

Water Use Advisory Zone Monitoring Plan
for Lampricide Treatments in Lake Champlain

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Introduction

In 1990, the Lake Champlain Fish and Wildlife Management Cooperative* (Cooperative) initiated an 8-year experimental program using lampricides to control sea lamprey in Lake Champlain. Lake Champlain tributaries receiving lampricide treatments during the experimental program included, the Great Chazy, Saranac, Salmon, Little Ausable, Ausable, Boquet, Poultney and Hubbardton rivers, Lewis and Putnam creeks, and, Mt. Hope, Trout and Stone Bridge brooks; the program included evaluations of the effects of sea lamprey control on salmonid populations, sport fisheries, and the area's economy (NYSDEC et al. 1990). Results of these and other studies demonstrated the experimental program was effective and showed fishery and economic benefits while having minimal adverse impacts on non-target organisms (Fisheries Technical Committee 1999). The Cooperative has been engaged in a long-term sea lamprey control program in Lake Champlain since 2002 (USFWS, et al. 2001).

Two lampricide active ingredients are used in sea lamprey control in New York and Vermont. First, 3-trifluoromethyl 4-nitrophenol (TFM) is used in liquid (TFM-HP [NY and VT] and Lampracid [NY only]) and in bar (TFM-BAR) formulations. The liquid formulations are metered carefully by calibrated pump to achieve a dosage lethal to sea lamprey. The bars are used in small tributaries to the treated mainstem to prevent dilution and the creation of freshwater refugia for larval sea lamprey. Second, Niclosaminde is used in liquid (Bayluscide 20% Emulsifiable Concentrate) and granular (3.2% Granular Bayluscide) formulations. The liquid formulation is used as an additive to TFM treatments and is metered through a calibrated pump. When used at a concentration equivalent of 0.5 to 2% by weight of TFM, Niclosamide can reduce the amount of TFM needed by up to 40 percent. Granular Bayluscide is used on river deltas to kill resident larval lamprey in those areas. Granular Bayluscide is only approved for use in New York waters of Lake Champlain.

Toxicological information indicates that human exposure to water treated with lampricides at concentrations and durations used for sea lamprey control will not result in adverse health effects (USFWS et al. 2001). In 2004, the U. S. Environmental Protection Agency (USEPA) issued risk assessment guidance stating that TFM may be present in drinking water at levels up to 300 parts per billion (ppb) before there would be any potential concern about risk to human health (Lindsay 2004). Niclosamide is used worldwide in human medicine to treat tapeworm infections at single doses of 500 to 2,000 mg (WHO 2007). At typical TFM-Niclosamide combination treatment concentrations in Lake Champlain streams, it would require ingesting 20,000 to 50,000 liters of treated water to provide a 500 mg dose of niclosamide.

Water Use Advisory Zone Monitoring Protocol

* Agencies in the Cooperative include the New York Department of Environmental Conservation (NYSDEC), Vermont Department of Fish and Wildlife (VTDFW), and the U.S. Fish and Wildlife Service (USFWS)

After a series of tracer dye plume studies (Myers 1987; Neuderfer 1988a and 1988b), plume modeling research (Laible and Walker 1987), and recommendations from the state health departments, the Cooperative implemented a lampricide monitoring plan for the 13 Lake Champlain tributary systems treated during the experimental program (Neuderfer 1989). The plan established water use advisory zones for the treated portion of each stream and the surrounding lakeshore, and includes a standardized water sampling and analysis protocol for monitoring TFM plume concentrations. During treatments, surface water uses are restricted in each advisory zone, and the advisories are discontinued 24 hours after TFM concentrations fall below state-specific threshold concentrations determined to have negligible risk to public health (Chipman 2010a). The drinking water use advisory threshold in Vermont is set at 3ppb. The advisory against swimming, bathing, and agricultural water uses, including irrigation and livestock watering, is set at 35 ppb and 100 ppb is set as the advisory threshold for recreational water uses other than swimming. Once monitoring is initiated, low-level monitoring stations are generally sampled daily until TFM concentrations at all stations fall below State specific thresholds.

Niclosamide, if used in combination with TFM, will not be monitored for water use advisory purposes because niclosamide is a minor component of the TFM-niclosamide combination for stream treatments and would be at levels undetectable by conventional methods. Combination treatments result in smaller exposure areas and shorter water use advisory durations because they significantly reduce overall amount of pesticide applied to the environment.

This plan is an update of previous water use advisory zone monitoring plans developed for Lake Champlain tributaries (Neuderfer 1989), (Chipman 2010a). Monitoring plans for certain streams may be revised prior to future treatments, based on new information.

Low-level TFM analysis follows the protocol of Neuderfer (1989), with some modifications as described below. Analysis of water use advisory-related TFM samples will be conducted by high performance liquid chromatography (HPLC). Standard operating procedures for HPLC analysis are detailed in the Great Lakes Fishery Commission standard operating procedures for lampricide applications ([Woldt and Sullivan 2014](#)). These procedures state that the method detection limit (MDL) for TFM is 2.4 ppb and quantitation limit (QL) for the measurement of TFM concentrations is 7.5 ppb. Actual detection and quantitation limits are instrument specific and can vary. Testing conducted at the USFWS Lake Champlain Fish and Wildlife Conservation office indicated our instrument MDL is approximately 1.0 ppb and QL is 3.0 ppb (Mason 2016). Water will be collected from each river and from within its Lake Champlain water use advisory zone prior to the beginning of the treatment for use in calibrating the analysis equipment and determining background conditions.

Water samples in the field will be collected in clean plastic sample bottles. Bottles will be triple rinsed with sample prior to filling. All sample bottles will be labeled with the appropriate station name. One surface water sample will be collected at each lake sampling station where depth is less than 15 feet. Both a surface and bottom sample will be taken at sampling stations where the depth is greater than 15 feet. Analysis of historical data over a 25-year period which included 84 different monitoring efforts and over 400 multi-depth sampling events indicates samples at multiple depths return a measurement within 5 ppb over 80% of the time. Following collection,

bottles will be stored in a cooler, or bucket with cover to prevent exposure to light. After all samples are collected they will be brought back to the appropriate HPLC analysis location as soon as practicable.

Past experience has shown that a lampricide plume will stay together as it radiates in progressive gradients of dilution into the lake; and because the lake water use advisory zone is delineated based on the combination of predicted extents of plumes under widely differing wind-forcing conditions, an actual plume will be detected in only a portion of the zone at any given time. Thus, some sampling stations are predictably void of lampricide once the location of the plume is identified thru analysis. This experience has led to the development of a modification of the Nuederfer (1989) analysis protocol, which will improve the efficiency of the low-level monitoring process. Samples will generally be collected daily through the monitoring period at all stations within the lake advisory zone, but instead of analyzing all samples collected each day, those stations found to be separated from the detectable plume may not require analysis for TFM. Specific elements of the modified analysis protocol are described below:

1. On the first day of monitoring, all samples collected will be analyzed to confirm presence or absence of TFM at all stations.
2. On subsequent days, analysis will begin with samples collected at the stations that were found to have the highest TFM concentrations on the previous day, followed progressively by samples from adjacent stations, radiating outward until TFM is no longer detected. When TFM is not detected at a given station, samples collected at stations more distant from the TFM plume will not be analyzed. Using the Poultney/Hubbardton River as an example (Figure 10), if the plume was not detected at Station PR10N, then the stations north of Station PR10N would not require analysis.
3. The recreational water use advisory will be lifted 24hours after samples from all stations are found to have concentrations less than 100 ppb.
4. The swimming, bathing, and agricultural/irrigation water use advisory will be lifted 24hours after all stations are found to have concentrations less than 35 ppb.
5. The drinking water use advisory will be lifted 24hours after all stations and any water treatment facility intakes are found to have concentrations less than 3ppb.

The above protocol was initiated and successfully implemented with the 2009 Lamoille River treatment (Chipman 2009, 2010b).

Further modification of the Neuderfer 1989 plan adjusts Appendix E, the water sampling and water use advisory zone descriptions, and related river-specific information for treated streams and deltas. New river-specific advisory zones and sampling stations for LaPlatte River and Stone Bridge Brook are described below. Water use advisories affecting the stream advisory zones will be initiated at the start of treatment. Timing of water use advisory initiation in zones on the encompassing lakeshore areas are determined based on time of travel data from past treatments, dye studies and/or hydrodynamic modeling; the advisories are set to go into effect before the earliest time that the TFM plume is predicted to enter the advisory zone under the highest permitted flow conditions. Lakeshore sampling stations are spaced at 0.5 mile intervals unless otherwise noted. Sampling station names will correspond to distance from the river mouth, i.e. SA2.0N would be located 2.0 miles north of the Saranac River mouth.

LaPlatte River

Two water use advisory zones are established for the LaPlatte River. Zone 1 includes the river from the application point downstream to Station 6, Rt. 7 Bridge; Zone 2 extends from the Rt 7 Bridge downstream and includes the lakeshore area of Shelburne Bay extending Northward from the mouth for approximately 3.0 miles to a West-East line across the Bay from Shelburne Point to Red Rock Point (Figure 1).

Water use advisories will go into effect in Zone 1 at the time the lampricide treatment begins, and Zone 2 water use advisories will go into effect no later than 12 hours after treatment initiation. Low-level monitoring in Zones 1 and 2 will begin three days after treatment is initiated. *The Rt. 7 Bridge site* will be sampled for low-level monitoring of Zone 1. Low-level monitoring in Zone 2 will begin two days after the TFM block passes Shelburne Falls. Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than Vermont DOH advisory thresholds.

The Champlain Water Districts (CWD) municipal water intake is located approximately 2.7 miles north of the LaPlatte River mouth (Figure 13) at a bottom depth of 75 feet (intake opening is ~10 feet off the bottom). The lampricide transport model predicts that TFM concentrations could reach the vicinity of this intake (Binkerd 2016). As an extra precaution, a powdered activated carbon (PAC) filtration system, developed by CWD and approved by the Vermont Department of Environmental Conservation's Drinking Water and Groundwater Protection Division, was installed and is to be operated at the CWD during the water use advisory. The Burlington Water Treatment Facility (BWTF) has a PAC system in place and was operated during the 2004, 2008, 2012, and 2015 treatments of the Winooski River. PAC will remove TFM (if present) and other organic chemicals from the water supply (Dawson, et al. 1976). The BWTF intake is located approximately 5.7 miles north of the LaPlatte River mouth. Plume modeling (Binkerd 2016) indicates that no TFM will reach the Burlington intake. However, in the extremely unlikely event that low levels of TFM extend to the either intake, users of the municipal water supply will not be exposed. The PAC systems may be operated in a similar manner in conjunction with all future LaPlatte River treatments, following guidance from the Drinking Water and Groundwater Protection Division.

No less than 30 days prior to any lampricide treatment of the LaPlatte River, the treatment supervisor will notify CWD and BWTF (Facilities) of the planned treatment date so that the PAC filtration systems can be tested and determined operational. One set of raw and finished water samples will be collected from each facility before the day of treatment and used to produce site-specific standards against which treatment samples will be measured. The Facilities will be advised to activate the PAC system at an agreed-upon time. On the morning of treatment, the treatment supervisor (or designee) will notify the Facilities to confirm that the treatment has or has not begun. The Facilities will be kept informed of any delays and rescheduling of the treatment. The Facilities will be advised to keep the PAC in operation for at least 24 hours after TFM concentrations at all low-level monitoring stations fall below 3 ppb, or at least 24 hours after analytical results of the raw intake water confirm that TFM levels in the intake water are less than 3 parts per billion, whichever comes later.

Low-level monitoring samples will be analyzed within 6 hours of collection and results will be reported to the Facilities daily after the analyses are completed. Low-Level monitoring of the CWD intake will begin on the day after the Lampricide block is detected at the Rt. 7 Bridge in Shelburne. Low-level monitoring of the Burlington intake will begin if/when TFM is detected at the Northern most sampling sites in Shelburne Bay. One set of raw and finished water samples will be collected and analyzed once each day. Results will be reported to the WTF as soon as possible after analysis. If TFM is detected in a raw water sample, then the accompanying finished water sample will be analyzed and the results reported as described above.

Stone Bridge Brook

Two water use advisory zones are established for Stone Bridge Brook. Zone 1 includes the treated reach of Stone Bridge Brook and Zone 2 includes the surrounding lakeshore within a 0.5 mile radius of the mouth of Stone Bridge Brook (Figure 2).

Water use advisories in Zone 1, will go into effect at the time the lampricide treatment begins, and will be lifted 24 hours after sampling at the mouth indicates concentrations have fallen below DOH thresholds. Advisories in Zone 2 will go into effect no later than 12 hours after treatment initiation and will be lifted 24 hours after all sampling sites indicate concentrations have fallen below DOH thresholds.

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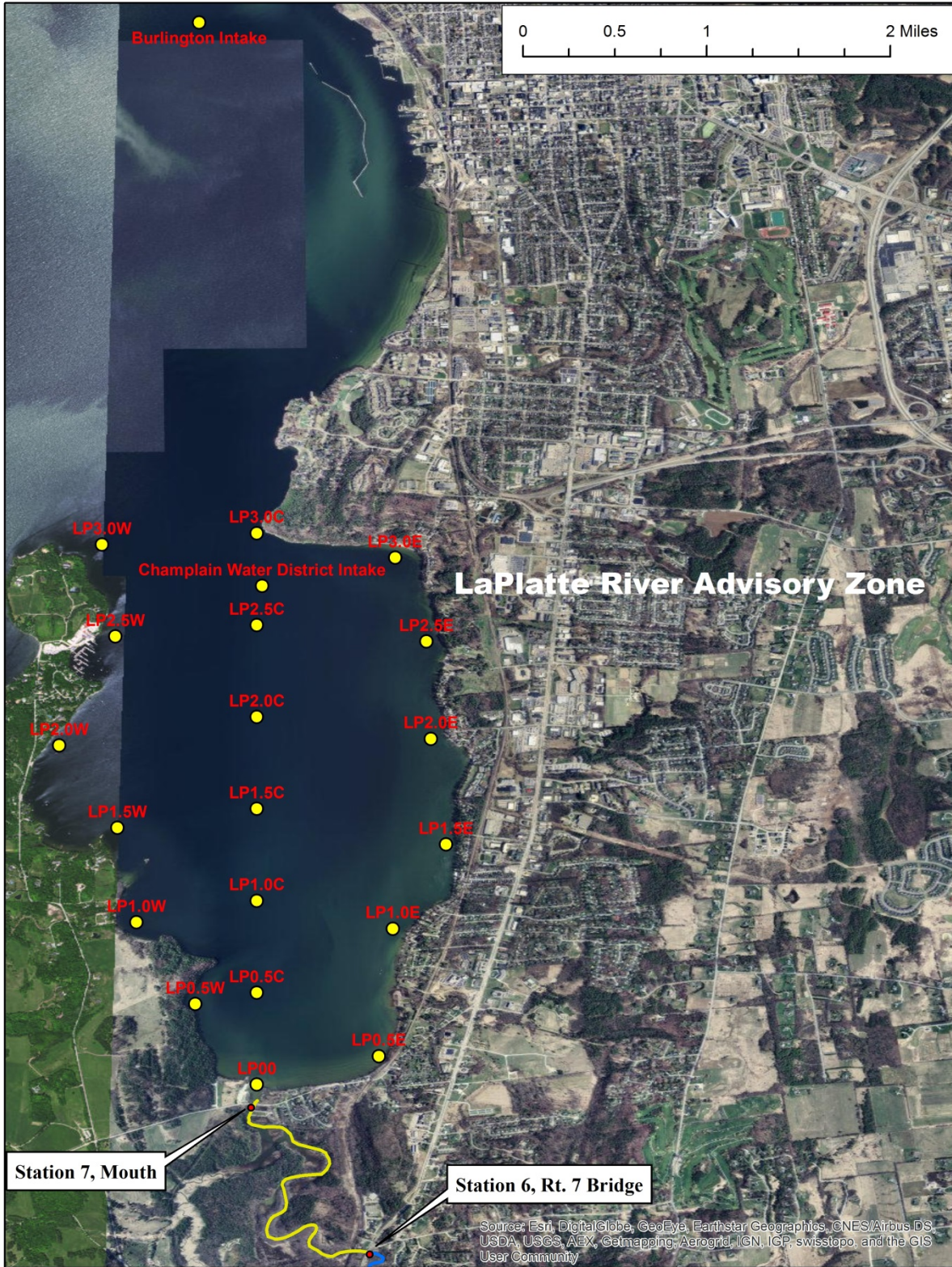


Figure 12. Water use advisory zones and TFM monitoring stations associated with the LaPlatte River lampricide treatment.

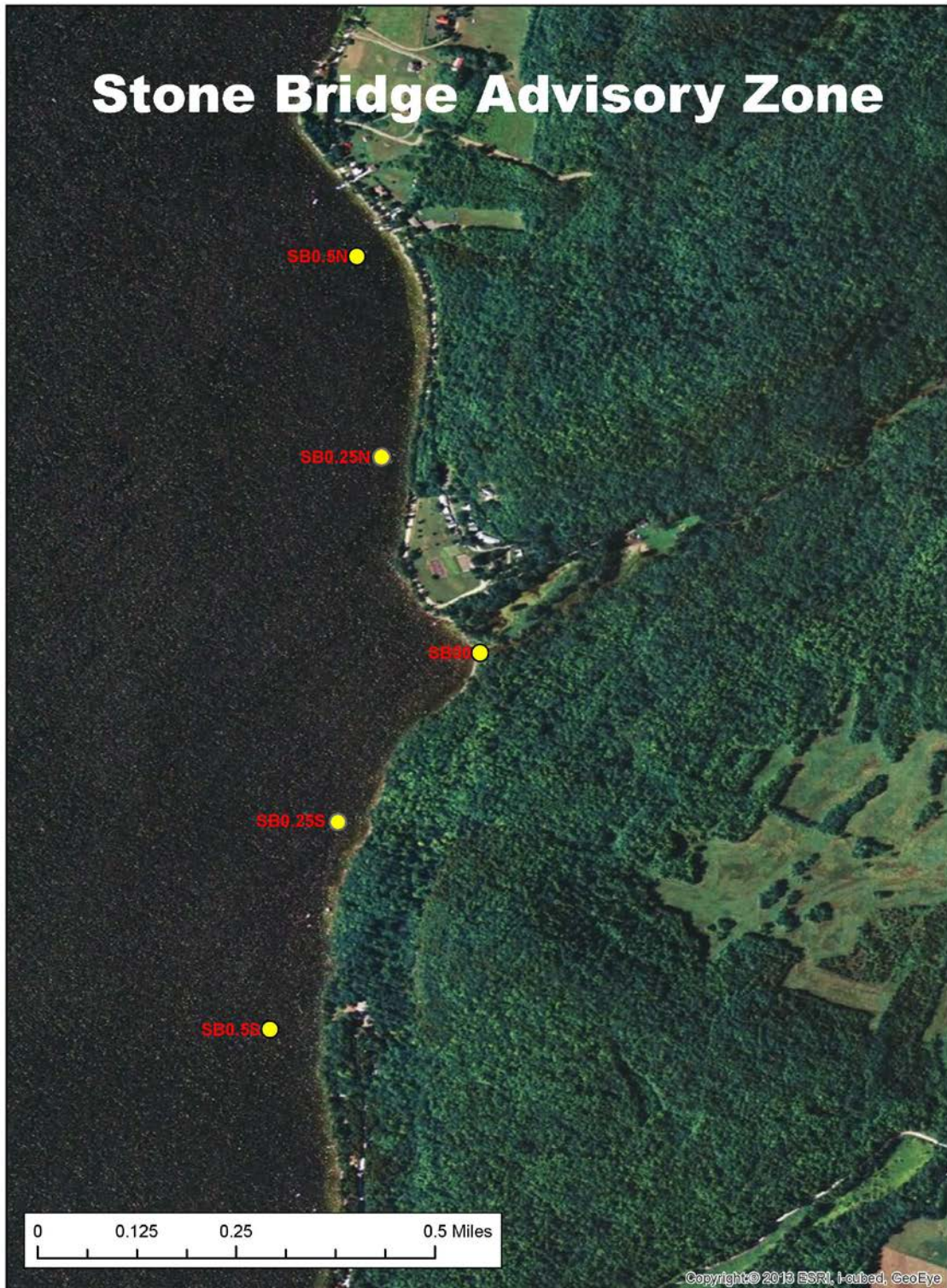


Figure 15. Water use advisory zone and TFM monitoring stations associated with the Stone Bridge Brook lampricide treatment.