start of treatment implementation by approximately one year resulting in extension of pre-treatment monitoring and reduction of planned post-treatment monitoring. In 1996, the project timetable was revised to reflect a three-year calibration period (1994–1996), one year of implementation (1997), and two years of post-treatment monitoring (1998–2000). In 1999, the active monitoring period was extended through November 2000 to provide three years of post-treatment monitoring.

The nonpoint source control strategy and design have been changed due to changes in agricultural operations in WS1. The original project design called for the implementation of intensive grazing management in WS1 as a means to minimize the time spent by livestock in or near the streamcourse without resorting to complete exclusion. However, since the beginning of the project, one farmer in WS1 ceased operations, one changed his management to complete confinement, and another was determined to have no riparian pasture. Moreover, the owner of the large dairy operation immediately above the monitoring station has implemented full rotational grazing on his own. Thus, opportunities for implementing the planned treatment were essentially eliminated. After additional field surveys and discussions with the Project Advisory Committee, the Principal Investigator requested approval from EPA Region I for a change in treatment design. Approval was granted in June, 1997.

Under the modified strategy, WS1 has received the same style of treatments as WS2, i.e. livestock exclusion, crossing protection, and streambank stabilization. Thus, WS1 can be viewed as a replicate of WS2 with respect to treatment. Because the level of treatment differed in WS1 compared to WS2, the opportunity existed to evaluate thresholds and degrees of water quality response to varying levels of treatment.

While no changes to the monitoring program design have occurred, changes in the TKN analysis within the Vermont Department of Environmental Conservation laboratory required rejection of TKN data generated prior to April, 1996. TKN analysis continues to be conducted.

Fish community sampling has been reduced from semi-annual to annual. In May, 1997, one precipitation gauge was moved about 300 meters at a landowner's request.

Progress to Date

The water quality monitoring component of the project became operational in May, 1994 and operated successfully to meet project goals. A severe drought and elevated temperatures during June and July, 1995, and a series of major floods in summer, 1997, and winter, 1998, interfered slightly with chemical and physical monitoring, and may have had some lasting influence on biological communities in the monitored streams. Analysis of calibration period water quality data (May 1994 – May 1997) confirmed that statistical conditions for acceptable calibration between the control and treatment watersheds were met with respect to physical and chemical variables.

Following a baseline inventory and new aerial videography in 1995, land use/agricultural activity has been conducted through annual farmer recordkeeping, annual interviews, and windshield surveys.

The process of identifying specific treatment needs and designs and negotiating agreements with landowners began in the fall of 1995. However, project difficulties and changes noted earlier delayed this process significantly. Under renewed initiatives, agreements were signed with eight watershed landowners in the spring of 1997 and implementation is underway. As of the end of 1997, installed practices included more than 8,800 feet of riparian fence, elimination of three livestock crossings, a culvert livestock crossing, three armored livestock crossings, and a livestock bridge. In addition, several thousand feet of streambank have been protected with brushrolls and tree revetments and willow plants. Significant assistance has been given by the Vermont Youth Conservation Corps, the Missisquoi River Basin Association, and local volunteers.

After full BMP implementation, the following levels of treatment were achieved in the treatment watersheds:

	WS 1	WS 2
Total stream length (m)	10,382	24,776
Pasture stream length (m)	1,481	8,150
Treated stream length (m)	726	2,283
Stream length treated (%)	7%	9%
Pasture stream length treated (%)	49%	28%
Livestock grazing on treated pasture (%)	96 – 97%	15 – 23%
Pasture area draining to treated stream (%)	42%	32%

BMP implementation was completed in November, 1997. Except for repair of winter/spring flood damage, no additional land treatments are planned. Water quality and land treatment monitoring continues to be conducted as described in the recent Comprehensive Calibration Period Project Report.

As of the end of the treatment implementation period, a total of $39,713 had been spent on land treatment, of which $18,759 were project funds, $4,166 were landowner contributions, and $16,788 were contributed by other agencies and volunteer groups. Subsequent maintenance of installed practices required expenditure of an additional $3,500.

Analysis of post-treatment water quality data suggests that bacteria counts, phosphorus concentration, and phosphorus export declined significantly in one or both of the treated watersheds with respect to the control watershed. Installed treatments continue to perform well with relatively little maintenance.

Land use changes in the two treatment watersheds caused some problems in 1999. In WS1, runoff and severe erosion from cleared land had increased TSS load to Samsonville Brook in 1998. An NRCS-designed diversion was installed in August 1999 to correct this problem. Visual inspection of the diversion over the remainder of the field season and water quality data indicated that the problems have been corrected.

In WS2, major expansion and mismanagement of a large farm operation in the center of the watershed continued to have major impact on water quality observed in that watershed. Elevated sediment, nutrient and bacteria levels resulting from this disturbance effectively negated the effects of land treatment in the final project year.

The principal impediment to project progress was funding, both mechanism and quantity. While in principle, Section 319 National Monitoring Program funding was intended to be set up for the entire project period, this was not the case in this project. The requirement to renew funding each year caused significant problems, including accounting confusion over fiscal vs. project vs. monitoring "years," inefficient expenditure of staff time, and, most importantly, difficulty in accounting for and documenting required match. This was a particular problem in the implementation budget, since actual implementation (and associated match) did not take place until project year 4, while funds were allocated in project years 1, 2, and 3 budgets. Budgeting over the entire project lifetime would have substantially alleviated these problems.

The other financial impediment to the project involved significant increases in charges for sample analysis by the state Department of Environmental Conservation (DEC) laboratory. These costs increased dramatically (on the order of $11,000–$16,500 per year) since the first funding year and, with no corresponding increase in overall funding, other budget categories had to be cut. In the last three budget years, this required elimination of all nonsignificant principal investigator support, limiting available time commitment to the project. The increase in analytical costs also reduced the previous match contributions from DEC. Annual funding from U.S. Environmental Protection Agency (USEPA), however, has been essentially level and nonnegotiable for the last three years. Some flexibility in funding, such as increasing USEPA funding to cover such cost increases, would be helpful. The project was significantly under-funded in FY 1997, resulting in a five-month suspension of project activities except for basic water quality monitoring. This problem was been corrected.

DATA MANAGEMENT AND ANALYSIS

Data Management and Storage

Primary data management was done using an in-house spreadsheet system. The USEPA Nonpoint Source Management System (NPSMS) software was not used to track and report data to USEPA because it was never upgraded to handle three watersheds. Requisite data entry into STORET was accomplished through annual file transfer. Water quality data were compiled and reported for quarterly project advisory committee meetings, including basic plots and univariate statistics. For annual reports, data were analyzed on a water-year basis.

Data analysis was performed using both parametric and nonparametric statistical procedures in standard statistical software.

NPSMS Data Summary

Monitoring Station Parameters Report
DATE: 08/04/98 PERIOD: calibration period, 5/94 - 9/97
STATION TYPE: Treatment Watershed #1 (Samsonville Brook)

CHEMICAL PARAMETERS

	Reporting	QUARTILE VALUES		
Parameter Name	**Units**	**-75-**	**-50-**	**-25-**
CONDUCTANCE	uS/CM	113	88	70
E. COLI	CFU/100ML	418	96	22
FECAL COLIFORM	CFU/100ML	440	77	28
FECAL STREPTOCOCCUS	CFU/100ML	1611	362	55
FLOW, STREAM, WEEKLY MEAN	CFS	7.7	2.4	1.0
OXYGEN, DISSOLVED	MG/L	14.8	12.1	9.8
PRECIPITATION, TOTAL	IN/WEEK	1.02	0.54	0.20
NITROGEN, TOTAL KJELDAHL[1]	MG/L	.80	.50	0.37
PHOSPHORUS, TOTAL	MG/L	0.166	0.090	0.052
TEMPERATURE, WATER	oC	16.5	7.7	0.7
TOTAL SUSPENDED SOLIDS	MG/L	68.5	28.0	12.8

STATION TYPE: Treatment Watershed #2 (Godin Brook)

CHEMICAL PARAMETERS

	Reporting	QUARTILE VALUES		
Parameter Name	**Units**	**-75-**	**-50-**	**-25-**
CONDUCTANCE	uS/CM	135	105	87
E. COLI	CFU/100ML	3950	515	40
FECAL COLIFORM	CFU/100ML	4500	455	58
FECAL STREPTOCOCCUS	CFU/100ML	1951	538	70
FLOW, STREAM, WEEKLY MEAN	CFS	14.9	6.0	3.1
OXYGEN, DISSOLVED	MG/L	14.8	12.0	10.1
PRECIPITATION, TOTAL	IN/WEEK	1.00	0.47	0.18
NITROGEN, TOTAL KJELDAHL[1]	MG/L	.93	0.50	0.35
PHOSPHORUS, TOTAL	MG/L	0.199	0.102	0.039
TEMPERATURE, WATER	oC	16.5	7.9	0.7
TOTAL SUSPENDED SOLIDS	MG/L	43.4	18.6	5.1

STATION TYPE: Control Watershed (Berry Brook)

CHEMICAL PARAMETERS

	Reporting	QUARTILE VALUES		
Parameter Name	**Units**	**-75-**	**-50-**	**-25-**
CONDUCTANCE	uS/CM	125	107	87
E. COLI	CFU/100ML	4175	550	36
FECAL COLIFORM	CFU/100ML	3875	510	39
FECAL STREPTOCOCCUS	CFU/100ML	1464	442	65
FLOW, STREAM, WEEKLY MEAN	CFS	13.7	7.1	3.9
OXYGEN, DISSOLVED	MG/L	14.3	11.3	9.6
PRECIPITATION, TOTAL	IN/WEEK	0.97	0.50	0.18
NITROGEN, TOTAL KJELDAHL[1]	MG/L	0.65	0.50	0.32
PHOSPHORUS, TOTAL	MG/L	0.174	0.084	0.052
TEMPERATURE, WATER	oC	16.1	8.0	0.9
TOTAL SUSPENDED SOLIDS	MG/L	35.1	16.5	6.7

[1] TKN Data 4/96 - 9/97 only

Monitoring Station Parameters Report

DATE: 07/09/01 PERIOD: 10/97 – 9/00 (Treatment Period)

STATION TYPE: Treatment Watershed #1 (Samsonville Brook)

CHEMICAL PARAMETERS

Parameter Name	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
CONDUCTANCE	uS/CM	105	85	64
E. COLI	CFU/100ML	235	68	10
FECAL COLIFORM	CFU/100ML	258	74	11
FECAL STREPTOCOCCUS	CFU/100ML	1125	237	38
FLOW, STREAM, WEEKLY MEAN	CFS	10.2	4.1	1.5
OXYGEN, DISSOLVED	MG/L	14.6	12.5	10.0
PRECIPITATION, TOTAL	IN/WEEK	0.90	0.52	0.18
NITROGEN, TOTAL KJELDAHL[1]	MG/L	0.65	0.54	0.39
PHOSPHORUS, TOTAL	MG/L	0.126	0.072	0.042
TEMPERATURE, WATER	oC	15.8	7.2	1.0
TOTAL SUSPENDED SOLIDS	MG/L	34.0	15.2	6.7

STATION TYPE: Treatment Watershed #2 (Godin Brook)

CHEMICAL PARAMETERS

Parameter Name	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
CONDUCTANCE	uS/CM	143	120	94
E. COLI	CFU/100ML	1653	201	18
FECAL COLIFORM	CFU/100ML	2113	253	24
FECAL STREPTOCOCCUS	CFU/100ML	1838	400	58
FLOW, STREAM, WEEKLY MEAN	CFS	13.8	5.6	2.8
OXYGEN, DISSOLVED	MG/L	14.5	12.0	9.9
PRECIPITATION, TOTAL	IN/WEEK	0.98	0.62	0.22
NITROGEN, TOTAL KJELDAHL[1]	MG/L	0.83	0.60	0.42
PHOSPHORUS, TOTAL	MG/L	0.170	0.104	0.058
TEMPERATURE, WATER	oC	16.8	8.3	1.0
TOTAL SUSPENDED SOLIDS	MG/L	31.5	18.3	7.5

STATION TYPE: Control Watershed (Berry Brook)

CHEMICAL PARAMETERS

Parameter Name	Reporting Units	QUARTILE VALUES -75-	-50-	-25-
CONDUCTANCE	uS/CM	132	115	92
E. COLI	CFU/100ML	3175	311	28
FECAL COLIFORM	CFU/100ML	4850	373	45
FECAL STREPTOCOCCUS	CFU/100ML	1430	438	70
FLOW, STREAM, WEEKLY MEAN	CFS	15.0	7.5	3.8
OXYGEN, DISSOLVED	MG/L	14.2	11.6	9.4
PRECIPITATION, TOTAL	IN/WEEK	0.86	0.54	0.20
NITROGEN, TOTAL KJELDAHL	MG/L	0.58	0.43	0.31
PHOSPHORUS, TOTAL	MG/L	0.124	0.073	0.40
TEMPERATURE, WATER	oC	16.2	8.4	1.3
TOTAL SUSPENDED SOLIDS	MG/L	23.8	9.9	4.4

Final Results

Analysis of calibration period physical and chemical monitoring data indicated that conditions for acceptable calibration between the control and treatment watersheds were met. Significant regression relationships were found to exist between watershed pairs for all parameters of interest. For all physical and chemical variables, the calibration period was adequate to detect reasonable changes following treatment. Residual errors around the regressions were small enough to allow determination for changes of 24% or less in response to treatment. TKN data collected since April, 1996, yielded acceptable calibration. Therefore, data collected during the calibration phase appeared to be adequate for the project to proceed into the treatment period.

The fish and macroinvertebrate assemblages indicated degraded conditions in the treatment watersheds over the calibration period due to nutrient enrichment and sedimentation. The impaired control section supported a biological community indicative of severe, intermittent stress resulting from improper manure and corn silage management upstream. Although mildly impacted by local non-agricultural activities, the reference control stream supports the healthiest biological community.

Analysis of three years of post-treatment data showed significant water quality response to treatment. In WS 1, mean TP, TKN, and TSS concentrations were reduced by 15%, 12%, and 34%, respectively. Indicator bacteria counts declined by 29% - 38%. Over the entire treatment period, TP export was reduced 49%, TKN export 38%, and TSS 28%. Similar water quality changes were observed in WS 2 over the first two years of treatment, but impacts from the farm expansion reversed those improvements.

The macroinvertebrate community in Samsonville Brook (WS 1) responded significantly to treatment, with BioIndex values meeting Vermont Water Quality Biocriteria in the second and third post-treatment year. Improvements noted in Godin Brook (WS 2) after two years of treatment were reversed in the final year due to catastrophic sedimentation from the farm expansion.

Copies of the Final Project Report may be obtained by contacting Rick Hopkins at the address given below.

INFORMATION, EDUCATION, AND PUBLICITY

Pre-project activity included letters to all watershed agricultural landowners followed by small "kitchen table" meetings with farmers in each watershed. The purpose of these meetings was to assess landowner interest and acceptance of the project.

Two articles concerning the project were published in the weekly county newspaper.

In July 1994, a monitoring station "open-house" was held to present the project, monitoring hardware, and some early monitoring results.

The first annual winter lunch meeting was held in February 1995, where watershed farmers discussed the project and heard a talk by a local farmer engaged in rotational grazing. A second such meeting was held in April, 1996, a third in February, 1998, and a fourth in March, 1999

A semi-annual project newsletter initiated in summer, 1995, was distributed to watershed farmers and other interested parties. In addition, a feature story on the project has been published in the monthly magazine of a regional environmental advocacy group.

The project included a Project Advisory Committee with representatives from United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS), Extension, Vermont Dept. of Agriculture, Vermont Dept. of Environmental Conservation, Vermont Natural Resources Conservation Council, U.S. Fish and Wildlife Service, the Vermont Pasturelands Outreach Program, and a watershed dairy farmer. The committee met quarterly to review progress and assist in program direction.

Information and education efforts during the pretreatment calibration phase focused on laying the groundwork for treatment by presenting demonstrations and information concerning grazing management and livestock access control. Additional contact with farmers occurs through routine collection of agricultural management data. Current information efforts are devoted to keeping watershed farmers and other residents informed of project activities and findings.

A vigorous communication strategy was undertaken to publicize final project results. Activities included:

- A newsletter to watershed landowners
- A presentation to local farmers and the Missisquoi River Basin Association
- Final meeting of the Project Advisory Committee
- Presentation to the Lake Champlain Basin Program Technical Advisory Committee
- Presentation to USDA-NRCS State Office staff
- Publication of articles in local environmental advocacy periodicals
- Publication of Final Project Report
- Presentation to USEPA Region I staff
- Presentation to New England region state nonpoint source management agencies
- Paper presented at International Water Association Diffuse Pollution/Watershed Management Conference
- Paper presented at 9th National Nonpoint Source Monitoring Workshop, August, 2001

The project is documented on: http://www.anr.state.vt.us/dec/waterq/VT319Watershed.htm

PROJECT BUDGET

The estimated budget for the Lake Champlain Basin Watersheds National Monitoring Program project for years 1–5 is shown in the following table.

Vermont NMP – Approximate Budget Breakdown

Project Element	Federal*	Federal**	State	University	Other+	Total
Land treatment (FFY92 – 96)	121,093	9,200	3,388	21,918	54,981	210,580
WQ monitoring (FFY1991 – 2000)	738,255	-	209,137@	134,773@	-	987,464
Total	859,348	9,200	212,525@	156,691@	54,981	**1,292,745@**

Table Notes:
* Includes funding from Clean Water Act Section 319 and Section 104b3
** Includes cost share funds from USF & WS and USDA-NRCS
+ Represents potential labor and/or materials needed to be provided by farmers and/or volunteers.
In 1997, some $4,166 and $7,588 were contributed to the project by landowners and other volunteers, respectively.
In 1998, 1999, and 2000 field seasons, an unquantified amount of in-kind was contributed by landowners associated with inspection and maintenance of installed practices.
@ Amounts shown are incorrect since non-federal match requirements associated with FFY00 funds are not finalized.

IMPACT OF OTHER FEDERAL AND STATE PROGRAMS

The project area was within the area of the Lake Champlain Basin Program (a program modeled after the Chesapeake Bay Program), directed toward the management of Lake Champlain and its watershed. Considerable effort on agricultural nonpoint source control is associated with this program, including funding for pollution control/prevention demonstration projects.

Additionally, the state of Vermont's phosphorus management strategy calls for targeted reductions of phosphorus loads from selected subbasins of Lake Champlain.

The U.S. Fish and Wildlife Service (USF&WS) was an active participant in the project. Two watershed landowners have agreements with the USF&WS *Partners for Wildlife* riparian zone restoration program. NRCS rendered valuable assistance in engineering design and streambank restoration. The onset of the new USDA EQUIP program, however, severely curtailed the availability of staff time to assist in the project. The Vermont Youth Conservation Corps Franklin County crew donated three days of labor in streambank stabilization. The Missisquoi River Basin Association, a citizens group, organized several days of volunteer labor, and employees of Ben & Jerry's Homemade donated substantial field work.

OTHER PERTINENT INFORMATION

None.

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