MEMORANDUM
FROM THE
LAKE CHAMPLAIN BASIN PROGRAM

To: **Erik Beck -** IJC Contract Officer's Representative **30 January 2009**
U. S. Environmental Protection Agency
New England Region

From: **Bill Howland**, Manager
Lake Champlain Basin Program
54 West Shore Road
Grand Isle, Vermont 05458

cc: **Willem Brakel,** IJC
Beth Card, NEIWPCC

Re: IJC - New England Interstate Water Pollution Control Commission/Lake Champlain Basin Program Contract, *Missisquoi Bay Basin Project: Identification of Critical Source Areas of Phosphorus Pollution,* **Deliverable: Monitoring Design Report**

Please accept this memorandum and attachments as the deliverable for Task 1, Subtask 1 (9.3.1.1.1) **–** *Monitoring Design Report* – under the IJC-NEIWPCC contract number 1042-800734.

Summary of Activities

The following account of activities summarizes the efforts to design the short-term monitoring program.

- *December 15th, 2008* – LCBP convened the *Workshop on Tributary Monitoring in the Missisquoi Bay Basin* to discuss short and long-term tributary monitoring needs in the Missisquoi Basin. The parameters to be measured, sampling intervals and sampling locations for the short term monitoring program to be funded under the IJC-NEIWPCC

contract were discussed at the workshop. Please see the attached workshop summary for details of the meeting and discussions.

- *January 23rd, 2009* – LCBP convened a project workgroup meeting. At the meeting the workgroup discussed the short-term tributary monitoring program and the recommendations from participants at the *Workshop on Tributary Monitoring in the Missisquoi Bay Basin*. The workgroup recommended potential monitoring locations and procedures. Please see the attached workgroup meeting summary for details on the discussion pertaining to the tributary-monitoring program.
- *January 30th, 2009* – LCBP submitted a draft quality assurance project plan (QAPP) detailing short-term monitoring procedures.

Summary of the Short-Term Monitoring Program

In consideration of the current basin-wide monitoring programs and recommendations from workshop and workgroup participants, the LCBP has designed a short-term monitoring program that will include tributary monitoring stations and meteorological monitoring stations. LCBP will establish a minimum of ten monitoring locations within the Missisquoi Bay Basin to be sampled over a two-year period. The increased sampling in the Basin will address the need for more detailed spatial data of tributary nutrient loads and meteorological (precipitation) data.

The monitoring program plans to extend the current long-term monitoring network using similar collection and analysis techniques at the following five tributaries: Hungerford Brook, Black Creek, Tyler Branch, Trout River, and Mud Creek. Installation of a flow gage on the Sutton River also will improve the accuracy of current monitoring. Tributary monitoring stations will be sampled approximately weekly and after major precipitation events and will include measurements of total and dissolved phosphorus, nitrogen, and suspended sediments. Sampling locations, methods, and parameters will be outlined in a forthcoming QAPP.

LCBP will establish or update existing sites, for a total of four meteorological stations in the Basin. The locations of the stations will include sites near Swanton, East Fletcher, and Troy. LCBP will consider continuing current National Weather Service cooperative sites in Enosburg Falls, Highgate Falls, and at Jay Peak in addition to establishing new sites.

Appended Files

1. Summary of the *Workshop on Tributary Monitoring in the Missisquoi Bay Basin*
2. Summary of short-term monitoring discussions at the *Workgroup Meeting on Defining Critical Source Areas and Management Needs*
3. GIS map of the proposed short-term monitoring program sites

Missisquoi Bay Basin Project:
Identifying Critical Source Areas of Pollution

Workshop on Tributary Monitoring in the Missisquoi Bay Basin
Monday, December 15, 2008
Gordon Center House, Grand Isle, VT

Workshop Summary

Welcome and Introductions

Overview of the Missisquoi Bay Basin Project

Bill Howland, manager of the Lake Champlain Basin Program (LCBP), provided an overview of the Missisquoi Bay Basin Project. The Program received funding from the International Joint Commission (IJC) to identify critical source areas of nonpoint source phosphorus pollution in the Missisquoi Bay Basin of Lake Champlain. The goal of the project is to identify and delineate areas of the Basin that contribute disproportionately large amounts of pollution to Missisquoi Bay, in order to efficiently target limited resources to reduce phosphorus loads.

Three major tasks will be completed as part of the project. The first task is to conduct a series of workshops and meetings to guide the project and development of a request for proposals. The second task is to establish a short-term tributary monitoring program. A minimum of ten new sampling sites will be established and maintained for the duration of the project (two years); data from the monitoring program is intended to assist the identification of critical source areas. The final task of the project is to conduct the critical source area identification analysis. This will be accomplished through a request for proposals and informed by the workshop and meeting series.

Monitoring Programs in the Missisquoi

A series of presentations provided background information on the current tributary monitoring programs in the Missisquoi Bay Basin.

Marc Simoneau, Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP), presented the report *Phosphorus Loading to the Missisquoi Bay from Sub-Basins in Vermont and Quebec, 2002-2005*, written in collaboration with Eric Smeltzer, Vermont Department of Environmental Conservation (VTDEC). Using ten sampling stations and nine flow gages, the phosphorus load from ten sub-basins in the Missisquoi Bay Basin was estimated. The results indicate that the phosphorus load to the Bay increased twelve percent, in comparison to the load measured in 1991 (the reference year). The U.S. Army Corp of Engineers' FLUX program was used to extrapolate the 2002 to 2005 basin phosphorus loads under the same hydrologic conditions that existed in 1991. This analysis estimated a decrease in the phosphorus load of 25% at the mouth of the Pike River and 8% at the mouth of the Missisquoi River under the reference year precipitation. The results of this study indicate that wastewater treatment upgrades and watershed management efforts have been beneficial. Additionally, increased precipitation and runoff in recent years has exacerbated pollution in the Missisquoi Bay Basin.

Eric Smeltzer, VTDEC, presented an overview of the tributary monitoring programs conducted in the basin and how they may assist in critical source area identification. Monitoring data can be used to calibrate and validate watershed models and to identify problematic sub-watersheds. Current MDDEP and VTDEC monitoring programs divide the Missisquoi Bay Basin into ten sub-basins, whose phosphorus export rates can be estimated. Increased sampling in the lower Missisquoi River sub-basin would divide it into smaller sub-basins, allowing a more thorough understanding of pollution sources. For example, establishing monitoring on Hungerford Brook, Black Creek, Trout River, and Tyler Branch would increase what is currently known about phosphorus sources to the lower Missisquoi River. The Sutton River, which is currently monitored, would also benefit from the addition of a flow gage.

The Vermont Center for Clean and Clear also conducts concentration-only sampling for a network of 22 sampling stations located in the Rock River Watershed. These stations were simultaneously sampled ten times for total phosphorus, dissolved phosphorus, total nitrogen, and total suspended solids. Preliminary results indicate order of magnitude differences in concentration among the sites. These results suggest that concentration-only sampling can provide a relative ranking of pollution; however, they are limited by the lack of flow data and are thus incomparable to other measurements of load.

Cynthia Scott, Missisquoi River Basin Association (MRBA), presented the volunteer monitoring program coordinated by the MRBA. The water sampling program began in 2005 as an effort to locate areas of phosphorus pollution. Sampling occurs every other Wednesday at 21 sites (five on the Missisquoi River and sixteen located at tributaries) and the State of Vermont's LaRosa Lab analyses the results. The preliminary results for the 2008 sampling season indicate that Mud Creek, Tyler Branch, and Tyler Branch at Duffy Hill Road carry high concentrations of phosphorus.

Aubert Michaud, Institut de Recherche et Développement Agroenvironnement (IRDA), presented an overview of the methodological aspects of a sampling program and the type of sampling needed to support modeling. Tributary monitoring can be used to document fluxes, describe spatial and temporal variability in nutrient concentrations, and develop and validate management tools by combining spatial data and modeling. Monitoring data supports management decisions by determining target loads, critical source areas of pollution, implementation actions, and progress.

Monitoring studies that pair similar watersheds with one controlled and one experimental (added management practice) can assist in the creation of models and the understanding of the effectiveness of a practice. Monitoring data is also useful when it provides a link between the watershed land use and water quality. Sampling that includes flow-stratified measurements of concentration can be used in regression and modeling to determine reliable estimates of loadings across space and time. Measuring conductivity can help estimate stream discharge as well. Watershed-specific hydrological responses and seasonality must also be incorporated in monitoring and modeling.

Transboundary Monitoring Coordination
A facilitated discussion focused on how to coordinate monitoring efforts across the border. The group considered the current monitoring and began to think about increasing collaboration with the new monitoring effort through the Missisquoi Bay Basin Project. The group also considered the availability of Canadian data and obstacles that may prohibit sharing information.

The long-term monitoring has been well coordinated, in particular between MDDEP and VTANR. This monitoring program is the basis for the report on phosphorus loads previously presented by Marc Simoneau. A difference in the calculated phosphorus concentration between VT and QC was due to methodologies and corrected in the report. Other differences in methodologies exist, such as those for measuring phosphorus soil concentrations. In general, different methodologies need to be considered and corrected when sharing and comparing data.

The group expressed interest in having a consistent and common precipitation data set that would be accurate across the entire basin. Data from weather stations in both countries could be compiled to generate a more complete map of the basin. It may be necessary to consider the locations of current meteorological stations and determine if there are any gaps to be filled; for example, there is no meteorological station in the Bay itself.

A map of the basin was created by the LCBP and displays the current sampling stations and designated impaired waters (please see attached map). The group discussed the difficulty of integrating different datasets for the entire basin because of inconsistencies across the border. The LCBP must assure the quality of the data or develop an acceptable integration method and is still in the process of collecting data from the different agencies.

International Joint Commission Funded Monitoring Program
Bill Howland, LCBP, reviewed the purpose of the short-term monitoring program funded by the International Joint Commission and handed out an information sheet to help guide the discussion (see attached handout). A minimum of ten new stations will be established and maintained for the duration of the two-year project. Station locations, parameters to be measured, and optimal sampling periods and intervals need to be identified.

The goal of tributary monitoring is to assist in the identification of critical source areas. The following should be considered when designing the monitoring program:

- What are the short- and long-term monitoring needs for phosphorus, nitrogen, and sediment in the Basin?
- What type of data would be most useful to validate and calibrate a basin-wide model?
- What type of information is needed to understand the processes at work in the Basin?
- What monitoring is needed to understand transboundary pollution loads?
- What is the importance of seasonal precipitation and rainfall intensity?

Short and Long-Term Monitoring Needs in the Missisquoi Bay Basin
The group discussed monitoring needs, potential sites, parameters to be sampled, and the optimal sampling periods and intervals. The discussion was intended to guide the tributary monitoring program to be established as part of the IJC funded project.

The group discussed the fundamental problem of designing a program to collect data before the methodology to identify a critical source area is known. The group also considered the fact that the term "critical source area" has yet to be defined for this project; this definition could have implications for the design of a monitoring program.

The group considered the current gaps in monitoring sites as possible locations for new stations. The group also discussed the possibility of improving some of the current sites (such as ones monitored by MRBA and the University of Vermont) so that measurements would be comparable and subject to agreed upon standards. Another suggestion was to classify drainage areas by characteristics (e.g. land use, soil, topography) and then establish a monitoring program that would encompass the variability within the Basin. Similarly, monitoring locations could be placed to capture the specific characteristics of different watersheds. Another approach may be to look at farm- and field-level information and implement edge-of-field sampling.

The group considered the importance of flow data and the possibility of installing automatic samplers. It was also suggested that the resources be used to obtain better spatial data. One possible approach would be to establish some long-term monitoring locations in addition to a short-term synoptic sampling program of twenty or more stations that capture a continuum of watershed characteristics to help in the identification of critical source areas and in model validation. It might also be instructive to examine current land use and changes in land use over time.

The group recommended the following potential monitoring locations be considered in addition to the current long-term monitoring program:

- Mud Creek
- Black Creek (opportunity to capture flood events) at the mainstem, upper, and lower ends
- Rock River at the international border
- Hungerford Brook

Thank You and Adjourn

Bill Howland thanked everyone for attending and providing input. It was a productive meeting and the LCBP will consider everyone's input in planning the tributary monitoring program. More workshops focused on guiding the critical source area identification will be scheduled for the winter and spring. The LCBP will send invitations and encourages everyone's participation.

Appended files

- Meeting Attendees
- Tributary Monitoring Guidelines Handout
- GIS map of the current monitoring locations and designated impaired waters in the Missisquoi Basin

Meeting Attendees

Name	Organization
Erik Beck	Environmental Protection Agency
Phil Benedict	Vermont Agency of Agriculture Food & Markets
Willem Brakel	International Joint Commission
Jeff Comstock	Vermont Agency of Agriculture
Jeff Deacon	United States Geological Survey
Laura DiPietro	Vermont Agency of Agriculture Food & Markets
Fred Dunlap	New York State Department of Environmental Conservation
Ben Gabos	Vermont Agency of Agriculture Food & Markets
Lula Ghebremichael	University of Vermont
David Healy	Stone Environmental, Inc.
Brian Jerose	Waste Not Resource Solutions
Richard Kiah	United States Geological Survey
Paul Madden	Friends of Missisquoi Bay
Don Meals	private consultant
Aubert Michaud	Institut de Recherche et Développement Agroenvironnement
Martin Mimeault	Ministère du Développement Durable, de l'Environnement et des Parcs
Julie Moore	Vermont Agency of Natural Resources
Lin Neifert	United States Geological Survey
Debra Perry	Northwest Regional Planning
Staci Pomeroy	Vermont Department of Environmental Conservation
Kip Potter	Vermont Natural Resources Conservation Service
Jake Riley	VHB Pioneer
Nate Sands	Vermont Agency of Agriculture Food & Markets
Cynthia Scott	Missisquoi River Basin Association
Marc Simoneau	Ministère du Développement durable, de l'Environnement et des Parcs
Eric Smeltzer	Vermont Department of Environmental Conservation
Michael Winchell	Stone Environmental, Inc.
Mike Winslow	Lake Champlain Committee
Jon Winsten	Winrock International/University of Vermont

Nicole Grohoski	Lake Champlain Basin Program
Colleen Hickey	Lake Champlain Basin Program
Bill Howland	Lake Champlain Basin Program
Kris Joppe-Mercure	Lake Champlain Basin Program
Meg Modley	Lake Champlain Basin Program

Missisquoi Bay Basin Project: Identifying Critical Source Areas of Pollution

Workshop on Tributary Monitoring in the Missisquoi Basin

Goal of the Missisquoi Bay Basin Project:
Help reduce the load of phosphorus entering the Bay by identifying and delineating areas of the basin that contribute a disproportionately large amount of pollution

Tributary Monitoring

Task: The Lake Champlain Basin Program will establish 10 new monitoring stations in the Missisquoi Basin to be maintained for the duration of the Missisquoi Bay Basin Project. This workshop is intended to inform this work.

Purpose: To assist in identifying and assessing Critical Source Areas

Objectives:

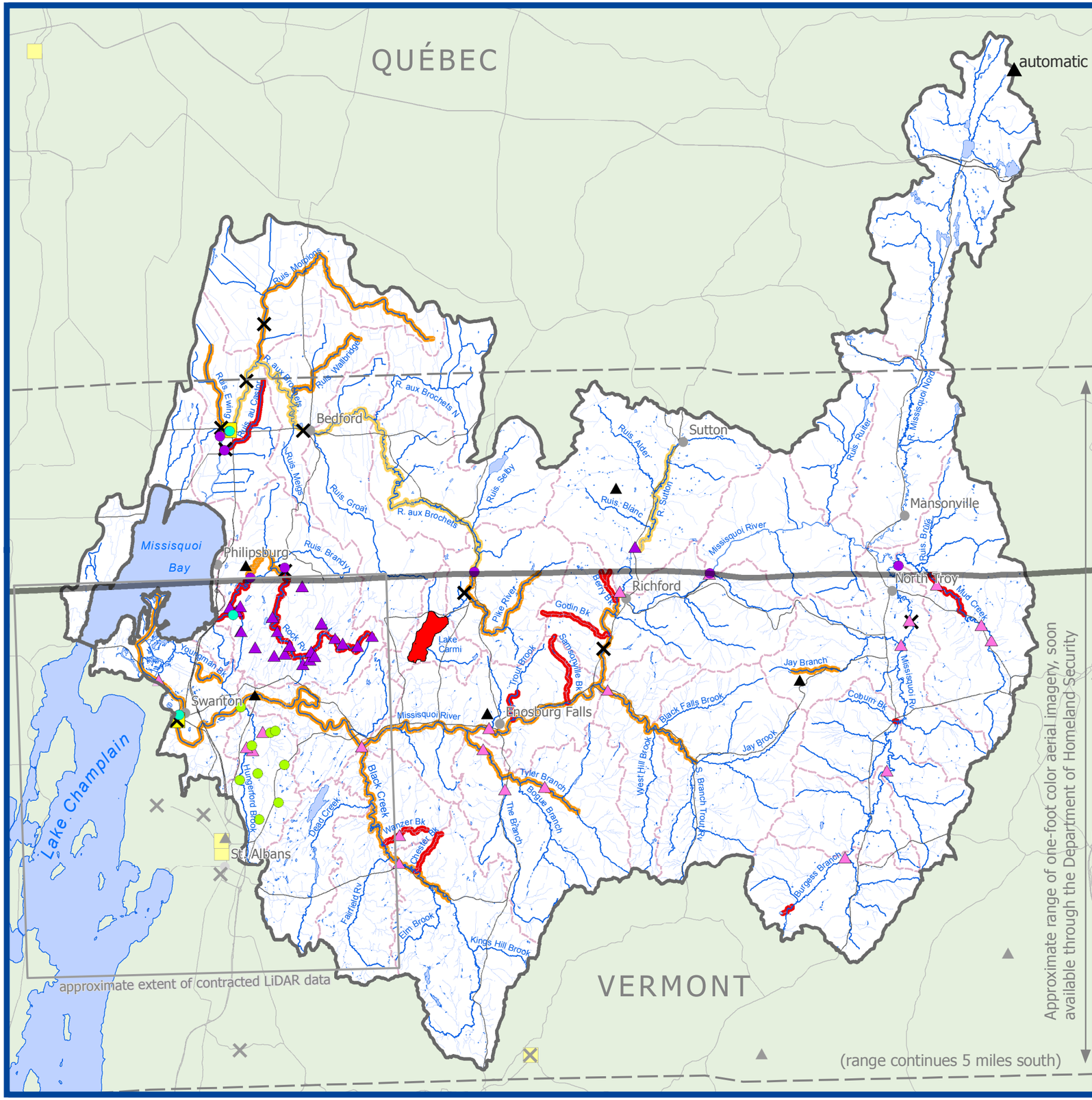
- Determine potential locations for the sampling stations
- Discuss the parameters to measure
- Discuss the optimal sampling periods and intervals

Considerations:

- What are the short and long-term monitoring needs for phosphorus, nitrogen and sediment in the Basin?
- What type of data would be most useful for validating and calibrating a model?
- What type of information is needed to understand the processes at work in the watershed?
- What monitoring is needed to understand transboundary pollution loads?
- What is the importance of precipitation and rainfall intensity?

Missisquoi Bay Basin

Impaired surface water and current monitoring



Vermont DEC Priority Surface Waters (2008)

- Impaired waters (from CWA 303(d) List of Waters)
- Stressed waters (need further assessment)

Québec MDDEP Impaired Waters (2005 - 2007)

- Very poor (WQI 0 - 20)
- Poor (WQI 20 - 40)
- Fair (WQI 40 - 60)

Type of Monitoring

- ○ Site of phosphorus, nitrogen, and sediment monitoring WITH flow data
- △ Site of phosphorus, nitrogen, and sediment monitoring WITHOUT flow data
- □ Site of other monitoring (all are currently inactive)
- ✕ River flow gage (USGS/MDDEP)
- ▲ Cooperative weather station (unless noted "automatic")

Monitoring Agency or Group

- LCBP/DEC
- USGS
- DEC/MDDEP
- UVM
- Missisquoi River Basin Association (2008 sites)

- Major waters
- Minor waters
- Sub-basin bounds (HUC12)
- Major roads

Miles: 0 5 10 15 20

Kilometers: 0 5 10 15 20 25

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Lake Champlain Basin Program

Missisquoi Bay Basin Project:
Identifying Critical Source Areas of Pollution

Workgroup Meeting on Defining Critical Source Areas and Management Needs
Friday, January 23, 2009
Gordon Center House, Grand Isle, VT

Tributary Monitoring Discussion Summary

Overview of Meeting

The Missisquoi Bay Basin Project Workgroup was convened to define the term "critical source area," taking into consideration the discussions of Workshop II: Defining Critical Source Areas and Management Needs. The group also discussed useful data types and formats to be generated through this project and how to share these with people in the Basin. In addition to these topics, the Workgroup considered the goals of the short-term monitoring program and possible locations and types of monitoring to be established. The following document summarizes only the discussion of short-term tributary monitoring.

Short-term Tributary Monitoring

Two basic monitoring methods were discussed at the first workshop: establish rigorous monitoring to supplement the current long-term monitoring network or sample more sites across the entire Basin without flow data to aid in more localized comparisons of possible pollution-contributing tributaries. The Lake Champlain Basin Program (LCBP) also could establish monitoring above and below a Best Management Practice (BMP) to determine its effectiveness, around shifts in land use to determine their effects on water quality, or for a paired-watersheds study.

The group decided that the greatest value would be to expand the long-term monitoring network in the Basin. New monitoring sites were identified at the mouths of Hungerford Brook, Black Creek, Tyler Branch, Trout River, and Mud Creek to fill the gaps in the current long-term monitoring program. Data collection and analysis at the new locations would be conducted similarly to the existing long-term monitoring, to allow for a consistent data set. In addition to these new stations, the group identified the need for a flow gage on the Sutton River to increase the accuracy of current monitoring. This gage would be established on the US side of the border.

The group also identified the need for a more in-depth network of meteorological stations. There are no automatic National Weather Service (NWS) stations in the Basin; however, there are NWS Cooperative Observer Program stations in and near the Basin. There are three stations in the Quebec Sector of the Basin. Automatic stations in three or four locations within the basin would add to the current NWS stations in the state. Alternatively, the LCBP could find volunteers and purchase stations to add to the Cooperative Observer Program network. In either case, the LCBP would aim to measure meteorological data under the quality assurance plans used by the NWS. The group recommended looking at future station sites near Swanton, East Fletcher, and Troy and will research the possibility of upgrading current sites in Enosburg Falls, Highgate Falls, and at Jay Peak.

Attendees
Erik Beck, Environmental Protection Agency
Laura DiPietro, Vermont Agency of Agriculture Food & Markets
Julie Moore, Vermont Agency of Natural Resources
Kip Potter, Vermont Natural Resources Conservation Service
Eric Smeltzer, Vermont Department of Environmental Conservation
Mike Winslow, Lake Champlain Committee

LCBP
Bill Howland
Kris Joppe-Mercure
Meg Modley
Nicole Grohoski

Missisquoi Bay Basin

Proposed short-term monitoring sites

Points represent approximate locations

- Short-term monitoring station
- Flow gage
- Possible weather station
- Existing weather station
- Major waters
- Sub-basin bounds (HUC12)

Miles: 0 5 10 15

Kilometers: 0 5 10 15 20

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