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STANDARD OPERATING PROCEDURES FOR APPLICATION OF LAMPRICIDES IN THE GREAT LAKES FISHERY COMMISSION INTEGRATED MANAGEMENT OF SEA LAMPREY (*Petromyzon marinus*) CONTROL PROGRAM

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DISCLAIMER

The Ludington Biological Station is temporarily stationed at 375 River Street, Manistee, Michigan 49660, U.S.A. Since this is a temporary situation all references to the Ludington Biological Station in the Introduction, Administrative Operating Procedures, Technical Operating Procedures, and Instrument Operating Procedures will retain the U.S. Fish and Wildlife Service, Ludington Biological Station, 229 South Jebavy Drive, Ludington, Michigan 49431, U.S.A. address until a new permanent location is determined.

This manual is intended solely for the use of individuals and organizations involved in sea lamprey control in the Great Lakes, Finger Lakes, and Lake Champlain under the terms, conditions and procedures cited herein. All data contained in the manual are exclusive to the use and the restrictions and stipulations contained herein. The U.S. Fish and Wildlife Service makes no claim of suitability and assumes no liability for uses of the material contained herein for control of sea lampreys.

This manual does not endorse or recommend the use of the brand names of products or equipment cited herein.

ADOPTION OF PROCEDURES

These Standard Operating Procedures for control of sea lampreys in the Great Lakes are adopted and will be implemented by all U.S. Fish and Wildlife Service and Fisheries and Oceans Canada Sea Lamprey Management personnel. The procedures include measures to assure conformance with all specifications and requirements for use.

This page serves to update the previous ADOPTION OF PROCEDURES

Jn M Barber ____________ Date 2-22-19

Jessica Barber
Field Supervisor
U.S. Fish and Wildlife Service

Mike Steeves for ____________ Date 22FEB19

W. Paul Sullivan
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Approval of Standard Operating Procedures

All standard operating procedures for the chemical control of sea lampreys require signatures of approval from the program Field Supervisor, U.S. Fish and Wildlife Service and/or Division Manager, Fisheries and Oceans Canada. Persons filling either of these positions assume the responsibility of approving all procedures. This page is provided to simplify the process of granting approval.

This page furnishes blanket approval of all standard operating procedures published in Document SLC 04-001.9 *Standard operating procedures for application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (Petromyzon marinus) control program* on the date of signing.

Approval is not furnished for procedures introduced, amended, or edited after date of signing. All subsequent additions and changes require signatures on an individual basis.

Jn M Barber Date 2-22-19

Jessica Barber
Field Supervisor
U.S. Fish and Wildlife Service

Luke Sfares for Date 22FEB19

W. Paul Sullivan
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Fisheries and Oceans Canada

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DEFINITION OF TERMS

Definitions specific for lampricides

Active Ingredient (A.I.)

The element or compound in a chemical formulation that causes the desired activity or effect.

Administrative Operating Procedure (AOP)

A document that describes the standardized procedures for conducting administrative functions which support field operations.

Analytical standard

A commercially prepared grade of 3-trifluoromethyl-4-nitrophenol (TFM) or 2',5-dichloro-4'-nitrosalicylanalide (niclosamide) of high purity, usually 95% or greater. The analytical standard must be accompanied by a Certificate of Analysis from the manufacturer stating the purity.

Bayluscide

The 2-aminoethanol salt of niclosamide, also known as Bayer 73 or Clonitralid.

Biological Survey

A procedure whereby personnel survey the stream before, during or after a treatment in order to characterize and document fish activity or mortality.

Boost

See Maintenance application

Certified applicator (Pesticide applicator in Canada)

A person who is approved by state and/or provincial regulatory agencies to apply pesticide products. Certified applicators of lampricides are limited to personnel from United States Fish and Wildlife Service, Fisheries and Oceans Canada, and provincial and state fish and game employees.

Emulsifiable concentrate

A formulation that contains active ingredient, one or more petroleum-based solvents, and an agent that allows the formulation to be mixed with water to form an emulsion.

Field standard

A laboratory formulated TFM or niclosamide standard prepared in an appropriate solvent. Concentrations of TFM field standards are 0.0, 4.0, 8.0, and 12.0 mg/L (A.I.) in sodium tetraborate buffered deionized water. Niclosamide field standards are formulated at 100 mg/L (A.I.) in dimethylformamide.

Instrument Operating Procedure (IOP)

A document that describes the standardized procedures for calibrating, operating, and maintaining an instrument or device.

Lamprecid® (TFM) or TFM HP Sea Lamprey Larvicide

The formulated sodium salt of 3-trifluoromethyl-4-nitrophenol.

Lampricide block

A continuous volume of stream discharge containing lampricide(s). The volume typically represents the discharge passing a site for about 12 hours.

Lampricide prediction table

Relates the toxicity of lampricides to the pH and alkalinity of stream water. The tables are produced from of a series of regressions conducted on data produced by laboratory toxicity tests. Prediction tables allow determination of lampricide concentrations used in stream treatments.

Maintenance application

An application of lampricide(s) into an existing lampricide block that is intended to maintain the effectiveness of the block; also termed a boost.

Maximum Allowable Concentration (MAC)

The concentration of lampricide(s) that produces 25 percent mortality of brown trout after a 9-hour exposure. This concentration is determined by prediction charts based on pH.

Minimum Lethal Concentration (MLC)

The concentration of lampricide(s) that produces 99.9 percent mortality of sea lamprey larvae after a 9-hour exposure. This concentration is determined by prediction charts based on pH and alkalinity or pretreatment on-site toxicity tests.

Niclosamide

The active ingredient (2',5-dichloro-4'-nitrosalicylanilide; also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxy-benzamide) in formulations of Bayluscide.

Nontarget organisms

All organisms other than sea lampreys.

National Pollutant Discharge Elimination System (NPDES)

The permit program that controls water pollution by regulating point sources that discharge pollutants into waters of the United States.

Primary application

The initial upstream application of lampricides to an infested stream. Maintenance applications are made into, and many supplemental applications are timed to blend with the lampricide block produced by this application.

Restricted use pesticide

A pesticide designated by the United States Environmental Protection Agency (USEPA)/Health Canada for use only by or under the direct supervision of certified applicators. The designation and additional regulatory restrictions are intended to prevent adverse effects on the environment or injury to the applicator.

Sea lamprey larvae

The immature, nonparasitic life stage of the sea lamprey (ammocoete).

Standard Operating Procedure (SOP)

A document used by personnel to perform procedures that are routine and standardized. An SOP helps to ensure the quality and integrity of data, provides a basis for uniformity and accountability, and offers a basis for training and guidance.

Stream Maximum Allowable Concentration (SMAC)

The concentration of lampricide(s) that may be applied to a stream without expectation of causing undue nontarget mortality. This is the highest concentration allowed during treatment.

Stream Minimum Lethal Concentration (SMLC)

The minimum concentration of lampricide(s) needed under specific water chemistry conditions for effective treatment of a stream or tributary. SMLC values for a stream can vary both temporally and spatially; many SMLC values may be used to conduct a single treatment.

Supplemental applications

Supplemental applications of lampricides are conducted in backwaters and tributaries of streams undergoing treatment. Applications are made with liquid or bar formulations of TFM or granular formulation of Bayluscide. Supplemental applications are generally timed to merge with the lampricide block from the primary application.

Technical Operating Procedure (TOP)

A document which describes the standardized steps required and used to perform a specific technical task.

TFM HP Sea Lamprey Larvicide

See Lampricide®

Toxicity test

A test in which the lethal effects of lampricide(s) on target and nontarget animals are assessed by exposing sea lamprey larvae and selected nontarget species to a series of concentrations of lampricide(s). The lowest observed concentration that produces 100% sea lamprey mortality in an on-site toxicity test can be used as the SMLC.

Wettable powder

A powdered formulation of a relatively insoluble pesticide in which the active ingredient is combined with an inert carrier and with a wetting or dispersing agent; a wettable powder forms a suspension rather than a true solution in water.

Working standard

A dilution of the niclosamide field standard to a suitable concentration for on-site analyses of niclosamide concentrations during stream treatments and toxicity tests.

LIST OF ACRONYMS

AI	Active Ingredient
AOP	Administrative Operating Procedure
ATV/ORUV	All-Terrain Vehicle/Off Road Utility Vehicle
CDL	Commercial Driver's License
CPR	Cardio-Pulmonary Resuscitation
DMF	Dimethyl formamide
DFO	Fisheries and Oceans Canada previously Department of Fisheries and Oceans
DOT	Department of Transportation (U.S.)
DO	Dissolved Oxygen
DVIR	Driver Vehicle Inspection Report
EC	Emulsifiable Concentrate
ES	Ecological Services
ESTR	Empirical Stream Treatment Ranking
FERC	Federal Energy Regulatory Commission
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GLFC	Great Lakes Fishery Commission
HBBS	Hammond Bay Biological Station
HPLC	High Performance Liquid Chromatograph(y)
IOP	Instrument Operating Procedure
LBS	Ludington Biological Station
LC	Lethal Concentration
LCFWMC	Lake Champlain Fish and Wildlife Management Cooperative

List of Acronyms (continued)

MBS	Marquette Biological Station
MDEQ	Michigan Department of Environmental Quality
MAC	Maximum Allowable Concentration
MLC	Minimum Lethal Concentration
MSDS/SDS	Material Safety Data Sheet/Safety Data Sheet
NCTC	National Conservation Training Center
NPDES	National Pollutant Discharge Elimination System
NYSDEC	New York State Department of Environmental Conservation
OMNR	Ontario Ministry of Natural Resources and Forestry
OMOE	Ontario Ministry of Environment and Climate Change
PEAS	Pollution Emergency Alerting System
PPE	Personal Protective Equipment
SLCC	Sea Lamprey Control Centre
SLCP	Sea Lamprey Control Program
SMAC	Stream Maximum Allowable Concentration
SMLC	Stream Minimum Lethal Concentration
SOP	Standard Operating Procedure
TFM	3-trifluoromethyl-4-nitrophenol; Lamprecid®
TOP	Technical Operating Procedure
UMESC	Upper Midwest Environmental Sciences Center
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WHMIS	Workplace Hazardous Materials Information System

List of Acronyms (continued)

WP	Wettable Powder

PREFACE

The Great Lakes Fishery Commission was established by the CONVENTION ON GREAT LAKES FISHERIES BETWEEN THE UNITED STATES OF AMERICA AND CANADA, in 1955 (Appendix A). Article IV section d states that one of the duties of the Great Lakes Fishery Commission is "to formulate and implement a comprehensive program for the purpose of eradicating or minimizing the sea lamprey populations in the Convention Area". Article V section b states that the Commission may "take measures and install devices in the Convention Area and the tributaries thereof for lamprey control". The Great Lakes Fishery Act of 1956 (Public Law 557-84th Congress, Chapter 358-2d Session, S.3524, 16 U.S.C. 931-939C) provides the enabling legislation in the United States (Appendix A). The United States Fish and Wildlife Service (USFWS) and Fisheries and Oceans Canada (DFO) conduct a sea lamprey control program as partners of the Great Lakes Fishery Commission (GLFC) by Memorandum of Agreement with the Commission as specified in the Convention. All sea lamprey control actions taken by the partners for the Commission are pursuant to the Great Lakes Fishery Act of 1956 and Great Lakes Fisheries Convention Act. 1955, c.34, s.1.

SCOPE

This document describes the standard operating procedures for application of lampricides in the Great Lakes Fishery Commission integrated management of sea lamprey (*Petromyzon marinus*) control program. The procedures described pertain to the chemical control and assessment of sea lampreys in the United States and Canada.

INTRODUCTION

I. Biology

The sea lamprey is a primitive eel-like fish distinguished from other fish by its lack of paired fins and jaws. The sea lamprey, closely related to the primitive hagfish, is an anadromous species endemic to the Atlantic Ocean. Most of the life of the sea lamprey is spent as a larva burrowed in the sediment of freshwater streams. In this life stage the animal is not harmful to other fish and feeds by filtering food from stream water. The sea lamprey may remain in the larval stage from 3 to more than 17 years before metamorphosing into the parasitic (predatory) stage. The parasitic-phase lamprey feeds by attaching to fish and rasping deep wounds from which blood, body fluids, and flesh are drawn. The results of such attacks are often fatal for the host fish.

II. History

The sea lamprey was first reported in Lake Erie in 1921. They rapidly spread throughout the upper Great Lakes and were well established by the 1940s. By 1950, lake trout (*Salvelinus namaycush*), a primary prey species, were nearly extirpated in lakes Michigan and Huron.

Early attempts to control sea lampreys began in the 1950s with the installation of mechanical traps and electrical weirs in spawning streams, but these measures were largely unsuccessful. No effective control was accomplished until the advent of a chemical control program in 1958.

A search for an effective lampricide began in the 1950s. After toxicological screening of nearly 6000 chemicals, two classes of compounds emerged as likely candidates, halogenated nitrophenols and salicylanilides. From these classes of compounds two lampricides, TFM (3-trifluoromethyl-4-nitrophenol) and Bayluscide (2',5-dichloro-4'-nitrosalicylanilide) were developed and have been used successfully for the control of larval sea lampreys in the Great Lakes basin.

TFM and Bayluscide were registered as restricted use pesticides in 1960. Both lampricides were successfully reregistered in 1997 in the U.S. and in Canada.

III. Lampricide Formulations

Lampricide formulations are registered by the USFWS as restricted use pesticides in both the United States and Canada. Use of these products is limited to certified applicators of the USFWS, DFO, and provincial and state fish and game employees. Pesticide labels (Appendix E) have been issued that define use practices in their respective countries. The "Restricted Use" designation restricts a product, or its uses, to use by a certified pesticide applicator or under the direct supervision of a certified applicator. Pesticide applicators must adhere to all label requirements and follow all precautionary statements. Among these stipulations are the following: lampricides are to be handled and applied only by trained personnel; local, state, and provincial fish and game agencies must be notified before use; municipalities which use stream water as a potential source of drinking water must be notified 24 hours prior to treatment; agricultural irrigators must be informed 24 hours in advance of a treatment that they must turn off irrigation systems for a 24 hour period during and after treatment; pretreatment surveys must be conducted to determine larvae populations; on-site water chemistry analyses must be conducted to determine the minimum concentration of lampricide required to kill larval sea lampreys and the maximum concentration that can be used without causing undue nontarget mortality; concentrations of lampricide in the water must be monitored by colorimetric analysis, or High Performance Liquid Chromatography (HPLC); and specified personal safety precautions must be followed.

A. TFM

The chemical compound 3-trifluoromethyl-4-nitrophenol also known as α,α,α-Trifluoro-4-nitro-m-cresol (TFM) is a halogenated mononitrophenol with the molecular formula $C_7H_4F_3NO_3$, and a molecular weight of 207.1. TFM has a pKa of 6.07 $\pm$ 0.03, and exhibits a maximum absorbance at 395 nm (for the phenolate ion) and 295 nm (for the unionized form).

1. Analytical Standard

This is a purified form and distributed by Sigma-Aldrich, St. Louis, Missouri. It is a light yellow crystalline substance with a purity of 99 percent active ingredient. The concentrations of TFM field standards used during lampricide applications are verified against a TFM analytical standard.

2. TFM

TFM is produced as a liquid formulation of the sodium salt that contains about 33 percent active ingredient (free cresol) with the remainder primarily isopropanol and water. TFM (common names; Lampricide Sea Lamprey Larvicide, Sea Lamprey Larvicide Lamprecid®, TFM HP Sea Lamprey Larvicide) is produced under USEPA registration number 6704-45, and Health Canada Pest Control Products numbers 21124 and 11763. TFM is manufactured by Iofina Chemical, Inc., 1025 Mary Laidley Drive, Covington, Kentucky 41017; and by Weylchem (Deutschland) GmbH, 65933 Frankfurt/Main, Germany (distributed by Weylchem (America) Inc., 3411 Silverside Road, Wilmington, Delaware 19810). This formulation is highly water soluble and is packaged in 5-gallon (U.S.) plastic containers.

3. TFM Bar

TFM bars are a water soluble solid formulation containing about 23 percent active ingredient embedded in an inert chemical matrix. TFM bars are manufactured by Iofina Chemical Inc., 1025 Mary Laidley Drive, Covington, Kentucky 41017, under USEPA registration number 6704-86, and Health Canada Pest Control Products number 22610. The bars are used to treat small tributaries. The water solubility of the matrix is formulated so dissolution occurs at a controlled rate in flowing water. TFM is released with the concentration controlled primarily by the number of bars applied to the tributary. TFM bars are individually packaged and weigh about 0.9 kilograms (kg) each.

B. Bayluscide

The ethanolamine salt of 2',5-dichloro-4'-nitrosalicylanilide (Bayluscide) also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1) is registered as a molluscicide and as a sea lamprey larvicide. This compound with a molecular weight of 388.1 exhibits a maximum light absorbance at 330 nm. Bayluscide is only marginally soluble in water; 230 $\pm$ 50 mg/L at 25 °C at pH > 7. At pH < 7 Bayluscide is practically insoluble. Other common and trade names include Bay 73, Bayer 73, Bayer 2353, and Clonitralid.

1. Analytical Standard

Niclosamide (2',5-dichloro-4'-nitrosalicylanilide; also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide) the active ingredient of Bayluscide, is manufactured by Sigma-Aldrich, St. Louis, Missouri. The Bayluscide field standards are formulated with niclosamide.

2. Analytical Grade Bayluscide (Bayluscide technical)

Bay 73 technical (the ethanolamine salt of 2',5-dichloro-4'-nitrosalicylanilide also known as 5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1)) is manufactured in the Republic of China, by Anhui Topsun Pharmaceutical Inc. under contract to Bayer Germany who supplies the material under the names Bayer 2353 or Clonitralid. This technical product contains 96 - 100 percent active ingredient (81 – 84 percent niclosamide). This technical product registered under USEPA registration number 6704-88, and Health Canada Pest Control Products number 25561 is used in the manufacture of Bayluscide 70% Wettable Powder (WP), Bayluscide 3.2% Granular Sea Lamprey Larvicide, and Bayluscide 20% Emulsifiable Concentrate (EC).

3. Bayluscide 70% WP (Sea Lamprey Larvicide and Manufacturing Use Pesticide).

Bayluscide 70% WP contains 70 - 74% of the ethanolamine salt of niclosamide (5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1), approximately 62% niclosamide) and is manufactured by Coating Place, Verona, Wisconsin. This formulation is assigned USEPA registration numbers 6704-89 (Manufacturing Use Pesticide) and 6704-87 (Sea Lamprey Larvicide) and the Health Canada Pest Control Products number 25562. The Manufacturing Use Pesticide formulation is used only for formulation into a lampricide for use in tributaries to the Great Lakes, Lake Champlain, or the Finger Lakes, or into a molluscicide for use against fresh water snails. During certain stream applications Bayluscide 70% WP is used as an additive with TFM to reduce amounts of TFM used, and to protect populations of burrowing mayflies. A water slurry of the wettable powder formulation is applied in combination with TFM at a weight to weight ratio (active ingredient) of two percent or less. Analysis for the purpose of concentration control is accomplished by high performance liquid chromatography (HPLC). The Bayluscide WP formulation is packaged in plastic packages containing one-half or three pounds product.

4. Bayluscide 3.2% Granular Sea Lamprey Larvicide

   Bayluscide 3.2% granular formulation contains 3.2% of the ethanolamine salt of niclosamide (5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1)), and is manufactured by Coating Place Inc., Verona, Wisconsin, under USEPA registration number 6704-91 and Health Canada Pest Control Products number 25563. This granular formulation is used to survey for and to control sea lamprey larvae in the Great Lakes, Finger Lakes, and Lake Champlain basins. It is applied at a rate of 5 pounds active ingredient per surface acre of water (5.6 kg active ingredient/hectare), and is packaged in plastic pails that contain 50 pounds (22.7 kg) of formulated product each.

5. Bayluscide 20% EC

   Bayluscide 20% EC contains 20-21% of the ethanolamine salt of niclosamide (5-Chloro-N-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1)), approximately 18% niclosamide, and is manufactured by Coating Place, Verona, Wisconsin. This product is assigned the USEPA registration number 6704-92 and Health Canada Pest Control Products number 27407. During certain stream applications Bayluscide 20% EC is used as an additive with TFM to reduce the amounts of TFM used, and to protect populations of burrowing mayflies. Bayluscide 20% EC is applied directly to the stream water in combination with TFM at a weight ratio (active ingredient) of two percent or less. Analysis for the purpose of maintaining desired concentrations is accomplished by HPLC. Bayluscide 20% EC is packaged in 1- and 5-liter plastic containers.

The successful chemical control of sea lampreys has allowed reestablishment of a robust sport and commercial fishery in the Great Lakes. This document describes in detail the standard operating procedures used for chemical control of the sea lamprey.

PROCEDURES

I. Administrative Procedures

Selected administrative procedures followed by the partners in conducting lampricide treatment functions are described in the Administrative Operating Procedures (AOPs).

A. Personnel

1. Organizational Structure

The Sea Lamprey Control Program (SLCP) is administered by the GLFC, Ann Arbor, Michigan. The partners operate from facilities located at Sault Ste. Marie, Ontario; Ludington, Michigan; and Marquette, Michigan. The Lake Champlain Fish and Wildlife Management Cooperative (LCFWMC) operates independently as a partner in sea lamprey control.

The organizational structure of the partners is depicted in Appendix B. The Larval Assessment Team identifies streams containing sea lamprey and generates population estimates. The Lampricide Control Team reduces in-stream populations of sea lamprey larvae by periodic application of lampricides in the states and provinces bordering the Great Lakes basin. Responsibilities for application of lampricides are divided geographically among the three facilities.

2. Lampricide Control Team Structure

Responsibilities for conducting lampricide treatments are shared by treatment supervisors of the Lampricide Control Teams. The USFWS employs a Chemist who provides analytical support to all partners in the program. Remaining field personnel are support staff.

a. Treatment Supervisor – Supervisory Fish Biologist and Fish Biologist (USFWS) or Aquatic Science Biologist III (DFO)

The treatment supervisors are responsible for the operation and direction of the lampricide control crew including planning, directing, and overseeing all aspects of lampricide treatment.

b. Chemist

The Chemist is responsible for adapting available analytical techniques for conducting water chemistry measurements and measurements of concentrations of lampricides metered into streams. The Chemist maintains a procedural manual of chemical analysis techniques and conducts a variety of investigations.

c. Technical Support Personnel –Technicians

Technical support personnel provide direct support and perform the duties necessary to conduct a lampricide treatment. These persons conduct pre-application measurements, conduct toxicity tests, apply lampricides, and carry out other essential tasks related to the program.

B. Quality Assurance

The purposes of Quality Assurance (AOP:001.x) are to (1) provide guidance on how applications of lampricides are conducted and (2) ensure that facilities, equipment, personnel, methods, practices, records, and controls conform with standards provided through the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Pest Control Products Act and enforced by the USEPA and Health Canada.

This manual is a digest of procedures used throughout the SLCP in the U.S. and Canada. Assuring that procedures outlined in this manual are current and accurate is a vital function of Quality Assurance. Methods used to update procedures are outlined in AOP:002.x.

1. Training

a. Administrative Orientation

Administrative orientation applies to all new personnel who enter on duty as full-time, part-time, temporary, or seasonal employees of the partners. This procedure ensures that new employees become familiar with all regulatory and physical aspects of the workplace (AOP:003.x).

b. Equipment

All employees are trained in proper use of all equipment needed to perform their jobs. This annual training occurs prior to or during the field season according to procedures outlined in AOP:004.x. Records of training are maintained.

c. Instrumentation and Operating Procedures

Personnel are trained annually in instrumentation and analytical procedures used routinely in sea lamprey control operations to determine lampricide concentrations and stream water chemistry AOP:004.x. Training is provided in the use of these instruments and techniques to assure the accuracy and precision of the data collected.

d. Quality Assurance

The Quality Assurance program (AOP:001.x) for sea lamprey control field operations includes formal training (AOP:004.x). The training process emphasizes three areas of quality assurance: operator training, demonstration of abilities, and testing of abilities. The Quality Assurance program is reviewed annually.

e. Pesticide Applicator Certification

Federal law regulating pesticides as covered under FIFRA and Pest Control Products Act regulations provides states and provinces the authority to certify applicators, register pesticides, and design programs to meet local needs. The lampricides used in SLCP are restricted use pesticides and use of these chemicals requires pesticide applicator certification. Certification is a continuing process, and recertification is conducted according to provincial and state guidelines.

2. Safety

a. Cardio-Pulmonary Resuscitation (CPR)/First Aid

Certification training in CPR and First Aid is provided to all new employees (AOP:004.x). Permanent and returning personnel must be currently certified in CPR and in First Aid.

b. Water Safety/Boat Safety

All personnel who operate watercraft receive training and certification in water safety (AOP:004.x). Subjects include the proper use of boats and motors, waterway navigation and rights-of-way, emergency procedures, and avoidance of low head dams and other navigation hazards.

c. Electrofishing

Each member of a USFWS electrofishing crew must have completed an electrofishing safety training course and crew leaders must be certified by the USFWS National Conservation Training Center (NCTC) in electrofishing. Electrofishing activities are conducted following procedures specified in the USFWS Safety Manual section 24AM13 and AOP:004.x.

d. Vehicles, All-Terrain Vehicles/Off Road Utility Vehicles (ATV/ORUV), and Heavy Equipment

Personnel are thoroughly trained in the operation of all vehicles and heavy equipment that they are required to operate (AOP:004.x). Driver certification and vehicle inspection requirements follow guidelines mandated by appropriate regulatory agencies.

Vehicles are thoroughly inspected on an annual basis to ensure safety. All vehicles are equipped with safety equipment that may include a fire extinguisher, first aid kit, chemical spill kits, and hazard warning devices.

New USFWS personnel must complete a certified course in defensive driving.

Personnel frequently tow trailers. State and provincial laws require specific licensing for drivers of some truck and trailer combinations. Personnel who tow trailers are provided with practical training by experienced drivers annually.

All personnel who use ATV/ORUVs in remote locations to transport personnel and equipment are instructed and certified in the proper operation of these vehicles. ATV/ORUV drivers are required to wear specified safety equipment.

Heavy equipment training is provided to selected personnel. Forklift operators (USFWS and DFO) must be certified.

e. Material Hazard Communication

The Hazard Communication Program (USFWS) and Workplace Hazardous Materials Information System (DFO) keep employees apprised of the hazardous properties of chemicals to which they are exposed and of appropriate safety measures. Training emphasizes identification and properties of hazardous chemicals, health hazards associated with exposures, procedures to protect against hazards, procedures for controlling spills and leaks, and safe disposal methods. Current Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS) are available in the station laboratories, shops, warehouses, laboratory trailers, and in a digital database for reference by employees.

f. Handling of Pesticides

(1) Storage

Lampricides are stored in a cool, dry place within a locked facility according to USEPA and Ontario Ministry of

Environment (OMOE) guidelines. TFM and Bayluscide are stored in original containers and in a manner consistent with regulations to prevent cross contamination with other substances. Appropriate safety equipment is provided to all personnel working in storage areas.

(2) Spills

Lampricides are handled in a manner that prevents spillage. Accidental spills of lampricides are managed according to stipulations of the Pesticide Spill Plan (Appendix D), pesticide label (Appendix E), and SDS (Appendix F).

(3) Pesticide Disposal

The procedures for disposal of lampricides follow federal, state, and provincial regulations. Pesticide containers are triple-rinsed (or equivalent) before disposal. Rinsate from the containers is incorporated into the stream treatment.

(4) Pesticide Container Disposal

Empty lampricide containers are rendered unsuitable for further use and disposed or recycled consistent with requirements of federal, state, and provincial regulations.

(5) Inventory

Logs are maintained at the storage facility and in the administrative section to record delivery and removal of pesticides. Information required on the log includes the employee's name, date, and the amount by batch of pesticide entering or leaving the facility. A record of each pesticide application also is maintained. This record includes the location, date, time, amount applied, batch number, application rate, and name of the applicator.

A record is maintained of amounts of lampricides applied during each application and of the total amount applied during each treatment. These records are part of the procedure used to maintain an inventory of lampricide stocks available to the program (AOP:006.x).

(6) Transport

TFM and Bayluscide are transported in a variety of vehicles according to federal, state, and provincial regulations (Appendix R). Weight capacities for individual trucks are not exceeded. Proper precautions are taken to evenly distribute and secure loads. Transport vehicles also carry absorbent materials (spill kits) in case of accidental spills.

(7) Protection of Workers

Personnel working with TFM and Bayluscide are trained to apply pesticides in a safe manner, in accordance with requirements stipulated on the pesticide labels (Appendix E), and SDS (Appendix F), Standard Operating Procedures, and applicable federal, state, and provincial laws. Protective equipment specified on the pesticide labels and SDS is worn by all personnel working with lampricides. Emergency eyewash and soap are available at each application site.

C. Stream Selection, Scheduling, and Planning

1. Stream Selection Process

Streams are selected for treatment on the basis of estimated treatment costs and benefits (AOP:014.x). This is done through the application of a computer model, the Empirical Stream Treatment Ranking (ESTR) program. The production of sea lamprey larvae within a stream is estimated by methods outlined in Appendix S. The cost of treatment is compared to the estimated number of large larvae (>100 mm) that would be eliminated through treatment. The resulting cost per large larva is ranked for streams throughout the Great Lakes basin. Fiscal limitations could determine the number of streams treated. Lake Champlain and Finger Lakes tributaries may be selected through the use of a modification of this process.

The selection of some streams is independent of the stream ranking system described above. Some streams are selected annually to limit recruitment to offshore areas and others on the basis of expert judgment. In addition, some streams are selected on the basis of other criteria: deferrals, geographical location, and scientific research.

2. Scheduling

The scheduling of stream treatments is influenced by many physical, chemical, biological, and sociological factors. A listing of sea lamprey producing streams and optimal treatment dates are listed in Appendix H. The process of scheduling lampricide treatments and factors considered in that process is outlined in Appendix U.

a. Physical

Streams are scheduled for treatment during periods in which applications are both efficacious and cost effective. Historical data are reviewed to provide a profile of optimal discharge at which a stream can be treated successfully. Insufficient stream discharge during a treatment can cause the lampricide block to weaken and be less effective, particularly in impoundments or river mouth areas. Streams in which low discharge presents a problem are usually treated soon after spring runoff. Lampricide treatments often are scheduled to utilize the ability of a water control structure to regulate water discharges.

Treatments of streams are scheduled to avoid extremely low water temperatures. The efficacy of lampricides is reduced at low water temperatures.

b. Chemical

The efficacy of lampricides is affected by water chemistry. Some streams are scheduled to avoid periods of high water temperature and unsuitable water chemistry such as extremely high or fluctuating pH. Some streams are scheduled to avoid runoff from applications of agricultural fertilizers.

c. Biological

Streams are scheduled to reduce exposure of potentially susceptible species or certain life stages of nontarget organisms such as lake sturgeons (*Acipenser fulvescens*), spawning suckers, and salmonids. Streams with large populations of burrowing mayflies may be scheduled to avoid exposing the animals to lampricides before emergence. The presence of an endangered, threatened, candidate species, or species of special concern results in special considerations that are outlined in treatment permits.

Treatments are scheduled to prevent production of transformed larvae. Certain early embryonic life stages of lampreys are not as susceptible to treatment concentrations of lampricides. In streams where young-of-the-year larvae drift into lentic areas, treatments usually are conducted annually after the larvae have reached a susceptible life stage.

d. Sociological

Public use of the stream during treatment does not present a known health hazard, but many persons do not wish to be exposed to lampricide (Appendix P). Stream treatments are scheduled to reduce potential exposure by avoiding public events.

3. Planning and Notification

After streams are selected for treatment and approved by the GLFC, lists are sent to state, provincial, tribal, and cooperating agencies that have local jurisdiction (AOP:007.x) for concurrence. The recipients review and comment on the list of streams. Comments and concerns are considered during scheduling.

a. USFWS

Preliminary lists of streams considered for treatment are provided to Federal, state, and tribal agencies each year. Concurrence of these lists is acquired from agencies in whose jurisdiction applications of lampricides are planned. County departments of public health are also notified. In addition, hydroelectric facilities and media receive notice of treatment plans.

b. DFO

A number of contacts are made prior to the treatment season. These include Ontario Ministry of Environment and Climate Change (OMOE), Ontario Ministry of Natural Resources and Forestry (OMNR), New York State Department of Environmental Conservation (NYSDEC), Parks Canada, Ontario Parks, conservation authorities, Health Canada, First Nations, hydroelectric power corporations, media, municipalities, cooperating industries, Canadian Border Services Agency, and U.S. Customs.

4. Reporting

The partners sign a Memorandum of Agreement with the GLFC annually. This document lists the streams that the partners plan to treat during the field season. The partners also furnish reports at the end of each treatment season to GLFC and each of the Lake Committees (AOP:007.x).

a. USFWS

The USFWS collects data on mortality of nontarget species during lampricide applications. A report that summarizes these data is provided to all states that request this information. In addition, a report may be issued to the USEPA to comply with the USEPA June 16, 1998 ruling of section 6(a)(2) of FIFRA.

b. DFO

Annual reports of treatment activities are sent to OMOE, OMNR, and NYSDEC. In addition, DFO reports any nontarget mortality above FIFRA section 6(a)(2) thresholds to the registrant (USFWS).

II. Lampricide Application Procedures

A. Pre-application

1. Offsite Preparations

a. Notifications

(1) Jurisdictional Agencies

Federal, state, provincial, and tribal agencies again receive notification prior to lampricide treatment. A confirmation of dates of treatment is made to each agency by telephone or email. The local municipal water utilities are contacted if community water supplies might be affected by the lampricide treatment. In these instances, monitoring of the water supply may be requested by state authorities and conducted by personnel from the U.S. Fish and Wildlife Service.

(2) Media

Local media may be contacted prior to the proposed date of application (AOP:007.x and AOP:010.x). Further arrangements can be made for media contact in the field.

(3) Power Utilities (Hydro-dams)

Authorities that regulate discharge and operate power (hydro) dams are contacted prior to treatment if the discharge from a power dam must be regulated to supply a stable flow or a specific discharge during lampricide application. The Federal Energy Regulatory Commission (FERC) largely governs discharge in the U.S.

(4) Riparians

Riparian water users are notified of intent to treat a scheduled stream. Examples of these water users include industrial (paper companies), residential (potable water users), agricultural (irrigators), recreational (canoe liveries), and commercial interests (bait dealers). Permission to access private property is obtained in person, by telephone, or by written correspondence before treatment.

b. Review and Planning

(1) Historic Treatment Information

Past treatment information is reviewed to estimate: (1) personnel, (2) time frame of the proposed treatment, (3) formulations and quantities of lampricides required, and (4) special considerations unique to the watershed. Historical lampricide flow times and time of passage dye studies can be used to predict starting times of future applications at various points on the streams.

(2) Larval Assessment Data

Larval assessment data are reviewed to determine the distribution and abundance of sea lamprey larvae. This information is used to assure that treatment will cover all areas of significant infestation of sea lampreys. A stream map showing access roads, application points, and land ownership is available to treatment supervisors as part of the assessment package.

(3) Preliminary Treatment Plan

A preliminary treatment plan is prepared after review of assessment and historical data. The plan consists of a tentative treatment date, the personnel assigned to each treatment, quantity and formulation of lampricides, vehicles and types of equipment needed, and schedule of pre-treatment toxicity tests.

2. Onsite Preparations

a. Contacts, Site Preparation, and Security

(1) Access Permission

Measures taken to secure access permission are initiated in the office and continue on site. Certain situations require additional contacts including change or addition of application sites, change of property ownership, or completion of efforts to acquire access permission.

Property owners are briefed on the proposed activities to occur on their property.

(2) Coordination with Consumptive and Non-consumptive Water Users and Cooperators.

The initial arrangements to coordinate lampricide treatments with water users on the stream are made prior to arriving on site; specific details are worked out just prior to, or during the application. Local water users are informed of lampricide treatment details, including time of application. All known agricultural irrigators are notified of an impending treatment at least 24 hours prior to application. Irrigators are advised of their obligation to turn off their irrigation systems for a 24-hour period during and following the arrival of the lampricide block. Recreational users such as canoe liveries, and households using the stream for potable water, are advised of lampricide treatment plans and remedial action. Hydro-electric dam operators are again contacted to ensure that stream discharge can be regulated. Frequently, the application of lampricides at hydro-electric sites requires access and use of the site buildings. This also needs to be coordinated with the dam operators.

(3) Identification and Preparation of Application and Analysis Sites

Sites used for the application and analysis of lampricides are determined by on-site inspection. Signs are placed at acceptable sites to inform the public of impending applications (AOP:010.x). Considerations include ease of access to the stream, quantity of lampricide required, logistical placement of equipment, vehicle use options, and personnel safety. Potential sites for analysis are selected at a sufficient distance downstream of the application site that ensures homogenous lampricide concentrations.

(4) Security and Storage of Equipment and Lampricides

Safe storage of equipment and lampricides is a primary concern (AOP:008.x). Specialized locked trailers protect application equipment from the elements and the public. Lampricides are stored in a manner to prevent unauthorized access. At times, arrangements are made with other organizations or agencies to obtain secure storage.

b. Determining Physical, Chemical, and Biological Characteristics of the Stream.

(1) Physical

(a) Stream Discharge

Stream discharge must be determined to accurately set application rates of lampricides. Stream discharge in free-flowing streams is constantly changing; portions of the watershed may respond independently to recent rainfall or to lack of rainfall. Point-in-time data at critical sites can be obtained either from on-site measurements, permanent gauge sites, or from known discharges at hydro-electric facilities.

Stream discharge data are obtained at selected sites by crews physically measuring (gauging) the stream discharge (TOP:001.x). Staff gauges are placed at all gauging sites to correlate discharge measurements with stream level.

(b) Flow Time Estimates

The time for water to flow between two points on a stream (flow time) is a function of stream discharge. Time of passage estimates are determined by applying fluorescent dyes (Rhodamine WT or Uranine) and monitoring the time of travel between selected sites in the watershed (TOP:002.x). Estimates of flow time are used to schedule and coordinate lampricide application and monitoring.

(c) Dye Dilution Studies

The objective of a dye dilution study is to estimate the dilution of lampricides during treatments (TOP:003.x). Several situations require dye dilution studies to estimate decrease of lampricide concentration. These include lack of historical data, unusually low stream discharge, significant presence of physical impairments to flow, and braided stream channels.

(2) Chemical

Total alkalinity, pH, and temperature of stream water are known to influence the efficacy of lampricides. Therefore, water chemistry data are collected by the deployment of water chemistry monitors (TOP:004.x) and by hand-sampling. In addition, concentrations of dissolved oxygen and ammonia may be measured, particularly in watersheds with a history of agricultural contamination.

(a) Total Alkalinity

The toxicity of lampricides has been correlated with the total alkalinity of water. Lampricides are more toxic to sea lampreys in waters of low total alkalinity. To predict appropriate treatment concentrations, it is necessary to measure the total alkalinity of stream water at selected sites in the watershed as well as the pH. Total alkalinity measurements are conducted according to methods outlined in TOP:005.x.

(b) Water pH

Lampricides are ionizable phenols, so the apparent toxicity of the chemicals is greatest where the neutral form predominates (low pH). Therefore, measurement of pH is necessary to determine application rates (TOP:006.x).

Frequently, stream waters exhibit daily fluctuations in pH that result from photosynthesis and respiration by biota in the stream or in impounded waters draining into the stream. Presence of a daily pH cycle may influence treatment delivery. Measurements of pH are made at selected sites in a watershed to provide a record of stream water pH.

(c) Temperature

Stream water temperatures are recorded routinely, although they are not generally considered critical in planning lampricide applications. Application time may be extended at low water temperatures (2-5° C) when applying TFM; treatments are not as effective at stream temperatures less than 2° C. Bayluscide is not recommended for use if stream temperatures are less than 3° C. Treatments at higher temperature may result in increased nontarget mortality.

Temperature is considered when measuring pH, dissolved oxygen concentration, and the concentration of ammonia in stream water. Measurements are made in °C with a thermometer or pH meter equipped with a temperature probe.

(d) Dissolved Oxygen

Dissolved oxygen concentrations are affected by photosynthesis and respiration by the biota in the stream and may influence the general health and resistance of animals in a stream. Oxygen concentrations fluctuate to some extent in most streams; depressed concentrations of dissolved oxygen may affect treatment efficacy.

Treatment crews use oxygen meters to measure dissolved oxygen concentrations (TOP:008.x). Particular attention is paid to the measurement of concentrations of dissolved oxygen in waters downstream of impoundments, wastewater facilities, agricultural areas, areas of rooted aquatic macrophytes, and lentic areas. Low concentrations of dissolved oxygen may cause deferral of a lampricide treatment.

(e) Ammonia

Although concentrations of ammonia rarely reach a level considered a threat to nontarget species, certain situations warrant monitoring. If the pH of stream water does not exceed about 8.3, especially in cool waters, the percent of toxic, un-ionized ammonia is usually too low to offer a significant additive toxic effect. Analyses are completed in areas with potentially high ammonia concentrations. These include areas of heavy agricultural use, areas downstream of feed lots or sanitation disposal facilities, and slow-moving stretches of stream with low dissolved oxygen concentrations. Ammonia nitrogen is quantified according to (TOP:009.x).

(3) Biological

(a) Toxicity Testing

Pretreatment toxicity tests may be conducted to verify the minimum lethal concentrations of lampricides required for effective treatment (TOP:010.x). Priority for conducting toxicity tests is given to streams being treated for the first time, streams with a history of nontarget mortality, or streams with water quality that may affect the efficacy of lampricides. In situations of intense public interest or sensitive environmental concerns, or when certain species of concern are present, tests may be conducted as a precautionary measure.

Results from toxicity tests are interpreted to provide estimated Minimum Lethal Concentrations (MLC) and LC25s (lethal concentrations producing 25% mortality) of nontarget test organisms. The results are compared with values for corresponding pH and total alkalinity levels in lampricide prediction charts (Appendix I).

c. Planning Treatment Strategy

Analysis and interpretation of pretreatment data is used to develop a treatment strategy which includes setting lampricide concentrations, determining the timing of lampricide applications, and scheduling personnel and use of equipment.

(1) Setting Lampricide Concentrations

(a) MLC and SMLC

MLC is the concentration of lampricide that produces 99.9 percent mortality among sea lamprey larvae during a 9-hour exposure for a given water chemistry. However, in stream applications the MLC will vary because of changes in water chemistry that occur throughout the watershed. The SMLC is the lowest concentration of lampricides determined by the treatment supervisor to provide an effective treatment over the range of expected water chemistries in a treatment area. Water chemistry may vary widely throughout a stream system. Therefore, SMLC values vary temporally and spatially, and multiple SMLC values may be needed to conduct a single treatment.

The pH/alkalinity prediction charts (Appendix I), data collected during toxicity tests, and water chemistry determinations are used to set treatment SMLCs. In addition, adjustments for seasonal variations in toxicity may be made.

(b) MAC and SMAC

MAC is based on the brown trout LC25 value from the pH/alkalinity prediction chart (Appendix I). At concentrations approaching or exceeding MAC, nontarget mortality may occur with increasing frequency. The SMAC is determined before application of lampricides and is the estimated maximum concentration of lampricide that may be applied to a stream. Typically stream application concentrations range from 1.0 to 2.0 times the MLC and are below SMAC.

Similar to SMLCs, multiple SMACs may be necessary for a treatment. These values are set by the treatment supervisor after consideration of the stream pH and prediction charts (Appendix I), the nontarget species present and their inherent sensitivity to lampricides, and the results of on-site toxicity tests. Endangered, threatened, or candidate species are afforded special consideration (TOP:011.x and TOP:011B.x). An example of a species that is afforded special consideration is the lake sturgeon.

(c) Application Concentrations

Application concentrations are the concentrations of lampricides metered into the stream at specific sites. The object of the treatment is to maintain SMLC throughout the treatment area. Discharge, water chemistry, dye study data, and historical treatment information are used to set the application concentrations.

(2) Determining Length and Timing of Lampricide Applications

Application time is normally 12 hours, but may be adjusted to assure 9 hours or more of SMLC at downstream sites. Applications of 24 hours may be considered for streams with significant diurnal pH cycles, and blocks longer than

12 hours may be applied to counter seasonal variations in sensitivity of sea lampreys. Concentrations of lampricides decrease as the treatment block travels downstream. The concentration loss depends on changes in stream discharge, the distance traveled by the lampricide block, and stream morphology. Historical data at similar stream discharges can help to estimate the application period required.

Timing of applications is an important part of treatment planning. In single application treatments, timing is often based on convenience and applications begin during normal working hours. As the complexity of the treatment increases, maintenance and supplemental applications are scheduled to assure the convergence of lampricide blocks and to maintain SMLC throughout the stream.

(3) Scheduling Personnel and Use of Equipment

Efficient use of manpower and equipment is necessary during stream treatments. Personnel are allocated to priority application and analysis duties until all duties are assigned. Generally, two shifts of application personnel are required for each site. In addition, analysis shifts are scheduled with all applications. When several applications take place concurrently, more than one person may be assigned per analysis shift. A treatment may be canceled if personnel shortages are critical.

(4) Projected Lampricide Needs

The quantity of lampricide needed at each application site can be projected by converting the application metering rate (Appendix J) to volume of lampricide applied per hour, then multiplying by the total hours of application. The total volume of lampricide then is divided by the volume of a TFM container to give the projected number of containers needed. Additional containers (20-25 percent of the projected total) usually are taken to the application site to allow for significant increases in application rates.

B. Application

After necessary preparations for treatment are completed, activities of field personnel shift to carrying out the treatment plan. Once applications begin, the focus of all activities is on maintaining lampricide concentrations between the SMLC and SMAC and assuring effective treatment in the stream.

1. Lampricide Applications

The locations and times of applications are set to effectively cover the treatment area. The types of applications and formulations used are tailored to effectively treat streams, backwaters, and lentic areas.

a. Primary and Maintenance Lampricide Applications

Primary and maintenance applications are made with TFM or a mixture of TFM and Bayluscide. The types of applications are differentiated by the locations at which they are conducted. Primary applications are the initial applications on any infested tributary, whereas maintenance applications (boosts) are made into existing lampricide blocks. Maintenance applications are required to prevent the concentrations of lampricides from decreasing to less than SMLC, and to allow primary applications at lower concentrations. The procedures and equipment used differ with the type of application and formulation of lampricide applied (TOP:012.x, TOP:013.x).

b. Supplemental Applications

Supplemental applications are conducted in backwater areas and in low-discharge tributaries to eliminate lampreys and to prevent escape of lampreys from treatments in larger tributaries. Supplemental applications are made either with liquid or bar formulations of TFM or a combination of both, or with Bayluscide 3.2% Granular Sea Lamprey Larvicide.

(1) TFM

TFM liquid formulation is sprayed onto slow-moving waters and isolated backwaters that are not effectively treated by lampricides from primary and maintenance applications. Procedures for conducting spray applications of TFM liquid formulation are outlined in TOP:014.x.

(2) TFM Bar Formulation

Bars of TFM are applied to low-discharge, flowing tributaries when application of liquid TFM is not practical. Procedures for application and control of concentration are outlined in TOP:015.x.

(3) Bayluscide 3.2% Granular Sea Lamprey Larvicide

The granular formulation of Bayluscide is occasionally applied as a supplemental means of eliminating lampreys in limited areas where TFM liquid formulation may not be effective. Procedures for the application of Bayluscide 3.2% Granular Sea Lamprey Larvicide are described in TOP:017.x.

c. Primary Applications of Bayluscide 3.2% Granular Sea Lamprey Larvicide

Bayluscide granules are applied as a control measure in areas where standard application techniques and other formulations of lampricide are not effective. Applications are conducted in lentic and lotic areas in the Great Lakes, Lake Champlain, and the Finger Lakes, vary in size, and may cover many acres (TOP:017.x and TOP: 017A.x).

2. Analysis of Lampricides and Concentration Adjustments

The concentrations of lampricides in stream water are monitored from the time of application until the lampricide block passes through the treatment area. The methods of measuring concentrations of lampricide and controlling rates of application are termed "analysis" procedures.

a. Duties of Analysis Personnel

Selected personnel from each treatment crew are trained to measure the concentrations of lampricides in stream water and to assess the progress and efficacy of an ongoing treatment. These personnel, after sufficient experience, are given the responsibility of controlling the applications of lampricides during a treatment. The procedures followed by analysis personnel are outlined in TOP:018.x, and TOP:021.x. In addition to monitoring and controlling concentrations of lampricides, total alkalinity is measured at least once during each analysis shift and pH is recorded at regular intervals to provide a record of stream water chemistry. Sampling frequency may be increased if conditions warrant.

b. Monitoring Progress of Lampricide Block

The concentrations of lampricides are measured at application sites and monitoring sites throughout the length of a stream treatment. Monitoring activities assure that safe, effective concentrations of lampricides are maintained throughout targeted treatment areas. Samples of stream water are collected by hand or by automatic water samplers (TOP:022.x).

3. Adjustments to Treatment Plan

A treatment plan is a basic framework for applications of lampricides and supporting activities. Variables in nature and other unexpected complications usually produce the need for subtle to significant adjustments in the plan as a treatment progresses.

a. Unscheduled Maintenance Applications

Stream conditions may necessitate additional applications to compensate for unanticipated loss of concentrations of lampricide. These conditions include unexpected increases in stream discharge due to rainfall or water releases from impoundments; failure to maintain desired concentrations of lampricide at primary application points; failure to effectively merge blocks of lampricide; stream/ground water exchange; unexpected increases in pH or alkalinity; and excessive losses of concentration in pools, riffles, marshes, braids, or ponds.

b. Adjustments to Timing of Applications

The starting times of applications often are adjusted in response to progress of a treatment. Adjustments may result from changes in time-of-flow due to variations in discharge; delays in starting upstream applications; and changes of arrival time, length, and concentration of the lampricide block.

c. Adjustments to Target Concentrations of Lampricides

Target concentrations of lampricides may be adjusted at application points. The changes may be made to compensate for variations in discharge, water chemistry, loss of concentration in the lampricide block, and unexpected mortality in nontarget species.

d. Cancellation or Termination of Treatment

The decision to cancel or terminate a treatment may be made by the treatment supervisor or a shift supervisor. Reasons for canceling a treatment include extremely high or low discharge; water chemistry outside of the safe working range; presence of contaminants; excessive nontarget mortality; equipment failure; unsafe working conditions; and serious conflicts with private, public, or government interests.

4. Supplemental Activities

Several peripheral activities may be conducted to support lampricide applications. These activities help assess and document treatment efficacy.

a. Biological Surveys

Biological surveys are routinely conducted during a treatment and after the lampricide block has passed in order to assess treatment effectiveness, verify sea lamprey distribution and age class structure where assessments are questionable, or document nontarget mortality. Typically, staff walk a stream and collect organisms using scap nets (Fyke nets are not recommended). Nontarget organisms are identified to species and sea lampreys are counted and measured. Survey types and detailed procedures are contained in TOP:029.x.

b. Caged Animal Assays

Sea lamprey larvae and nontarget animals may be placed in cages at selected sites within the treatment area and at an untreated control site to assess the safety and effectiveness of a treatment. Mortalities of each species are counted and recorded after passage of the lampricide block.

c. Data Processing

Field data are processed and summarized in a computer database. Some data are transcribed from forms to temporary files on computers in the field (TOP:024.x). All data are eventually entered into permanent files at stations in Marquette, Ludington, Sault Ste. Marie, and Essex Junction. These data are available for reports and for reference during future treatments. Methods of records management are outlined in AOP:011.x.

C. Post application

Post application procedures may include the collection of water samplers, measurement of lampricide concentrations in water samples, and the collection and analysis of samples of water from municipal water intakes. Biological observations including surveys of lamprey and nontarget mortality may continue after the treatment, and the results of caged animal assays are tabulated. Clean-up procedures are completed at application sites, and equipment and empty lampricide containers are packed for transport. Disinfection of equipment is conducted according to TOP:028.x.

III. Public and Environmental Safety

The public and environmental safety program complies with the requirements of the lampricide labels (Appendix E) and SDS (Appendix F) in a practical and effective manner. The program also complies with additional restrictions and precautions to assure the safe use of lampricides.

A. Preliminary Measures - Notification

Government agencies and the public are notified of planned treatments through several avenues to allow adequate time for questions, comments, and revisions of the treatment schedule.

1. Government Agencies

Notification may be furnished to departments of Public Health and Natural Resources of each Federal, state, province, county, municipality, tribe, or First Nation in whose jurisdiction lampricide applications are planned. The preliminary notification occurs prior to the field season so each department can respond with approvals or specific requests. Agencies may be notified again before each application.

2. Media

Notices may be sent to newspapers and to radio and television stations in the treatment area. Examples of press releases are presented in Appendix L. Personnel may participate in interviews for radio and television stations and for newspapers. The interviews inform the public of treatment operations and make the public aware of the applications of lampricides.

3. Public Outreach

Informational programs on sea lamprey control are presented to numerous groups throughout the year. Presentations are made to sporting groups, service organizations, schools, and all interested parties. Thousands of individual contacts are made through this approach annually. The talks and accompanying videos detail all aspects of the program including details on lampricide safety (Appendix P).

B. Pretreatment Measures

Measures designed to ensure public and environmental safety during a treatment for sea lampreys begin before the application of lampricides. Procedures followed immediately before lampricide applications are outlined below.

1. Transport and Storage of Lampricides

Lampricides are transported from the storage facility to the base of operations in enclosed vehicles. All vehicles used to transport lampricides are supplied with a list of emergency telephone numbers and a contingency plan (Appendix D) that outlines emergency procedures to be used in case of an accidental spill. Also, each vehicle is supplied with a spill kit that contains chemically absorbent materials, and is equipped with a two-way radio to allow rapid communication if a problem occurs.

2. Riparian Contacts

Efforts are made to notify known irrigators and other riparian users of stream water of treatment schedules at least 24 hours in advance of treatment. Considerable time is spent locating irrigators. Lists of irrigators are maintained to assure timely notification. Water users are advised not to take water from the stream while the lampricide block passes. Irrigators are advised of their obligation to cease irrigation for a 24-hour period during and following passage of the lampricide block. Progress of the lampricide block is closely monitored to verify estimates of time-of-passage and to allow notification of changes to irrigators.

3. Toxicity Testing

Toxicity tests may be conducted before stream treatments to assure that appropriate concentrations of lampricides are applied. Toxicity test procedures are described in TOP:010.x.

4. Setting Lampricide Concentrations

Treatment strategies devised by the Sea Lamprey Control Board's Lampricide Control Task Force require applying the least lampricide needed to effectively treat a stream. Applying the lowest effective concentration of lampricide minimizes effects on nontarget organisms.

C. Treatment Measures

Attention to safety issues continues throughout all applications of lampricides. Specific measures taken during treatments are outlined below.

1. Treatment site

Contact by the public with concentrated lampricide is prevented by restricting access to application sites. Few lampricide containers are open at any time and open, empty containers are triple-rinsed (or equivalent) and returned to the transport vehicle. All applications are conducted under direct supervision of a certified pesticide applicator.

Field personnel working on a stream are engaged in a high-profile activity that results in contact with the public. Personnel provide information on the use and safety of lampricides to hundreds of individuals each year through distribution of informational publications (Appendix P). A listing of standardized statements is provided as a training aid to assure that the public receives correct information in response to inquiries (Appendix T). If persons require more information they are contacted by a treatment supervisor.

Protective equipment and safety procedures as described in the pesticide labels (Appendix E) and SDS (Appendix F) are provided to all applicators. Equipment includes chemical splash goggles, hip boots, rubber gloves, and a chemical protection apron. Smoking, eating, and drinking are not permitted near open lampricide containers or when wearing contaminated protective clothing.

Personnel are prepared for accidental spills of lampricide and follow procedures in Appendix D. Any contamination is cleaned and disposed of according to label requirements.

2. Stream

Although in-stream concentrations of lampricides have been shown to pose no adverse health effects, treatment personnel inform people who inquire that a stream treatment is in progress and caution them about potential exposure. Warning signs (Appendix O) may be placed at known public access sites.

The lampricide block is closely monitored to assure that prescribed concentrations are maintained, and care is taken to monitor mortality of nontarget organisms during each treatment. Applicators and analysis personnel routinely watch for signs of stress in nontarget species (TOP:029.x). Indications of stress in nontarget organisms may result in reevaluation of the treatment plan. Observations of mortality in nontarget organisms may result in an immediate investigation (Appendix W Flowchart for Response to Fish Mortality Concurrent with Lampricide Treatment; TOP: 026.x).

3. Municipal Water Supplies

Municipal water supplies are monitored upon request for the presence of lampricides (TOP.023.x). Managers at municipal intakes without carbon filtration systems are notified immediately if lampricide is detected, so remedial actions can be initiated. Results of monitoring efforts are reported to supervisors of water treatment plants and state health authorities. Monitoring may be required after treatment of a stream or following the application of Bayluscide 3.2% Granular Sea Lamprey Larvicide in the vicinity of a municipal intake.

D. Post treatment Measures

Dissemination of information to assure public and environmental awareness continues throughout the year. Reports on treatment activities in each lake drainage are prepared for representatives of jurisdictional agencies bordering the Great Lakes, and other interested parties. Nontarget surveys are conducted according to TOP:029.x. Information on effects of treatments to nontarget organisms in Michigan and New York tributaries are detailed in an annual report to the Michigan Department of Environmental Quality (MDEQ) or NYSDEC. Information on effects of treatments on nontarget organisms and lampricide use in the province of Ontario is provided to the OMNR, OMOE. Reports of effects on nontarget organisms are submitted to the USEPA in compliance with section 6(a)(2) of FIFRA (AOP:007.x).

Contingency Plan for Accidental Spillage of Lampricides During Lake Champlain Sea Lamprey Control Operations

Updated February 2019

Stephen Smith

Table of Contents

Introduction

The U.S. Fish and Wildlife Service (USFWS), New York State Department of Environmental Conservation (NYSDEC) and the Vermont Department of Fish and Wildlife (VTDFW) plan to apply the lampricides TFM and Bayluscide to Lake Champlain tributaries and delta areas as part of an integrated, basin-wide sea lamprey control program. The NYSDEC and VTDFW, in cooperation with the U.S. Fish and Wildlife Service (USFWS), completed an experimental sea lamprey control program in 1997. The three agencies form the Lake Champlain Fish and Wildlife Management Cooperative (Cooperative). During the experimental program, TFM was used to treat 13 Lake Champlain tributaries, and Bayluscide was used to treat 5 delta areas infested with sea lamprey ammocoetes. Currently, the Cooperative is implementing a long-term sea lamprey control program using the principles of integrated pest management. However, the lampricides TFM and Bayluscide are still major components of the long-term program.

Bayluscide is currently available for lamprey control in two forms: a 3.2% granular formation, and a 20% emulsifiable concentrate (EC). The 3.2% granular formation is used to treat sea lamprey infestations in delta and or deep water areas difficult to treat with TFM. The emulsifiable formulation is used to treat large streams simultaneously with TFM. A stream treatment combining TFM and Bayluscide 20% EC results in significantly less total pesticide used resulting in cost savings and presumably shorter health advisory durations.

New York stream systems currently planned for TFM or TFM/Bayluscide treatment are the Great Chazy, Little Chazy, Saranac, Salmon, Little Ausable, Ausable and Boquet rivers, Rea, Beaver, Mill, and Mount Hope brooks, and Putnam Creek. Vermont stream systems currently scheduled for TFM or TFM/Bayluscide treatment are the Missisquoi, Lamoille, Winooski, and LaPlatte rivers, StoneBridge Brook and Lewis Creek. The Poultney River, which borders both Vermont and New York, will also be treated. Delta treatments with 3.2% granular Bayluscide are currently planned for Mill Brook, Boquet River, Ausable/Little Ausable River, Salmon River, and Saranac River deltas.

Contingency Plan

The following contingency plan outlines procedures that would be undertaken if accidental spillage occurs during storage, transport or application of TFM or Bayluscide. In New York, an accidental spill of the contents of one or more container units must be immediately reported to the NYSDEC, Environmental Quality Unit at Ray Brook. For TFM this translates to 5 gallons (one can) or greater and for Bayluscide, 50 pounds (one bucket) or greater. In Vermont, all accidental spills of Hazardous materials in excess of 2 gallons must be immediately reported to the Vermont 24-hour Hazardous Materials Spills Hotline. Safety data sheets for each lampricide are attached to this plan for informational purposes. The contingency plan will be on hand at all storage sites, in all transport vehicles and at all lampricide application points.

Training Program

This contingency plan will become a standard part of pre-control training program sessions for lampricide treatments. Familiarization with the various scenarios described in this plan and the implementation of prompt, responsive action(s) in each situation will be stressed. The plan will be reviewed and updated whenever it may become necessary. Copies of the contingency plan and required spill clean-up equipment and protective gear will be included on pre-treatment (transport) and treatment equipment checklists.

Packaging

TFM is a liquid formulation that is currently packaged in approximately 5 gallon heavy-duty plastic cans. Net weight of the TFM product in a can is less than 50 pounds. Each can contains about 16 pounds of active ingredient. TFM is also available in solid form as a 2 lb bar that comes sealed in a plastic container. TFM bars contain about ½ pound of active ingredient, and are used exclusively to block small tributary streams from being used by sea lamprey to escape the treatment in the main river. Bayluscide (3.2 % Granular) is a granular formulation that has been packaged in cylindrical heavy-duty 5 gallon-sized plastic buckets or pails. Each bucket has a net weight of 50 pounds. Each bucket of Bayluscide (3.2% Granular) contains 1.6 pounds of active ingredient. Emulsifiable Bayluscide (20%) is packaged in 5 liter plastic jugs. New manufacturers may result in changes to the size or material used in packaging. These packaging types, moderate container sizes, self-imposed stacking restrictions, and use of pallets significantly minimizes the likelihood of accidental spillage of either lampricide during storage, transport or handling.

Storage

Pesticide storage buildings, located at the NYSDEC office in Ray Brook, New York, and at the Ed Weed Fish Culture Station in Grand Isle, Vermont serve for bulk storage of TFM and Bayluscide with capacity to contain a substantial, accidental spill if it occurs within the storage building. These storage facilities meet New York and Vermont pesticide storage guidelines. Lampricide stockpiles are secured under lock. Local fire departments have been alerted of the presence of TFM and Bayluscide and special firefighting procedures recommended for TFM (see safety data sheet). Building placarding follows state guidelines.

Transport

Trucks will be used to transport the lampricides to TFM application points and Bayluscide loading or application points. Only quantities of 1,000 pounds or less of TFM will be transported by any single vehicle. Neither placarding nor certification is required to transport quantities of TFM up to 1,000 pounds. However, on occasion we use a parked, on-site trailer to store quantities of TFM in excess of 1,000 lbs. When and if this occurs, the storage trailer will be placarded to alert emergency personnel of the trailer's contents in case of fire or other emergency. TFM has a DOT category shipping paper description of "Substituted nitrophenol pesticide, liquid, inflammable, toxic, N.O.S. (40% 3-trifluoromethyl-4-nitrophenol/isopropanol), 6.1, UN3013, III". (See material safety data sheets appended). Transport of Bayluscide is not currently regulated by DOT, and neither certification nor placarding are required for its transport, regardless of quantity. Each truck driver will have a copy of this plan in possession. A Shovel, broom, protective clothing, and rubber boots will also be carried on all trucks transporting lampricides and maintained at all storage, loading, and application points. In addition, each truck will carry absorbent material (e.g., Speedy Dry) in order to sufficiently react to an unexpected spill incident.

Application

TFM applications are conducted by properly trained and certified pesticide applicators of the NYSDEC, USFWS, and VTDFW. TFM application and monitoring procedures insure that the chemical concentration remains within an effective and safe range, as determined by bioassays and/or water chemistry parameters for individual streams. TFM containers will only be opened as needed at streamside application points. Precautions are taken to ensure that only potentially required quantities of TFM are transported to and stored at individual application points. As a further precaution against spillage, all mixing and product tanks capable of holding greater than 6 gallons of TFM will be placed in either a small bermed and lined containment/dike area or a rigid secondary containment vessel. Each containment system will have at least a 10% greater capacity than the primary vessel. Lampricide requirements for a single treatment are categorized by state, county, and water in Table 1.

Bayluscide treatments conducted in New York waters of Lake Champlain will be directed by NYSDEC, USFWS and VTDFW personnel who are fully trained and experienced with Bayluscide treatments. Personnel from NYSDEC, VTDFW and the USFWS may assist in Bayluscide applications and in support activities for both TFM and Bayluscide treatments.

Empty TFM containers will be rinsed with an automated can washer or triple-rinsed at treatment sites. Empty TFM containers will be rendered useless and disposed of as appropriate. Lampricide dispensing equipment and gear will be thoroughly rinsed at treatment sites. Other chemical treatment procedures used to insure a high degree of environmental safety are described in Section VII.A.2.a (pp. 178-188) of the Final Supplemental Environmental Impact Statement (U. S. Fish and Wildlife Service, et al. 2001) for the experimental long-term sea lamprey control program. The actions described above would ensure that the highest levels of environmental safeguards have been imposed before, during, and after lampricide treatments in Lake Champlain streams and deltas.

Spillage on Land

In the event that a major TFM spill occurs during storage, transport or at an application site, it is important that the discharge be stopped at its source and the spilled material be contained. Shovels and other hand tools will be used for immediate containment and/or channelization of the spilled TFM into a containment area. Spillage of Bayluscide on land can be readily controlled by sweeping and shoveling, taking care to avoid creating and inhaling dust. The following actions would be taken as necessary to contain and clean up a major spill on ground:

1. Stop the spillage at its source, then notify the appropriate authorities (see pp. 6-7);

2. Diking TFM in pools as appropriate;

3. Containment into piles for dry Bayluscide;

4. Diking if Bayluscide makes contact with a liquid;

5. Materials such as clay, soil, or other noncombustible, absorbent materials can be used to absorb TFM spillage;

6. Sand, clay, soil and other non-combustibles can be used to absorb dry Bayluscide or absorb liquids carrying Bayluscide; and

7. The clean-up material resulting from a TFM and/or Bayluscide spill would be stored in drums at the bulk storage site(s) for transport by a licensed hauler to a permitted hazardous waste treatment storage or disposal facility or other suitable facility.

Spillage into Water

During highway transport, as with other chemicals routinely being transported in this manner, there is a possibility of a vehicular accident over or near a waterway. If an accident occurred near a waterway containment action would be initiated immediately to prevent or minimize movement into a waterway. If major TFM spillage occurs into a stream not scheduled for immediate lampricide treatment, the following emergency actions would be initiated:

1. Immediate notification and consultation with state and/or county health office;

2. Issuance of an emergency advisory on water use at, and downstream of, the spill location. Issuance would be through local broadcast media, door-to-door contacts and postings (printed supply to be available) for unoccupied houses and conspicuous public places;

3. The emergency advisory would recommend no use of water for drinking, cooking, other household uses, swimming and fishing until further notice.

4. Emergency supplies of bottled drinking water would be distributed to affected households and bulk supplies of tanker transported water would be made available for other household uses;

5. Lampricide monitoring would be initiated to follow the chemical block and its concentration;

6. Emergency advisories regarding water consumption and household use would be in effect until 24 hours after the TFM concentration has decreased to less than State Specific DOH thresholds. Swimming and fishing would also be prohibited until the same criteria are met;

7. Notification that advisories are lifted would be made through local radio, door-to-door contacts and removal of advisory signs.

Accidental spillage of TFM into a stream during treatment operations (very unlikely) would occur during a period when a water use advisory, water distribution and chemical monitoring activities would already be underway. In such an instance, monitoring activities and scope would be extended to ensure that the plume impact area > 20 ppb TFM did not exceed previous projections. Automatic water samplers would also be set at the intake(s) of any municipal water supply systems that might be impacted as the result of a major TFM spillage into a waterway. Should the scope of the TFM impact area expand following a major spill, water use advisories and potable water distribution areas would be expanded accordingly.

Accidental spillage of Bayluscide into waters not designated for immediate Bayluscide treatment would trigger the initiation of the following emergency actions:

1. Immediate notification and consultation with state and/or county health office;

2. Issuance of an emergency advisory on water use at, and downstream of, the spill location. Issuance would be through local broadcast media, door-to-door contacts and postings (printed supply to be available) for unoccupied houses and conspicuous public places;

3. The emergency advisory would recommend no use of water for drinking, cooking, other household uses, swimming and fishing until further notice.

4. Emergency supplies of bottled drinking water would be distributed to affected households and bulk supplies of tanker transported water would be made available for other household uses;

5. Emergency advisories regarding water consumption and household use would be in effect for 120 hours (5 days). Swimming and fishing would also be prohibited until the same criteria are met. However, harvesting of fish for consumption from impacted waters would be advised against for 14 days after the spill.

6. Notification that advisories are lifted would be made through local radio, door-to-door contacts and removal of advisory signs.

As with TFM, accidental spillage of Bayluscide in an area undergoing treatment would occur during a period when water use advisories, potable water distribution and related Bayluscide treatment activities are already underway.

Reporting Spills

Reportable spills of lampricides will be reported to the following:

Spills in New York (one or more container units)

Duty-Hours

1. Environmental Quality Office, Ray Brook, phone (518) 897-1241 or
Hotline phone (800) 457-7362.

2. New York State and appropriate County Health Officials.
   a. Clinton county - John Kanoza (Director) Office (518) 565-4840
   Office (518) 565-3270 (24 hours)

   b. Essex County - Jules Callaghan (NYS DOH) Office (518) 891-1800

   c. Washington County - Anita Gabalski (NYS DOH) Office (518) 793-3893

   Michael Shaw, Senior Sanitary Engineer or Greg Reynolds, Principal Sanitarian
   Office (518) 793-3893 (inc. off hours)

   d. Central Office - Jim Leach Office (518) 402-7800

Non-Duty Hours (including weekends)

1. DEC Spill Hotline, phone (800) 457-7362 and the first person below who is available:
   a. Russ Huyck, Regional Remediation Engineer (518) 891-4380 (home) / office: (518) 897-1242
   b. Joseph Zalewski P.E., Regional Engineer (315) 396-3093 (home) / office: (518) 897-1270
   c. Daniel Darrah, Captain, ENCON Officer (518) 897-1323 office, (518) 593-7965cell

d. Robert Stegemann, Regional Director (518) 897-1211

2. a. New York State Health Department Duty Officer - (866) 881-2809

Additional New York Contacts (only if conditions require)
1. Saranac Lake Dispatch Center - (518) 897-1300

(NYSDEC: Non-Duty Hours)

2. State Police - Troop B - Ray Brook - (518) 897-2000

3. U.S. Coast Guard
a. Burlington Duty Hours - non-emergency (802) 951-6792
emergency contact # (ONLY if imminent danger to property or life) (802) 864-6791

b. 24 Hours - (207) 767-0303 - Command Center

4. New York State Emergency Management Office - (518) 793-6646 (Bruce Jordan);

NY State Warning Point: (518) 292-2200 (off duty hours)
Possible source of emergency water supply equipment.

Spills in Vermont (2 gallons or more)
Duty-Hours
1. Vermont HAZMAT Hotline - (800) 641-5005

2. Vermont Department of Agriculture - Cary Giguere: 802- 828-2431 (Office) 802-793-1706 (cell)

3. Vermont Department of Environmental Conservation, Hazardous Materials Management Program – Office (802) 241-3888 Emergency Spill Reporting 802-828-1138

Non-Duty Hours (including weekends)

1. Vermont HAZMAT Hotline - (800) 641-5005

2. Vermont Department of Agriculture - Cary Giguere 802-793-1706 (cell)

Medical Emergencies

<u>TFM</u>

1. TFM-HP

Iofina Chemical Inc. 1025 Mary Laidley Drive, Covington, KY 41017
Telephone for information: 1-859-356-8000
Emergency (CHEMTREC) 24-Hr Emergency Telephone: 1-(800) 424-9300

2. TFM Bar

Iofina Chemical Inc. 1025 Mary Laidley Drive, Covington, KY 41017
Telephone for information: 1-859-356-8000
Emergency (CHEMTREC) phone - (800) 424-9300

<u>Bayluscide</u>

1. Bayluscide 3.2% Granular

Coating Place, Inc. 200 Paoli Street Verona, WI 53593
Telephone for Information 608-845-9521
Emergency (CHEMTREC) phone - (800) 424-9300

2. Bayluscide 20% Emulsifiable Concentrate

Coating Place, Inc. 200 Paoli Street Verona, WI 53593
Telephone for Information 608-845-9521
Emergency (CHEMTREC) phone - (800) 424-9300

Table 1. Estimated maximum lampricide requirements for one treatment.

Bayluscide (3.2% Granular)

New York Treatments	Total Weight[1,2]	Number of Cartons	
Clinton County			
Saranac River Delta	25,000	500	
Salmon River Delta	15,000	300	
Little Ausable/ Ausable River Delta	40,000	800	
Essex County			
Boquet River Delta	25,000	500	
Mill Brook Delta	10,000	200	

TFM [3]

New York Treatments	Total Weight (lbs) [3]	Total Gallons	Number of Drums [4]
Clinton County			
Great Chazy River	8,160	850	170
Little Chazy River	1,680	175	35
Rea Brook	964	100	20
Saranac River	9,640	1,000	200
Salmon River	1,446	150	30
Little Ausable River	1,928	200	40
Ausable River[5]	5,784	600	120
Essex County			
Boquet River	3,856	400	80
Beaver Brook	96.4	10	2
Putnam Creek[6]	1,928	200	40
Mill Brook	723	75	15
Washington County			
Mt. Hope Brook[7]	578	60	12
Poultney River/Hubbardton [8]	5,784	600	120
Vermont Treatments			
Addison County			
Lewis Creek	2,651	275	55
Chittenden County			
Winooski River	24,100	2,500	500
Lamoille River	28,920	3,000	600
LaPlatte River	1,446	150	30
Stone Bridge Brook	482	50	10
Franklin County			
Missisquoi River	16,870	1750	350

[1,2.3,4,5,6,7,8] Full footnote references appear on following page.

Table 1. (continued)

[1] Net weight of the contents of an individual Bayluscide (3.2% Granular) bucket is 50 lbs.

[2] Weight of Bayluscide (3.2% Granular) needed is based on the maximum area that would be considered for any one treatment. Actual treatment area will be based on intensive surveys of ammocoete infestation areas on deltas and estuarine river areas using modified deepwater electrofishing gear. Only those containing ammocoetes will be treated.

[3] TFM calculations based on maximum number of drums potentially on site for a treatment. Number of drums x 5 = total gallons of formulation. Total weight = Gallons of Formulation * 9.64(lbs formulation per gallon of TFM)

[4] TFM drums are 14 inches high and about 11 inches on each side. The net weight of the TFM product in each drum is ~ 50 pounds. Each drum contains approximately 16.5 pounds of active ingredient and 5 gallons of formulation.

[5] Includes Dry mill Brook requirements. The section of the Ausable River proposed for TFM treatment is in both Clinton and Essex Counties.

[6] Includes Ranney, Cold Spring and Brevoort brooks requirements.

[7] Includes Greenland, Spectacle, Cold Spring, and Dump brooks requirement.

[8] Poultney River lies in both states. TFM requirements include those for the Hubbardton River.

Literature Cited

New York State Department of Environmental Conservation, U. S. Fish and Wildlife Service, and Vermont Department of Fish and Wildlife. 1990. Final Environmental Impact Statement: Use of Lampricides in a temporary program of sea lamprey control in Lake Champlain with an assessment of effects on certain fish populations and sport fisheries. NYSDEC, Ray Brook, New York. 273 pp.

U. S. Fish and Wildlife Service, Vermont Department of Fish and Wildlife, and New York State Department of Environmental Conservation. 2001. A long-term program of sea lamprey control in Lake Champlain. Final Supplemental Environmental Impact Statement FES# 01-27. Lake Champlain Fish and Wildlife Management Cooperative. 356 pp. plus appendices.

APPENDIX A

Safety Data Sheets

Appendix A Lampricide Safety Data Sheets.pdf

SAFETY DATA SHEET

1. Identification

Product identifier **TFM HP Sea Lamprey Larvicide; Lamprecid® Sea Lamprey larvicide**

Other means of identification Not available.

Recommended use Industrial use.

Recommended restrictions None known.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer Iofina Chemical, Inc.

Address 1025 Mary Laidley Drive, Covington, KY 41017
United States

Telephone number 859-356-8000

Supplier U.S. Fish and Wildlife Service

Address 1849 C Street NW Washington, D.C. 20240
United States

Emergency telephone number Chemtrec (U.S.) 1-800-424-9300

Supplier Department of Fisheries and Oceans Canada - Sea Lamprey Control Centre

Address 1219 Queen Street Sault Ste. Marie Ontario, Canada P6A 2E5

Emergency telephone number Canutec (Canada) 1-613-996-6666

2. Hazard(s) identification

Physical hazards	Flammable liquids	Category 3
Health hazards	Acute toxicity, oral	Category 3
	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
	Specific target organ toxicity, single exposure	Category 3 narcotic effects
OSHA defined hazards	Not classified.	

Label elements

Signal word Danger

Hazard statement Flammable liquid and vapor. Toxic if swallowed. Causes skin irritation. Causes serious eye damage. May cause respiratory irritation. May cause drowsiness or dizziness.

Precautionary statement

Prevention Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Keep container tightly closed. Ground/bond container and receiving equipment. Use explosion-proof electrical/ventilating/lighting equipment. Use only non-sparking tools. Take precautionary measures against static discharge. Avoid breathing mist/vapors. Wear protective gloves/protective clothing/eye protection/face protection. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Use only in well-ventilated areas.

Response If on skin: Wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash before reuse. If swallowed: Rinse mouth. Do NOT induce vomiting. If inhaled: Remove person to fresh air and keep comfortable for breathing. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. Wash contaminated clothing before reuse. In case of fire: Use foam, carbon dioxide, dry powder or water fog for extinction.

Storage Store in a well-ventilated place. Keep cool. Keep container tightly closed. Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) Static accumulating flammable liquids

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
3-Trifluoromethyl-4-nitrophenol	88-30-2	20-40
Isopropyl alcohol	67-63-0	10-30
Sodium hydroxide	1310-73-2	1-10

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation Remove victim from source of exposure. Get medical attention for any breathing difficulty.

Skin contact Remove contaminated clothing and shoes. Wash the skin immediately with soap and water. Get medical attention if irritation develops or persists.

Eye contact Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

Ingestion Never give anything by mouth to a victim who is unconscious or is having convulsions. Immediately rinse mouth and drink plenty of water. Do not induce vomiting without advice from poison control center. Seek immediate medical attention.

Most important symptoms/effects, acute and delayed Irritation of nose and throat. Irritation of eyes and mucous membranes. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

Indication of immediate medical attention and special treatment needed Treat symptomatically.

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Thermal burns: Flush with water immediately. While flushing, remove clothes which do not adhere to affected area. Call an ambulance. Continue flushing during transport to hospital.

5. Fire-fighting measures

Suitable extinguishing media Water fog. Foam. Carbon dioxide (CO_2).

Unsuitable extinguishing media None.

Specific hazards arising from the chemical The product is flammable, and heating may generate vapors which may form explosive vapor/air mixtures.

Special protective equipment and precautions for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

Fire-fighting equipment/instructions Move containers from fire area if you can do it without risk.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Ventilate. Avoid inhalation of vapors and spray mist and contact with skin and eyes. Use personal protection as recommended in Section 8 of the SDS.

Methods and materials for containment and cleaning up Should not be released into the environment. Remove sources of ignition.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal.

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills in original containers for re-use.

Environmental precautions Avoid discharge into drains, water courses or onto the ground unless authorized by permit.

7. Handling and storage

Precautions for safe handling Avoid inhalation of vapors and contact with skin and eyes. Use appropriate Personal Protective Equipment. The product is a flammable liquid. Take the necessary precautionary measures. Follow rules for flammable liquids. Ground and bond containers when transferring material. Ground container and transfer equipment to eliminate static electric sparks. Wash at the end of each work shift and before eating, smoking and using the toilet. Change contaminated clothing. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities Keep containers tightly closed in a dry, cool and well-ventilated place. Keep upright. Do not reuse containers. Store away from incompatible materials.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value
Isopropyl alcohol (CAS 67-63-0)	PEL	980 mg/m3
		400 ppm
Sodium hydroxide (CAS 1310-73-2)	PEL	2 mg/m3

US. ACGIH Threshold Limit Values

Components	Type	Value
Isopropyl alcohol (CAS 67-63-0)	STEL	400 ppm
	TWA	200 ppm
Sodium hydroxide (CAS 1310-73-2)	Ceiling	2 mg/m3

US NIOSH Pocket Guide to Chemical Hazards: Ceiling Limit Value and Time Period (if specified)

Components	Type	Value
Sodium hydroxide (CAS 1310-73-2)	Ceiling	2 mg/m3

US NIOSH Pocket Guide to Chemical Hazards: Recommended exposure limit (REL)

Components	Type	Value
Isopropyl alcohol (CAS 67-63-0)	TWA	980 mg/m3
		400 ppm

US NIOSH Pocket Guide to Chemical Hazards: Short Term Exposure Limit (STEL)

Components	Type	Value
Isopropyl alcohol (CAS 67-63-0)	STEL	1225 mg/m3
		500 ppm

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
Isopropyl alcohol (CAS 67-63-0)	40 mg/l	Acetone	Urine	*

* - For sampling details, please see the source document.

Exposure guidelines Use personal protective equipment as required. Keep working clothes separately.

Appropriate engineering controls If working with material indoors: Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields.

Skin protection

Hand protection Wear protective gloves. Suitable gloves can be recommended by the glove supplier.

Other Wear suitable protective clothing.

Respiratory protection	When engineering controls are not sufficient to lower exposure levels below the applicable exposure limit, use a NIOSH approved respirator. Seek advice from local supervisor. Selection and use of respiratory protective equipment should be in accordance with OSHA General Industry Standard 29 CFR 1910.134; or in Canada with CSA Standard Z94.4. Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.
Thermal hazards	Wear appropriate thermal protective clothing, when necessary.
General hygiene considerations	Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance	Dark brown liquid.
Physical state	Liquid.
Form	Liquid.
Color	Dark brown.
Odor	Oily-nutty, phenolic.
Odor threshold	Not available.
pH	9
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	88.0 - 103.0 °F (31.1 - 39.4 °C)
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	23.28 cP (77°F/25°C)
Other information	
Density	1.27 g/ml

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat, sparks, flames.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides. Nitrogen oxides. Hydrogen fluoride.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Toxic if swallowed.
Inhalation	Causes respiratory tract irritation. May cause central nervous system effects.
Skin contact	Causes skin irritation.
Eye contact	Causes severe eye damage.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Irritation of eyes and mucous membranes. Symptoms of overexposure may be headache, dizziness, tiredness, nausea and vomiting.

Information on toxicological effects

Acute toxicity Toxic if swallowed.

Components	Species	Test Results
3-Trifluoromethyl-4-nitrophenol (CAS 88-30-2)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Oral		
LD50	Rat	141 mg/kg

Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes severe eye damage.
Respiratory sensitization	Not classified.
Skin sensitization	Not a skin sensitizer.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	May cause respiratory irritation. May cause drowsiness or dizziness.
Specific target organ toxicity - repeated exposure	Not classified.
Aspiration hazard	Not classified.
Further information	Components of the product may be absorbed into the body through the skin.

12. Ecological information

Ecotoxicity Very toxic to aquatic organisms; may cause adverse effects in the aquatic environment.

Components		Species	Test Results
3-Trifluoromethyl-4-nitrophenol (CAS 88-30-2)			
Aquatic			
Fish	LC50	Freshwater fish	0.6 - 37 mg/l
		Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.842 mg/l, 96 hours
Invertebrate	LC50	Freshwater invertebrate	3.8 - 22.3 mg/l

Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	No data available.
Mobility in soil	No data available.
Other adverse effects	The product contains volatile organic compounds which have a photochemical ozone creation potential.

13. Disposal considerations

Disposal instructions	This material and its container must be disposed of as hazardous waste. Dispose in accordance with all applicable regulations.
Hazardous waste code	D001: Waste Flammable material with a flash point <140 °F
Waste from residues / unused products	Dispose of in accordance with local regulations.

Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number	UN3013
UN proper shipping name	Substituted nitrophenol pesticides, liquid, toxic, flammable
Transport hazard class(es)	6.1
Subsidiary class(es)	3
Packing group	III
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	T14, TP2, TP13, TP27
Packaging exceptions	None
Packaging non bulk	201
Packaging bulk	243

IATA

UN number	UN3013
UN proper shipping name	Substituted nitrophenol pesticide, liquid, toxic, flammable
Transport hazard class(es)	6.1
Subsidiary class(es)	3
Packaging group	III
Environmental hazards	Yes
Labels required	6.1, 3
ERG Code	6F
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number	UN3013
UN proper shipping name	SUBSTITUTED NITROPHENOL PESTICIDE, LIQUID, TOXIC, FLAMMABLE
Transport hazard class(es)	6.1
Subsidiary class(es)	3
Packaging group	III
Environmental hazards	
Marine pollutant	Yes
Labels required	6.1, 3
EmS	F-E, S-D
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations	This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200. This material is not listed on the US TSCA 8(b) Inventory, and is exempt because it is FIFRA regulated.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Sodium hydroxide (CAS 1310-73-2)	LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - Yes Delayed Hazard - No Fire Hazard - Yes Pressure Hazard - No Reactivity Hazard - No
SARA 302 Extremely hazardous substance	No
SARA 311/312 Hazardous chemical	Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Food and Drug Administration (FDA) Not regulated.

US state regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Isopropyl alcohol (CAS 67-63-0)
Sodium hydroxide (CAS 1310-73-2)

US. New Jersey Worker and Community Right-to-Know Act

Isopropyl alcohol (CAS 67-63-0) 500 lbs

US. Pennsylvania RTK - Hazardous Substances

Isopropyl alcohol (CAS 67-63-0)
Sodium hydroxide (CAS 1310-73-2)

US. Rhode Island RTK

Isopropyl alcohol (CAS 67-63-0)
Sodium hydroxide (CAS 1310-73-2)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

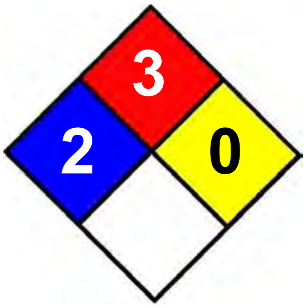
16. Other information, including date of preparation or last revision

Issue date 28-October-2013

Revision date -

Version # 01

NFPA Ratings



References

EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer The information in the sheet was written based on the best knowledge and experience currently available.

SAFETY DATA SHEET

1. Identification

Product identifier **TFM Bar**

Other means of identification Not available.

Recommended use Industrial use.

Recommended restrictions None known.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer Iofina Chemical, Inc.

Address 1025 Mary Laidley Drive, Covington, KY 41017
United States

Telephone number 859-356-8000

Supplier U.S. Fish and Wildlife Service

Address 1849 C Street NW Washington, D.C. 20240
United States

Emergency telephone number Chemtrec (U.S.) 1-800-424-9300

Supplier Department of Fisheries and Oceans Canada - Sea Lamprey Control Centre

Address 1219 Queen Street Sault Ste. Marie Ontario, Canada P6A 2E5

Emergency telephone number Canutec (Canada) 1-613-996-6666

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards	Acute toxicity, oral	Category 4
	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 1
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Harmful if swallowed. Causes skin irritation. Causes serious eye damage. May cause respiratory irritation.

Precautionary statement

Prevention Avoid breathing dust. Wear protective gloves/protective clothing/eye protection/face protection. Wash thoroughly after handling. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area.

Response If swallowed: Call a poison center/doctor if you feel unwell. Rinse mouth. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a poison center/doctor. If on skin: Wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash it before reuse. If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell.

Storage Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) Not classified.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Oxirane, 2-methyl-, Polymer With Oxirane	9003-11-6	42-46
3-trifluoromethyl-4-nitrophenol	88-30-2	22-24
Alcohols, C16-18, ethoxylated	68439-49-6	15-17
Nonylphenol, ethoxylated	9016-45-9	15-17

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation Remove victim from source of exposure. Get medical attention for any breathing difficulty.

Skin contact Remove contaminated clothes and rinse skin thoroughly with water for at least 15 minutes. Get medical attention if irritation develops or persists.

Eye contact Do not rub eyes. Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention immediately.

Ingestion Never give anything by mouth to a victim who is unconscious or is having convulsions. Immediately rinse mouth and drink plenty of water. Do not induce vomiting without advice from poison control center. Seek immediate medical attention.

Most important symptoms/effects, acute and delayed Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation.

Indication of immediate medical attention and special treatment needed Treat symptomatically.

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media Water fog. Foam. Carbon dioxide (CO_2).

Unsuitable extinguishing media None.

Specific hazards arising from the chemical The product is not flammable. Will burn if involved in a fire.

Special protective equipment and precautions for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

Fire-fighting equipment/instructions Move containers from fire area if you can do it without risk.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Avoid inhalation of dust and contact with skin and eyes. Use personal protection recommended in Section 8 of the SDS.

Methods and materials for containment and cleaning up Shovel into dry containers. Cover and move the containers. Flush the area with water. Ventilate the area.
Clean up in accordance with all applicable regulations.

7. Handling and storage

Precautions for safe handling Avoid inhalation of dust and contact with skin and eyes. Wash at the end of each work shift and before eating, smoking and using the toilet. Change contaminated clothing. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities Keep upright. Store in tightly closed original container in a dry, cool and well-ventilated place. Protect from direct sunlight. Store away from incompatible materials. Do not reuse containers.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
3-trifluoromethyl-4-nitro phenol (CAS SEQ250)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
3-trifluoromethyl-4-nitro phenol (CAS SEQ250)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 millions of particle	Total dust.
		15 millions of particle	Respirable fraction.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
3-trifluoromethyl-4-nitro phenol (CAS SEQ250)	TWA	3 mg/m3	Respirable particles.
		10 mg/m3	Inhalable particles.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Use personal protective equipment as required. Keep working clothes separately.

Appropriate engineering controls Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields.

Skin protection

Hand protection Wear appropriate chemical resistant gloves. Suitable gloves can be recommended by the glove supplier.

Other Wear suitable protective clothing.

Respiratory protection When engineering controls are not sufficient to lower exposure levels below the applicable exposure limit, use a NIOSH approved respirator. Seek advice from local supervisor. Selection and use of respiratory protective equipment should be in accordance with OSHA General Industry Standard 29 CFR 1910.134; or in Canada with CSA Standard Z94.4. Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.

Thermal hazards Not applicable.

General hygiene considerations Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Light brown solid.

Physical state Solid.

Form Solid bars.

Color Light brown.

Odor Metallic.

Odor threshold Not available.

pH 3.81

Melting point/freezing point Not available.

Initial boiling point and boiling range Not available.

Flash point Not available.

Evaporation rate Not available.

Flammability (solid, gas) Not available.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) Not available.

Flammability limit - upper (%) Not available.

Explosive limit - lower (%) Not available.

Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	1.19
Solubility(ies)	Not available.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	None under normal conditions.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides. Nitrogen oxides. Hydrogen fluoride.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Harmful if swallowed.
Inhalation	Irritating to respiratory system.
Skin contact	Causes skin irritation.
Eye contact	Causes serious eye damage.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of nose and throat. Irritation of eyes and mucous membranes. Skin irritation.

Information on toxicological effects

Acute toxicity Harmful if swallowed.

Components	Species	Test Results
3-trifluoromethyl-4-nitrophenol (CAS 88-30-2)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Oral		
LD50	Rat	141 mg/kg
Oxirane, 2-methyl-, Polymer With Oxirane (CAS 9003-11-6)		
Acute		
Oral		
LD50	Rat	> 2000 mg/kg

Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye damage.
Respiratory sensitization	Not classified.
Skin sensitization	Not a skin sensitizer.
Germ cell mutagenicity	No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.
Reproductive toxicity	Not classified.
Specific target organ toxicity - single exposure	May cause respiratory irritation.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard Not classified.

Further information No other specific acute or chronic health impact noted.

12. Ecological information

Ecotoxicity Toxic to aquatic life. Due to the form of the product the environmental hazard is considered to be limited.

Components		Species	Test Results
3-trifluoromethyl-4-nitrophenol (CAS 88-30-2)			
Aquatic			
Fish	LC50	Freshwater fish	0.6 - 37 mg/l
		Rainbow trout,donaldson trout (Oncorhynchus mykiss)	0.842 mg/l, 96 hours
Invertebrate	LC50	Freshwater invertebrate	3.8 - 22.3 mg/l
Nonylphenol, ethoxylated (CAS 9016-45-9)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	12.2 mg/l, 48 hours
Fish	LC50	Bluegill (Lepomis macrochirus)	1 - 1.8 mg/l, 96 hours
Oxirane, 2-methyl-, Polymer With Oxirane (CAS 9003-11-6)			
Aquatic			
Crustacea	EC50	Invertebrates (Invertebrates)	> 100 mg/l, 48 hours
Fish	LC50	Fish	> 100 mg/l, 96 hours

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential No data available.

Mobility in soil No data available.

Other adverse effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

13. Disposal considerations

Disposal instructions This material and its container must be disposed of as hazardous waste. Dispose in accordance with all applicable regulations.

Hazardous waste code Not regulated.

Waste from residues / unused products Dispose of in accordance with local regulations.

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as a hazardous material by DOT.

IATA

Not regulated as a dangerous good.

IMDG

Not regulated as a dangerous good.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.
This material is not listed on the US TSCA 8(b) Inventory, and is exempt because it is FIFRA regulated.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - Yes Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
SARA 302 Extremely hazardous substance	No
SARA 311/312 Hazardous chemical	Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.
Food and Drug Administration (FDA)	Not regulated.
US state regulations	This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Not regulated.

US. New Jersey Worker and Community Right-to-Know Act

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

Not regulated.

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

International Inventories

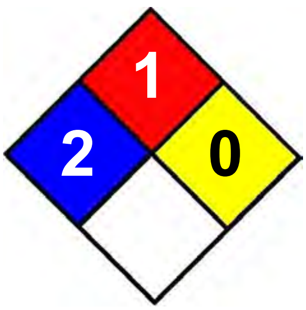
Country(s) or region	**Inventory name**	**On inventory (yes/no)***
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date	26-November-2013
Revision date	-
Version #	01

NFPA Ratings



References

EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

The information in the sheet was written based on the best knowledge and experience currently available.

SAFETY DATA SHEET

1. Identification

Product identifier **Bayluscide Technical; Bay 73 Technical**

Other means of identification Not available.

Recommended use Industrial use.

Recommended restrictions None known.

Manufacturer / Importer / Supplier / Distributor information

Supplier U.S. Fish and Wildlife Service

Address 1849 C Street NW Washington, D.C. 20240
United States

Emergency telephone number Chemtrec (U.S.) 1-800-424-9300

Canutec (Canada) 1-613-996-6666

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards Acute toxicity, inhalation — Category 4
Serious eye damage/eye irritation — Category 2A

OSHA defined hazards Not classified.

Label elements

Signal word Warning

Hazard statement Causes serious eye irritation. Harmful if inhaled.

Precautionary statement

Prevention Avoid breathing dust. Wear eye/face protection. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area.

Response If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

Storage Store away from incompatible materials.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) Not classified.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Niclosamide ethanolamine salt	1420-04-8	>95.4
2-chloro-4-nitroaniline	121-87-9	0.4-1.5
5-chloro-2-hydroxybenzoic acid	321-14-2	0.15-1.5

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation Remove victim to fresh air. If breathing is difficult, give oxygen. Get medical attention.

Skin contact Remove contaminated clothing and shoes. Wash the skin immediately with soap and water. Get medical attention if irritation develops and persists.

Eye contact Do not rub eyes. Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Get medical attention immediately.

Ingestion	Never give anything by mouth to a victim who is unconscious or is having convulsions. Immediately rinse mouth and drink plenty of water or milk. Keep person under observation. Do not induce vomiting. If vomiting occurs, keep head low. Seek immediate medical attention or advice.
Most important symptoms/effects, acute and delayed	Irritation of eyes and mucous membranes. Irritation of nose and throat. Cough. Skin irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Dry chemical powder, water spray.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.
Fire-fighting equipment/instructions	Move containers from fire area if you can do so without risk.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Avoid inhalation of dust and contact with skin and eyes. Use personal protection as recommended in Section 8 of the SDS.
Methods and materials for containment and cleaning up	Cover with plastic sheet to prevent spreading. Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Nonsparking tools should be used. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Following product recovery, flush area with water. Ventilate the area. Clean up in accordance with all applicable regulations.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground unless authorized by permit.

7. Handling and storage

Precautions for safe handling	Avoid inhalation of dust and contact with skin and eyes. Minimize dust generation and accumulation. Add material slowly when mixing with water. Do not add water to the material; instead, add the material to the water. Wash at the end of each work shift and before eating, smoking and using the toilet. Change contaminated clothing. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Keep upright. Store in tightly closed original container in a dry, cool and well-ventilated place. Protect from direct sunlight. Store away from incompatible materials. Do not reuse containers. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. Dry powders can build static electricity charges when subjected to the friction of transfer and mixing operations. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres. Refer to NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, for safe handling.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
		50 millions of particle	Total dust.
		15 millions of particle	Respirable fraction.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	3 mg/m3	Respirable particles.
		10 mg/m3	Inhalable particles.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Use personal protective equipment as required. Keep working clothes separately. No exposure standards allocated.

Appropriate engineering controls Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. It is recommended that all dust control equipment such as local exhaust ventilation and material transport systems involved in handling of this product contain explosion relief vents or an explosion suppression system or an oxygen deficient environment. Ensure that dust-handling systems (such as exhaust ducts, dust collectors, vessels, and processing equipment) are designed in a manner to prevent the escape of dust into the work area (i.e., there is no leakage from the equipment).

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields.

Skin protection

Hand protection Wear protective gloves.

Other Normal work clothing (long sleeved shirts and long pants) is recommended.

Respiratory protection Use a NIOSH–approved respirator if there is a potential for exposure to dust exceeding exposure limits (See 29 CRF 1910.134, respiratory protection standard). Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.

Thermal hazards Not applicable.

General hygiene considerations Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Bright yellow (with faint green tint) solid.

Physical state Solid.

Form Solid.

Color Bright yellow (with faint green tint).

Odor Metallic.

Odor threshold 20 (on a scale of 1 to 100)

pH 9.27 (1% aqueous solution at 23°C/73°F)

Melting point/freezing point 408 - 419 °F (208.89 - 215 °C)

Initial boiling point and boiling range Not available.

Flash point Not available.

Evaporation rate Not available.

Flammability (solid, gas) Not available.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) Not available.

Flammability limit - upper (%) Not available.

Explosive limit - lower (%) Not available.

Explosive limit - upper (%)	Not available.
Vapor pressure	<0.00001 Pa (25°C/77°F)
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	0.0283 g/l (20°C/68°F) in water.
Partition coefficient (n-octanol/water)	5.33 LogKow
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not available.
Other information	
Bulk density	0.45 g/ml (23°C/73°F)

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat.
Incompatible materials	Strong acids. Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides. Nitrogen oxides. Hydrogen chloride.

11. Toxicological information

Information on likely routes of exposure

Ingestion	Ingestion may cause irritation and malaise.
Inhalation	Harmful if inhaled.
Skin contact	Dust may irritate skin.
Eye contact	Causes serious eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of eyes and mucous membranes. Irritation of nose and throat. Cough. Skin irritation.

Information on toxicological effects

Acute toxicity Harmful if inhaled.

Components	Species	Test Results
2-chloro-4-nitroaniline (CAS 121-87-9)		
Acute		
Oral		
LD50	Mouse	1250 mg/kg
	Rat	6430 mg/kg
Niclosamide ethanolamine salt (CAS 1420-04-8)		
Acute		
Oral		
LD50	Rat	> 5000 mg/kg

Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	Causes serious eye irritation.
Respiratory sensitization	No data available.
Skin sensitization	Not a skin sensitizer.
Germ cell mutagenicity	Niclosamide ethanolamine salt: Ames test: Negative.
Carcinogenicity	Not classifiable as to carcinogenicity to humans.
Reproductive toxicity	Knowledge about reproductive effects is incomplete.
Specific target organ toxicity - single exposure	No data available.

Specific target organ toxicity - repeated exposure	No data available.
Aspiration hazard	Not classified.
Chronic effects	Frequent inhalation of dust over a long period of time increases the risk of developing lung diseases.
Further information	Contains 2-chloro-4-nitroaniline: may cause transformation of hemoglobin to methemoglobin, nitrosulfhemoglobin, sulfhemoglobin and a decrease in oxyhemoglobin in animal studies.

12. Ecological information

Ecotoxicity Very toxic to aquatic life.

Components		Species	Test Results
2-chloro-4-nitroaniline (CAS 121-87-9)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	1.4 - 2 mg/l, 48 hours
Fish	LC50	Fathead minnow (Pimephales promelas)	17.7 - 20.2 mg/l, 96 hours
Niclosamide ethanolamine salt (CAS 1420-04-8)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	0.14 - 0.27 mg/l, 48 hours
	LC50	Daphnia	0.38 mg/l, (70% niclosamide ethanolamine salt mixture)
Fish	LC50	Channel catfish (Ictalurus punctatus)	0.035 - 0.051 mg/l, 96 hours
		Rainbow Trout	0.34 mg/l, 96 Hours, (70% niclosamide ethanolamine salt mixture)

Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	Has moderate potential to bioaccumulate. BCF: 45.

Partition coefficient n-octanol / water (log Kow)
Bayluscide Technical; Bay 73 Technical (CAS Mixture) 5.33, LogKow

Mobility in soil	Niclosamide ethanolamine salt: Estimated Koc = 350. Moderate soil mobility.
Other adverse effects	An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

13. Disposal considerations

Disposal instructions	This material and its container must be disposed of as hazardous waste. Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazardous waste code	Not regulated.
Waste from residues / unused products	Dispose in accordance with all applicable regulations.
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number	UN3077
UN proper shipping name	Environmentally hazardous substances, solid, n.o.s.
Transport hazard class(es)	9
Subsidiary class(es)	-
Packing group	III
Environmental hazards	
Marine pollutant	Yes
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	8, 146, 335, A112, B54, IB8, IP3, N20, T1, TP33
Packaging exceptions	155
Packaging non bulk	213
Packaging bulk	240

IATA

UN number	UN3077
UN proper shipping name	Environmentally hazardous substance, solid, n.o.s.
Transport hazard class(es)	9
Subsidiary class(es)	-
Packaging group	III
Environmental hazards	No

Labels required Not available.
ERG Code 9L
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number UN3077
UN proper shipping name ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.
Transport hazard class(es) 9
Subsidiary class(es) -
Packaging group III
Environmental hazards
Marine pollutant Yes
Labels required Not available.
EmS F-A, S-F
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is hazardous according to OSHA 29 CFR 1910.1200. This material is not listed on the US TSCA 8(b) Inventory, and is exempt because it is FIFRA regulated.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Food and Drug Administration (FDA) Not regulated.

US state regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Niclosamide ethanolamine salt (CAS 1420-04-8)

US. New Jersey Worker and Community Right-to-Know Act

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

Niclosamide ethanolamine salt (CAS 1420-04-8)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

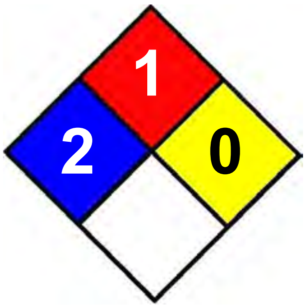
16. Other information, including date of preparation or last revision

Issue date 28-October-2013

Revision date -

Version # 01

NFPA Ratings



References

EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

The information in the sheet was written based on the best knowledge and experience currently available.

SAFETY DATA SHEET

1. Identification

Product identifier **Bayluscide 20% Emulsifiable Concentrate; Bayluscide Emulsifiable Concentrate Lampricide**

Other means of identification Not available.

Synonyms Niclosamide ethanolamine salt mixture; clonitralide mixture

Recommended use Industrial use.

Recommended restrictions None known.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer Coating Place, Inc.

Address 200 Paoli Street Verona, WI 53593
United States

Telephone number 608-845-9521

Supplier U.S. Fish and Wildlife Service

Address 1849 C Street NW Washington, D.C. 20240
United States

Emergency telephone number Chemtrec (U.S.) 1-800-424-9300

Supplier Department of Fisheries and Oceans Canada - Sea Lamprey Control Centre

Address 1219 Queen Street Sault Ste. Marie Ontario, Canada P6A 2E5

Emergency telephone number Canutec (Canada) 1-613-996-6666

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards	Skin corrosion/irritation	Category 2
	Serious eye damage/eye irritation	Category 1
	Carcinogenicity	Category 2
	Reproductive toxicity	Category 1B
	Specific target organ toxicity, single exposure	Category 3 respiratory tract irritation
	Specific target organ toxicity, repeated exposure	Category 2 (kidney, liver)

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement Causes skin irritation. Causes serious eye damage. Suspected of causing cancer. May damage the unborn child. May cause respiratory irritation. May cause damage to organs (kidney, liver) through prolonged or repeated exposure.

Precautionary statement

Prevention Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Avoid breathing mist. Wear protective gloves/protective clothing/eye protection/face protection. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area.

Response If exposed or concerned: Get medical advice/attention. If on skin: Wash with plenty of water. If skin irritation occurs: Get medical advice/attention. Take off contaminated clothing and wash it before reuse. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell.

Storage Store in a well-ventilated place. Keep container tightly closed. Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) Not classified.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
1-Methyl-2-pyrrolidinone	872-50-4	64-68
Niclosamide ethanolamine salt	1420-04-8	16-18
Coconut oil, reaction products with diethanolamine	8051-30-7	12-14
Diethanolamine	111-42-2	1.1-1.3

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation Remove victim to fresh air. If breathing is difficult, give oxygen. Get medical attention.

Skin contact Remove contaminated clothing and shoes. Wash the skin immediately with soap and water. Get medical attention if irritation develops and persists.

Eye contact Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Get medical attention immediately.

Ingestion Never give anything by mouth to a victim who is unconscious or is having convulsions. Immediately rinse mouth and drink plenty of water or milk. Keep person under observation. Do not induce vomiting. If vomiting occurs, keep head low. Seek immediate medical attention or advice.

Most important symptoms/effects, acute and delayed Symptoms include itching, burning, redness, and tearing of eyes. Irritation of nose and throat. Cough. Skin irritation.

Indication of immediate medical attention and special treatment needed Treat symptomatically. Symptoms may be delayed.

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media Dry chemical powder, water spray.

Unsuitable extinguishing media None known.

Specific hazards arising from the chemical The product is not flammable. By heating and fire, toxic vapors/gases may be formed.

Special protective equipment and precautions for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

Fire-fighting equipment/instructions Move containers from fire area if you can do so without risk.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Avoid inhalation of mist and contact with skin and eyes. For personal protection, see Section 8 of the SDS.

Methods and materials for containment and cleaning up Keep unnecessary personnel away.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water.

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills in original containers for re-use.

Environmental precautions Avoid discharge into drains, water courses or onto the ground unless authorized by permit.

7. Handling and storage

Precautions for safe handling Avoid inhalation of mist and contact with skin and eyes. Avoid contact during pregnancy/while nursing. Do not smoke and do not spray near a naked flame or other sources of ignition. Wash at the end of each work shift and before eating, smoking and using the toilet. Change contaminated clothing. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities Keep upright. Store in tightly closed original container in a dry, cool and well-ventilated place. Protect from direct sunlight. Store away from incompatible materials. Do not reuse containers.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 millions of particle	Total dust.
		15 millions of particle	Respirable fraction.

ACGIH

Components	Type	Value	Form
Diethanolamine (CAS 111-42-2)	STEL	0.2 ppm	Inhalable fraction and vapor.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Diethanolamine (CAS 111-42-2)	TWA	1 mg/m3	Inhalable fraction and vapor.
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	3 mg/m3	Respirable particles.
		10 mg/m3	Inhalable particles.

US NIOSH Pocket Guide to Chemical Hazards: Recommended exposure limit (REL)

Components	Type	Value
Diethanolamine (CAS 111-42-2)	TWA	15 mg/m3
		3 ppm

US. Workplace Environmental Exposure Level (WEEL) Guides

Components	Type	Value
1-Methyl-2-pyrrolidinone (CAS 872-50-4)	TWA	40 mg/m3
		10 ppm

Biological limit values

ACGIH Biological Exposure Indices

Components	Value	Determinant	Specimen	Sampling Time
1-Methyl-2-pyrrolidinone (CAS 872-50-4)	100 mg/l	5-Hydroxy-N-m et hyl-2-pyrr olidone	Urine	*

* - For sampling details, please see the source document.

Exposure guidelines

US - California OELs: Skin designation

Diethanolamine (CAS 111-42-2) Can be absorbed through the skin.

US ACGIH Threshold Limit Values: Skin designation

Diethanolamine (CAS 111-42-2) Can be absorbed through the skin.

US WEEL Guides: Skin designation

1-Methyl-2-pyrrolidinone (CAS 872-50-4) Can be absorbed through the skin.

Appropriate engineering controls Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields.

Skin protection	
Hand protection	Wear protective gloves.
Other	Normal work clothing (long sleeved shirts and long pants) is recommended.
Respiratory protection	If airborne concentrations exceed applicable exposure limits (PEL), wear NIOSH-approved respirators to maintain exposures below the PEL. Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.
Thermal hazards	Not applicable.
General hygiene considerations	Observe any medical surveillance requirements. Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance	Dark yellow-red liquid.
Physical state	Liquid.
Form	Liquid.
Color	Dark yellow-red.
Odor	Metallic.
Odor threshold	Not available.
pH	9.8 1% suspension at 77°F (25°C)
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	201.6 °F (94.2 °C)
Evaporation rate	Not available.
Flammability (solid, gas)	Not applicable.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	1.09 68°F (20°C)
Solubility(ies)	Not applicable.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	12.2 cps average at 30 RPM at 68°F (20°C)

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat.
Incompatible materials	Strong alkalis. Strong acids. Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides. Nitrogen oxides. Ammonia. Hydrogen chloride.

11. Toxicological information

Information on likely routes of exposure	
Ingestion	Ingestion may cause irritation and malaise.
Inhalation	Vapors and mist may irritate throat and respiratory system and cause coughing.

Skin contact	Causes skin irritation.
Eye contact	Causes serious eye damage.
Symptoms related to the physical, chemical and toxicological characteristics	Symptoms include itching, burning, redness, and tearing of eyes. Irritation of nose and throat. Cough. Skin irritation.

Information on toxicological effects

Acute toxicity Ingestion may cause irritation and malaise.

Components	Species	Test Results
1-Methyl-2-pyrrolidinone (CAS 872-50-4)		
Acute		
Dermal		
LD50	Rabbit	8000 mg/kg
Inhalation		
LC50	Rat	> 5.1 mg/l
Oral		
LD50	Rat	3914 mg/kg
Diethanolamine (CAS 111-42-2)		
Acute		
Dermal		
LD50	Rabbit	11.9 ml/kg
Oral		
LD50	Rat	710 mg/kg
Niclosamide ethanolamine salt (CAS 1420-04-8)		
Acute		
Oral		
LD50	Rat	> 5000 mg/kg

Skin corrosion/irritation	Causes skin irritation.
Serious eye damage/eye irritation	Causes serious eye damage.
Respiratory sensitization	No data available.
Skin sensitization	Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
Germ cell mutagenicity	Niclosamide ethanolamine salt: Ames test: Negative.
Carcinogenicity	Suspected of causing cancer.

IARC Monographs. Overall Evaluation of Carcinogenicity

Diethanolamine (CAS 111-42-2) 2B Possibly carcinogenic to humans.

Reproductive toxicity	May damage the unborn child. Avoid contact during pregnancy/while nursing.
Specific target organ toxicity - single exposure	May cause respiratory irritation.
Specific target organ toxicity - repeated exposure	May cause damage to organs (kidney, liver) through prolonged or repeated exposure.
Aspiration hazard	No data available.

12. Ecological information

Ecotoxicity Toxic to aquatic life.

Components		Species	Test Results
1-Methyl-2-pyrrolidinone (CAS 872-50-4)			
Aquatic			
Crustacea	EC50	Daphnia magna	> 1000 mg/l, 24 hours
Diethanolamine (CAS 111-42-2)			
Aquatic			
Crustacea	EC50	Water flea (Ceriodaphnia dubia)	61.8 - 86.04 mg/l, 48 hours
Fish	LC50	Fathead minnow (Pimephales promelas)	>= 100 mg/l, 96 hours

Components		Species	Test Results
Niclosamide ethanolamine salt (CAS 1420-04-8)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	0.14 - 0.27 mg/l, 48 hours
	LC50	Daphnia	0.38 mg/l, (70% niclosamide ethanolamine salt mixture)
Fish	LC50	Channel catfish (Ictalurus punctatus)	0.035 - 0.051 mg/l, 96 hours
		Rainbow Trout	0.34 mg/l, 96 Hours, (70% niclosamide ethanolamine salt mixture)

Persistence and degradability No data is available on the degradability of this product.

Bioaccumulative potential Niclosamide ethanolamine salt: BCF: 46 Has moderate potential to bioaccumulate.

Partition coefficient n-octanol / water (log Kow)

1-Methyl-2-pyrrolidinone (CAS 872-50-4)	-0.54
Diethanolamine (CAS 111-42-2)	-1.43

Mobility in soil The product is partly miscible with water and may spread in the aquatic environment. Niclosamide ethanolamine salt: Estimated Koc = 350. Moderate soil mobility.

Other adverse effects An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

13. Disposal considerations

Disposal instructions This material and its container must be disposed of as hazardous waste. Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazardous waste code Not regulated.

Waste from residues / unused products Dispose in accordance with all applicable regulations.

Contaminated packaging Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as a hazardous material by DOT.

IATA

Not regulated as a dangerous good.

IMDG

Not regulated as a dangerous good.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is hazardous according to OSHA 29 CFR 1910.1200. This material is not listed on the US TSCA 8(b) Inventory, and is exempt because it is FIFRA regulated.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Diethanolamine (CAS 111-42-2) LISTED

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories
Immediate Hazard - Yes
Delayed Hazard - Yes
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)

Chemical name	CAS number	% by wt.
1-Methyl-2-pyrrolidinone	872-50-4	64-68
Diethanolamine	111-42-2	1.1-1.3

SARA 313 (TRI reporting)
Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List
Diethanolamine (CAS 111-42-2)

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)
Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Food and Drug Administration (FDA) Not regulated.

US state regulations WARNING: This product contains chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List
1-Methyl-2-pyrrolidinone (CAS 872-50-4)
Diethanolamine (CAS 111-42-2)
Niclosamide ethanolamine salt (CAS 1420-04-8)

US. New Jersey Worker and Community Right-to-Know Act

1-Methyl-2-pyrrolidinone (CAS 872-50-4)	500 lbs
Diethanolamine (CAS 111-42-2)	500 lbs

US. Pennsylvania RTK - Hazardous Substances
1-Methyl-2-pyrrolidinone (CAS 872-50-4)
Diethanolamine (CAS 111-42-2)
Niclosamide ethanolamine salt (CAS 1420-04-8)

US. Rhode Island RTK
1-Methyl-2-pyrrolidinone (CAS 872-50-4)
Diethanolamine (CAS 111-42-2)

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance
1-Methyl-2-pyrrolidinone (CAS 872-50-4)
Diethanolamine (CAS 111-42-2)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 28-October-2013

Revision date -

Version # 01

NFPA Ratings

References
EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer The information in the sheet was written based on the best knowledge and experience currently available.

SAFETY DATA SHEET

1. Identification

Product identifier	**Bayluscide 3.2% Granular Sea Lamprey Larvicide; Bayluscide Granular Sea Lamprey Larvicide.**
Other means of identification	Not available.
Synonyms	Niclosamide ethanolamine salt mixture; clonitralide mixture
Recommended use	Industrial use.
Recommended restrictions	None known.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer	Coating Place, Inc.
Address	200 Paoli Street Verona, WI 53593 United States
Telephone number	608-845-9521
Supplier	U.S. Fish and Wildlife Service
Address	1849 C Street NW Washington, D.C. 20240 United States
Emergency telephone number	Chemtrec (U.S.) 1-800-424-9300
Supplier	Department of Fisheries and Oceans Canada - Sea Lamprey Control Centre
Address	1219 Queen Street Sault Ste. Marie Ontario, Canada P6A 2E5
Emergency telephone number	Canutec (Canada) 1-613-996-6666

2. Hazard(s) identification

Physical hazards	Not classified.
Health hazards	Not classified.
OSHA defined hazards	Not classified.

Label elements

Hazard symbol	None.
Signal word	None.
Hazard statement	The mixture does not meet the criteria for classification.
Precautionary statement	
Prevention	Observe good industrial hygiene practices.
Response	Wash hands after handling.
Storage	Store away from incompatible materials.
Disposal	Dispose of waste and residues in accordance with local authority requirements.
Hazard(s) not otherwise classified (HNOC)	Not classified.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Silicon dioxide	7631-86-9	68-72
Polyoxyethylene-poly oxypropylene block copolymer	9003-11-6	18-20
Ethyl cellulose	9004-57-3	4
Niclosamide ethanolamine salt	1420-04-8	3-3.6
Hydroxypropyl cellulose salt	9004-64-2	2

Composition comments	All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation	Remove victim to fresh air. Get medical attention if symptoms persist.
Skin contact	Remove contaminated clothing and shoes. Wash the skin immediately with soap and water. Get medical attention if irritation develops and persists.
Eye contact	Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Get medical attention if irritation develops and persists.
Ingestion	Never give anything by mouth to a victim who is unconscious or is having convulsions. Immediately rinse mouth and drink plenty of water or milk. Keep person under observation. Do not induce vomiting. If vomiting occurs, keep head low. Seek immediate medical attention or advice.
Most important symptoms/effects, acute and delayed	Irritation of eyes and mucous membranes. Irritation of nose and throat. Cough. Skin irritation.
Indication of immediate medical attention and special treatment needed	Treat symptomatically.
General information	Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media	Dry chemical powder, water spray.
Unsuitable extinguishing media	None known.
Specific hazards arising from the chemical	The product is not flammable. By heating and fire, toxic vapors/gases may be formed.
Special protective equipment and precautions for firefighters	Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.
Fire-fighting equipment/instructions	Move containers from fire area if you can do so without risk.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures	Avoid inhalation of dust and contact with skin and eyes. Use personal protection as recommended in Section 8 of the SDS.
Methods and materials for containment and cleaning up	Cover with plastic sheet to prevent spreading. With clean shovel place material into clean, dry container and cover loosely; move containers from spill area. Following product recovery, flush area with water. Ventilate the area. Clean up in accordance with all applicable regulations.
Environmental precautions	Avoid discharge into drains, water courses or onto the ground unless authorized by permit.

7. Handling and storage

Precautions for safe handling	Avoid inhalation of dust and contact with skin and eyes. Wash at the end of each work shift and before eating, smoking and using the toilet. Change contaminated clothing. Observe good industrial hygiene practices.
Conditions for safe storage, including any incompatibilities	Keep upright. Store in tightly closed original container in a dry, cool and well-ventilated place. Protect from direct sunlight. Store away from incompatible materials. Do not reuse containers.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 millions of particle	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
		15 millions of particle	Respirable fraction.
Silicon dioxide (CAS 7631-86-9)	TWA	0.8 mg/m3	
		20 mppcf	

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	3 mg/m3	Respirable particles.
		10 mg/m3	Inhalable particles.

US NIOSH Pocket Guide to Chemical Hazards: Recommended exposure limit (REL)

Components	Type	Value
Silicon dioxide (CAS 7631-86-9)	TWA	6 mg/m3

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Use personal protective equipment as required. Keep working clothes separately. No exposure standards allocated.

Appropriate engineering controls Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields.

Skin protection

Hand protection Wear protective gloves.

Other Normal work clothing (long sleeved shirts and long pants) is recommended.

Respiratory protection Use a NIOSH–approved respirator if there is a potential for exposure to dust exceeding exposure limits (See 29 CRF 1910.134, respiratory protection standard). Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.

Thermal hazards Not applicable.

General hygiene considerations Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Dark yellow. Granules.

Physical state Solid.

Form Granules.

Color Dark yellow.

Odor Cresol-like.

Odor threshold Not available.

pH 9.05 (1% aqueous solution at 78.8°F/26°C)

Melting point/freezing point Not available.

Initial boiling point and boiling range Not available.

Flash point Not available.

Evaporation rate Not available.

Flammability (solid, gas) Not available.

Upper/lower flammability or explosive limits

Flammability limit - lower (%) Not available.

Flammability limit - upper (%) Not available.

Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	6.9 x 10-13 mm Hg at 68°F/20°C
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	Completely Soluble (100%) 11 ppm at pH 8.9 (for Niclosamide).
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not applicable.
Other information	
Bulk density	1.26 g/ml

10. Stability and reactivity

Reactivity	Stable at normal conditions. None known.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat.
Incompatible materials	Strong alkalis. Strong acids. Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides. Nitrogen oxides. Ammonia. Hydrogen chloride.

11. Toxicological information

Information on likely routes of exposure

Ingestion	May cause discomfort if swallowed.
Inhalation	Inhalation of dusts may cause respiratory irritation.
Skin contact	May cause skin irritation.
Eye contact	May cause eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of eyes and mucous membranes. Irritation of nose and throat. Cough. Skin irritation.

Information on toxicological effects

Acute toxicity Ingestion may cause irritation and malaise.

Components	Species	Test Results
Hydroxypropyl cellulose salt (CAS 9004-64-2)		
Acute		
Oral		
LD50	Rat	10200 mg/kg
Niclosamide ethanolamine salt (CAS 1420-04-8)		
Acute		
Oral		
LD50	Rat	> 5000 mg/kg
Polyoxyethylene-polyoxypropylene block copolymer (CAS 9003-11-6)		
Acute		
Oral		
LD50	Rat	> 2000 mg/kg

Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	Not classified.
Respiratory sensitization	No data available.
Skin sensitization	Not a skin sensitizer.
Germ cell mutagenicity	Niclosamide ethanolamine salt: Ames test: Negative.

Carcinogenicity	Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Silicon dioxide (CAS 7631-86-9)	3 Not classifiable as to carcinogenicity to humans.

Reproductive toxicity	Knowledge about reproductive effects is incomplete.
Specific target organ toxicity - single exposure	No data available.
Specific target organ toxicity - repeated exposure	No data available.
Aspiration hazard	Not classified.
Chronic effects	Frequent inhalation of dust over a long period of time increases the risk of developing lung diseases.

12. Ecological information

Ecotoxicity Toxic to aquatic life.

Components		Species	Test Results
Niclosamide ethanolamine salt (CAS 1420-04-8)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	0.14 - 0.27 mg/l, 48 hours
	LC50	Daphnia	0.38 mg/l, (70% niclosamide ethanolamine salt mixture)
Fish	LC50	Channel catfish (Ictalurus punctatus)	0.035 - 0.051 mg/l, 96 hours
		Rainbow Trout	0.34 mg/l, 96 Hours, (70% niclosamide ethanolamine salt mixture)
Polyoxyethylene-polyoxypropylene block copolymer (CAS 9003-11-6)			
Aquatic			
Crustacea	EC50	Invertebrates (Invertebrates)	> 100 mg/l, 48 hours
Fish	LC50	Fish	> 100 mg/l, 96 hours

Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	Has moderate potential to bioaccumulate. BCF: 46
Mobility in soil	Niclosamide ethanolamine salt: Estimated Koc = 350. Moderate soil mobility.
Other adverse effects	An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

13. Disposal considerations

Disposal instructions	This material and its container must be disposed of as hazardous waste. Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazardous waste code	Not regulated.
Waste from residues / unused products	Dispose in accordance with all applicable regulations.
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

Not regulated as a hazardous material by DOT.

IATA

Not regulated as a dangerous good.

IMDG

Not regulated as a dangerous good.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code	This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations	This product is not hazardous according to OSHA 29CFR 1910.1200. This material is not listed on the US TSCA 8(b) Inventory, and is exempt because it is FIFRA regulated.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - No Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
SARA 302 Extremely hazardous substance	No
SARA 311/312 Hazardous chemical	No

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA)	Not regulated.
Food and Drug Administration (FDA)	Not regulated.
US state regulations	This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US. Massachusetts RTK - Substance List

Niclosamide ethanolamine salt (CAS 1420-04-8)
Silicon dioxide (CAS 7631-86-9)

US. New Jersey Worker and Community Right-to-Know Act

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

Niclosamide ethanolamine salt (CAS 1420-04-8)
Silicon dioxide (CAS 7631-86-9)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

International Inventories

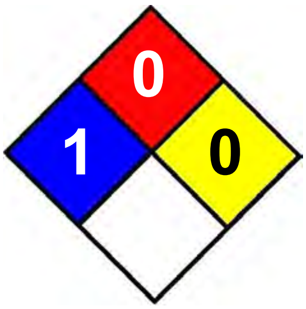
Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date	04-November-2013
Revision date	-
Version #	01

NFPA Ratings



References

EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

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The information in the sheet was written based on the best knowledge and experience currently available.

SAFETY DATA SHEET

1. Identification

Product identifier **Bayluscide 70% Wettable Powder; Bayluscide Wettable Powder Lampricide**

Other means of identification Not available.

Synonyms Niclosamide ethanolamine salt mixture; clonitralide mixture

Recommended use Industrial use.

Recommended restrictions None known.

Manufacturer / Importer / Supplier / Distributor information

Manufacturer Coating Place, Inc.

Address 200 Paoli Street Verona, WI 53593
United States

Telephone number 608-845-9521

Supplier U.S. Fish and Wildlife Service

Address 1849 C Street NW Washington, D.C. 20240
United States

Emergency telephone number Chemtrec (U.S.) 1-800-424-9300

Supplier Department of Fisheries and Oceans Canada - Sea Lamprey Control Centre

Address 1219 Queen Street Sault Ste. Marie Ontario, Canada P6A 2E5

Emergency telephone number Canutec (Canada) 1-613-996-6666

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards	Acute toxicity, inhalation	Category 4
	Serious eye damage/eye irritation	Category 2A

OSHA defined hazards Not classified.

Label elements

Signal word Warning

Hazard statement Causes serious eye irritation. Harmful if inhaled.

Precautionary statement

Prevention Avoid breathing dust. Wear eye/face protection. Wash thoroughly after handling. Use only outdoors or in a well-ventilated area.

Response If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison center/doctor if you feel unwell. If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: Get medical advice/attention.

Storage Store away from incompatible materials.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) Not classified.

3. Composition/information on ingredients

Mixtures

Chemical name	CAS number	%
Niclosamide ethanolamine salt	1420-04-8	60 - 80
Talc	14807-96-6	20-40
Sodium lignosulfonate	8061-51-6	2.5-10

Alkylated napthalene sulfonate, sodium salt	68909-82-0	1-2.5
Silicon dioxide	7631-86-9	0.1-1
Quartz	14808-60-7	0-<0.1

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First-aid measures

Inhalation Remove victim to fresh air. If breathing is difficult, give oxygen. Get medical attention.

Skin contact Remove contaminated clothing and shoes. Wash the skin immediately with soap and water. Get medical attention if irritation develops and persists.

Eye contact Do not rub eyes. Immediately flush with plenty of water for at least 15 minutes. If easy to do, remove contact lenses. Get medical attention immediately.

Ingestion Never give anything by mouth to a victim who is unconscious or is having convulsions. Immediately rinse mouth and drink plenty of water or milk. Keep person under observation. Do not induce vomiting. If vomiting occurs, keep head low. Seek immediate medical attention or advice.

Most important symptoms/effects, acute and delayed Irritation of eyes and mucous membranes. Irritation of nose and throat. Cough. Skin irritation.

Indication of immediate medical attention and special treatment needed Treat symptomatically.

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

5. Fire-fighting measures

Suitable extinguishing media Dry chemical powder, water spray.

Unsuitable extinguishing media None known.

Specific hazards arising from the chemical Avoid generating dust; fine dust dispersed in air in sufficient concentrations, and in the presence of an ignition source is a potential dust explosion hazard.

Special protective equipment and precautions for firefighters Self-contained breathing apparatus and full protective clothing must be worn in case of fire. Selection of respiratory protection for firefighting: follow the general fire precautions indicated in the workplace.

Fire-fighting equipment/instructions Move containers from fire area if you can do so without risk.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Extinguish all ignition sources. Avoid sparks, flames, heat and smoking. Avoid inhalation of dust and contact with skin and eyes. Use personal protection as recommended in Section 8 of the SDS.

Methods and materials for containment and cleaning up Cover with plastic sheet to prevent spreading. Dust deposits should not be allowed to accumulate on surfaces, as these may form an explosive mixture if they are released into the atmosphere in sufficient concentration. Avoid dispersal of dust in the air (i.e., clearing dust surfaces with compressed air). Nonsparking tools should be used. Use a non-combustible material like vermiculite, sand or earth to soak up the product and place into a container for later disposal. Following product recovery, flush area with water. Ventilate the area.
Clean up in accordance with all applicable regulations.

Environmental precautions Avoid discharge into drains, water courses or onto the ground unless authorized by permit.

7. Handling and storage

Precautions for safe handling Avoid inhalation of dust and contact with skin and eyes. Minimize dust generation and accumulation. Add material slowly when mixing with water. Do not add water to the material; instead, add the material to the water. Wash at the end of each work shift and before eating, smoking and using the toilet. Change contaminated clothing. Observe good industrial hygiene practices.

Conditions for safe storage, including any incompatibilities Keep upright. Store in tightly closed original container in a dry, cool and well-ventilated place. Protect from direct sunlight. Store away from incompatible materials. Do not reuse containers. Routine housekeeping should be instituted to ensure that dusts do not accumulate on surfaces. Dry powders can build static electricity charges when subjected to the friction of transfer and mixing operations. Provide adequate precautions, such as electrical grounding and bonding, or inert atmospheres. Refer to NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids, for safe handling.

8. Exposure controls/personal protection

Occupational exposure limits

US. OSHA Table Z-1 Limits for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	PEL	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.

US. OSHA Table Z-3 (29 CFR 1910.1000)

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	5 mg/m3	Respirable fraction.
		15 mg/m3	Total dust.
		50 millions of particle	Total dust.
		15 millions of particle	Respirable fraction.
Talc (CAS 14807-96-6)	TWA	0.3 mg/m3	Total dust.
		0.1 mg/m3	Respirable.
		20 millions of particle	
		2.4 millions of particle	Respirable.

US. ACGIH Threshold Limit Values

Components	Type	Value	Form
Niclosamide ethanolamine salt (CAS 1420-04-8)	TWA	3 mg/m3	Respirable particles.
		10 mg/m3	Inhalable particles.
Talc (CAS 14807-96-6)	TWA	2 mg/m3	Respirable fraction.

US NIOSH Pocket Guide to Chemical Hazards: Recommended exposure limit (REL)

Components	Type	Value	Form
Talc (CAS 14807-96-6)	TWA	2 mg/m3	Respirable.

Biological limit values No biological exposure limits noted for the ingredient(s).

Exposure guidelines Use personal protective equipment as required. Keep working clothes separately. No exposure standards allocated.

Appropriate engineering controls Use process enclosures, local exhaust ventilation, or other engineering controls to control airborne levels below recommended exposure limits. It is recommended that all dust control equipment such as local exhaust ventilation and material transport systems involved in handling of this product contain explosion relief vents or an explosion suppression system or an oxygen deficient environment. Ensure that dust-handling systems (such as exhaust ducts, dust collectors, vessels, and processing equipment) are designed in a manner to prevent the escape of dust into the work area (i.e., there is no leakage from the equipment).

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields.

Skin protection

Hand protection Wear protective gloves.

Other Normal work clothing (long sleeved shirts and long pants) is recommended.

Respiratory protection Use a NIOSH–approved respirator if there is a potential for exposure to dust exceeding exposure limits (See 29 CRF 1910.134, respiratory protection standard). Use a positive-pressure air-supplied respirator if there is any potential for an uncontrolled release, exposure levels are not known, or any other circumstances where air-purifying respirators may not provide adequate protection.

Thermal hazards Not applicable.

General hygiene considerations Wash hands before breaks and immediately after handling the product. Handle in accordance with good industrial hygiene and safety practice.

9. Physical and chemical properties

Appearance Dark yellow. Powder.

Physical state Solid.

Form Powder.

Color Dark yellow.

Odor	None.
Odor threshold	Not available.
pH	9.26 (1% aqueous solution at 25°C/77°F)
Melting point/freezing point	Not available.
Initial boiling point and boiling range	Not available.
Flash point	Not available.
Evaporation rate	Not available.
Flammability (solid, gas)	Not available.
Upper/lower flammability or explosive limits	
Flammability limit - lower (%)	Not available.
Flammability limit - upper (%)	Not available.
Explosive limit - lower (%)	Not available.
Explosive limit - upper (%)	Not available.
Vapor pressure	Not available.
Vapor density	Not available.
Relative density	Not available.
Solubility(ies)	Completely soluble in water.
Partition coefficient (n-octanol/water)	Not available.
Auto-ignition temperature	Not available.
Decomposition temperature	Not available.
Viscosity	Not applicable.
Other information	
Bulk density	0.49 g/ml (25°C/77°F)

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable at normal conditions.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat.
Incompatible materials	Strong acids. Strong oxidizing agents.
Hazardous decomposition products	Carbon oxides. Nitrogen oxides. Sulfur oxides.

11. Toxicological information

Information on likely routes of exposure	
Ingestion	Ingestion may cause irritation and malaise.
Inhalation	Harmful if inhaled.
Skin contact	Dust may irritate skin.
Eye contact	Causes serious eye irritation.
Symptoms related to the physical, chemical and toxicological characteristics	Irritation of eyes and mucous membranes. Irritation of nose and throat. Cough. Skin irritation.
Information on toxicological effects	
Acute toxicity	Harmful if inhaled.

Components	**Species**	**Test Results**
Niclosamide ethanolamine salt (CAS 1420-04-8)		
Acute		
Oral		
LD50	Rat	> 5000 mg/kg

Skin corrosion/irritation	Not classified.
Serious eye damage/eye irritation	Causes serious eye irritation.
Respiratory sensitization	No data available.
Skin sensitization	Not a skin sensitizer.
Germ cell mutagenicity	Niclosamide ethanolamine salt: Ames test: Negative.
Carcinogenicity	Not classifiable as to carcinogenicity to humans.

IARC Monographs. Overall Evaluation of Carcinogenicity

Talc (CAS 14807-96-6)	3 Not classifiable as to carcinogenicity to humans.

Reproductive toxicity	Knowledge about reproductive effects is incomplete.
Specific target organ toxicity - single exposure	No data available.
Specific target organ toxicity - repeated exposure	No data available.
Aspiration hazard	Not classified.
Chronic effects	Frequent inhalation of dust over a long period of time increases the risk of developing lung diseases.
Further information	Talc may have effects on the lungs, resulting in talc pneumoconiosis.

12. Ecological information

Ecotoxicity Very toxic to aquatic life.

Components		Species	Test Results
Niclosamide ethanolamine salt (CAS 1420-04-8)			
Aquatic			
Crustacea	EC50	Water flea (Daphnia magna)	0.14 - 0.27 mg/l, 48 hours
	LC50	Daphnia	0.38 mg/l, (70% niclosamide ethanolamine salt mixture)
Fish	LC50	Channel catfish (Ictalurus punctatus)	0.035 - 0.051 mg/l, 96 hours
		Rainbow Trout	0.34 mg/l, 96 Hours, (70% niclosamide ethanolamine salt mixture)

Persistence and degradability	No data is available on the degradability of this product.
Bioaccumulative potential	Has moderate potential to bioaccumulate. BCF: 46
Mobility in soil	Niclosamide ethanolamine salt: Estimated Koc = 350. Moderate soil mobility.
Other adverse effects	An environmental hazard cannot be excluded in the event of unprofessional handling or disposal.

13. Disposal considerations

Disposal instructions	This material and its container must be disposed of as hazardous waste. Dispose of contents/container in accordance with local/regional/national/international regulations.
Hazardous waste code	Not regulated.
Waste from residues / unused products	Dispose in accordance with all applicable regulations.
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport information

DOT

UN number	UN3077
UN proper shipping name	Environmentally hazardous substances, solid, n.o.s. (Niclosamide ethanolamine salt)
Transport hazard class(es)	9
Subsidiary class(es)	-
Packing group	III
Special precautions for user	Read safety instructions, SDS and emergency procedures before handling.
Special provisions	8, 146, 335, A112, B54, IB8, IP3, N20, T1, TP33
Packaging exceptions	155
Packaging non bulk	213
Packaging bulk	240

IATA

UN number	UN3077
UN proper shipping name	Environmentally hazardous substance, solid, n.o.s. (Niclosamide ethanolamine salt)

Transport hazard class(es) 9
Subsidiary class(es) -
Packaging group III
Environmental hazards Yes
Labels required 9
ERG Code 9L
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

IMDG

UN number UN3077
UN proper shipping name ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Niclosamide ethanolamine salt)
Transport hazard class(es) 9
Subsidiary class(es) -
Packaging group III
Environmental hazards
Marine pollutant Yes
Labels required 9
EmS F-A, S-F
Special precautions for user Read safety instructions, SDS and emergency procedures before handling.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This substance/mixture is not intended to be transported in bulk.

15. Regulatory information

US federal regulations This product is hazardous according to OSHA 29 CFR 1910.1200. This material is not listed on the US TSCA 8(b) Inventory, and is exempt because it is FIFRA regulated.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

US. OSHA Specifically Regulated Substances (29 CFR 1910.1001-1050)

Not listed.

CERCLA Hazardous Substance List (40 CFR 302.4)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories Immediate Hazard - Yes
Delayed Hazard - No
Fire Hazard - No
Pressure Hazard - No
Reactivity Hazard - No

SARA 302 Extremely hazardous substance No

SARA 311/312 Hazardous chemical Yes

SARA 313 (TRI reporting)
Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

Food and Drug Administration (FDA) Not regulated.

US state regulations WARNING: This product contains a chemical known to the State of California to cause cancer.

US. Massachusetts RTK - Substance List

Niclosamide ethanolamine salt (CAS 1420-04-8)
Talc (CAS 14807-96-6)

US. New Jersey Worker and Community Right-to-Know Act

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

Niclosamide ethanolamine salt (CAS 1420-04-8)

Talc (CAS 14807-96-6)

US. Rhode Island RTK

Not regulated.

US. California Proposition 65

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Quartz (CAS 14808-60-7)

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	No

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s).
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

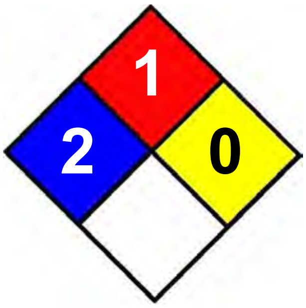
16. Other information, including date of preparation or last revision

Issue date 28-October-2013

Revision date -

Version # 01

NFPA Ratings



References

EPA: AQUIRE database
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
HSDB® - Hazardous Substances Data Bank
IARC Monographs. Overall Evaluation of Carcinogenicity
National Toxicology Program (NTP) Report on Carcinogens
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices

Disclaimer

The information in the sheet was written based on the best knowledge and experience currently available.

APPENDIX B

Lampricide Labels

Appendix B Lampricide Labels.pdf

[LEFT PANEL]

RESTRICTED USE PESTICIDE

DUE TO ACUTE HAZARDS TO THE EYE AND SKIN AND TO NON-TARGET ORGANISMS, NEED FOR HIGHLY SPECIALIZED APPLICATOR TRAINING, AND NEED FOR SPECIALIZED EQUIPMENT.

ONLY FOR SALE TO AND APPLICATION BY CERTIFIED APPLICATORS OF THE U.S. FISH AND WILDLIFE SERVICE, FISHERIES AND OCEANS CANADA AND PROVINCIAL AND STATE FISH AND GAME EMPLOYEES

TFM HP
Sea Lamprey Larvicide

Active Ingredient:
TFM, 3-Trifluoromethyl-4-nitrophenol, sodium salt 36.5%
Inert Ingredients: 63.5%
TOTAL: 100.0%
*Equivalent to (33.0%) 3 -Trifluoromethyl-4-nitrophenol

This product contains __ lbs. of TFM per gallon

Batch No. _____ Net Contents ____lbs.

KEEP OUT OF REACH OF CHILDREN

DANGER-POISON

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	• Call a poison control center or doctor immediately for treatment advice • Have person sip a glass of water, if able to swallow • Do not induce vomiting unless told to do so by poison control center or doctor
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately, with plenty of water, for 15-20 minutes. • Call a poison control center or doctor immediately for treatment advice.

[LEFT PANEL]

If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center or doctor immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor immediately for treatment advice.
Hot Line Number: You may also contact 1-800-858-7378 for health concerns, emergency medical treatment information or pesticide incidents	

SEE LEFT PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-45

EPA Est.______________

[LEFT PANEL]

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Acute Hazards: Corrosive. Causes irreversible eye damage and skin burns. May be fatal if swallowed. Harmful if absorbed through skin or inhaled.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Avoid breathing vapor. Wear protective clothing as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse. Prolonged or frequent repeated skin contact may cause allergic reactions in some individuals.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:
- Coveralls or rubber apron over long-sleeved shirt and long pants
- Chemical-resistant gloves (such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, or polyvinyl chloride [PVC], Viton)
- Chemical-resistant footwear plus socks
- Protective eyewear (goggles or face shield)

Applicators who apply diluted product must wear:
- Chemical-resistant gloves (such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, or polyvinyl chloride [PVC], Viton)

USER SAFETY REQUIREMENTS:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Non-target organisms may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposal of wastes.

PHYSICAL AND CHEMICAL HAZARDS

Combustible. Do not use and store near open flame.

Not to be used by unauthorized personnel.

[RIGHT PANEL]

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

CATEGORY OF APPLICATOR: Aquatic Pest Control.

USE RESTRICTIONS:

For control of Sea Lamprey Larvae (*Petromyzon marinus*) in the Great Lakes Basin, the Lake Champlain system and the Finger Lakes.

Aerial applications of this product are prohibited.

Local, State, and Provincial Fish and Game Agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Known agricultural irrigators that use streams requiring treatment as a source of irrigation water must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators must turn off their irrigation system for a 24-hour period during and after treatment.

PRETREATMENT DIRECTIONS:

Pretreatment surveys are always made to determine the presence of sea lamprey larvae. All waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes selected for treatment must first be analyzed on site to determine both the minimum concentration of TFM HP required to kill sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. “Analysis” constitutes live animal toxicity tests, or the use of a multiple regression relating toxicity test results to on-site determination of total alkalinity and pH of the body of water.

APPLICATION DIRECTIONS:

When applying this product, do not apply in a way that will cause the concentrated product to contact unprotected workers or other persons, either directly or through drift.

Persons applying TFM HP must follow the Standard Operating Procedures for Application of Lampricides in the Great Lakes Fishery Commission’s Integrated Management of Sea Lamprey Control Program, and ensure that the correct application rates are used. Prior to and during the application of this chemical, take appropriate actions to notify public water users including notification actions specified in this manual.

The concentration of TFM HP needed to kill sea lamprey larvae may vary depending upon water chemistry. Measure volume or flow-rate and add the amount of TFM HP necessary at rates based on the foregoing analysis. Dispense TFM HP by application devices sufficiently accurate to maintain predetermined concentration. Concentration in the body of water must be monitored either by spectrophotometric analysis or high-performance liquid chromatography. TFM HP may be used by itself in the treatment of waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes.
At times, however, formulations of Bayluscide (EPA REG. NO. 6704-88) may be used in combination with TFM HP (EPA REG. NO. 6704-45) for control of sea lamprey larvae. Application of Bayluscide may be as a simultaneous addition with TFM HP to reduce the amount of TFM HP required or as a subsequent addition downstream to enhance TFM HP larvicidal activity. Prior to using Bayluscide- TFM HP,

[RIGHT PANEL]

pretreatment surveys must be made to determine the presence of larvae. When using Bayluscide in combination with TFM HP, mix in proportions that result in a final concentration of Bayluscide of not more than 2% of TFM HP by weight (based on active ingredient). Bayluscide may be added to TFM HP in two ways:

1. One method of application is to apply both lampricides at the primary application site. TFM HP is metered into the stream while Bayluscide is applied with a separate pump system in amounts calculated to deliver the desired ratio of Bayluscide to TFM HP. Bayluscide is applied separately to provide a uniform application and to enhance control of concentration.

2. A second application method is to apply Bayluscide into an existing TFM HP block. Because a TFM HP block can be diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates are calculated, the toxicity of the block in the stream must be raised by the addition of TFM HP or Bayluscide. The latter may be used in place of TFM HP. In these situations, TFM HP alone is pumped into the stream at the primary application site. Bayluscide is introduced into the TFM HP block at a point or points downstream in amounts calculated to produce the desired Bayluscide to TFM ratio.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

SPILLS: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed below. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Offer for recycling if available or puncture and dispose in sanitary landfill, or by other procedures approved by state and local authorities. If rinsate cannot be used, follow pesticide disposal instructions. If not triple rinsed, these containers are acute hazardous wastes and must be disposed in accordance with local, state and federal regulations.

(Front Panel)

RESTRICTED USE PESTICIDE

Due to Acute Eye Irritation, Acute Oral Toxicity and Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI, FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control or persons under their direct supervision.

TFM BAR

Active Ingredient:
TFM, 3-Trifluoromethyl-4-nitrophenol 23.0%
Inert Ingredients: 77.0%
TOTAL: 100.0%

KEEP OUT OF REACH OF CHILDREN

DANGER

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	• Call a poison control center or doctor immediately for treatment advice • Have person sip a glass of water, if able to swallow • Do not induce vomiting unless told to do so by poison control center or doctor
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately, with plenty of water, for 15-20 minutes. • Call a poison control center or doctor immediately for treatment advice.

If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center or doctor immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor immediately for treatment advice.
Hot Line Number: You may also contact 1-800-858-7378 for health concerns, emergency medical treatment information of pesticide incidents	

See Left Panel for additional precautionary statements.

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-86

EPA Est No. _____________

Batch No. ____________

Net Contents _________ lbs.

(Left Panel)

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Acute Hazards: Corrosive. Causes irreversible eye damage. May be fatal if swallowed. Harmful if absorbed through skin or inhaled.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Avoid breathing vapors. Wear protective clothing as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Protective eyewear (goggles, face shield, or safety glasses)
- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as Natural Rubber, selection Category A)
- Socks and shoes

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget organisms (such as freshwater clams and mussels) may be killed at recommended rates. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

(Right Panel)

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL:

Read the entire label and Sea Lamprey Control Document No. SLC-92-001[Standard Operating Procedures for Application of Lampricides in the Great Lakes Fishery Commission Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with both the label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

GENERAL INFORMATION:

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget species are potentially vulnerable to TFM, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS:

Use Pattern:

TFM Bars may be used for control of sea lamprey (*Petromyzon marinus*) in waters in the Great Lakes Basin, the Lake Champlain system and the Finger Lakes. Only apply this product according to this label.

Permits:

Obtain any permits needed from local, State, Provincial and Federal wildlife authorities.

Potable Water:

At least 24 hours prior to application, notify municipalities and agricultural irrigators that potable and irrigation water will be treated. Agricultural irrigators must turn off their irrigation systems for a 24-hour period during and after treatment. Prior to and during the application of this chemical, take all appropriate actions to notify public water users and municipalities including notification actions specified in the application manual referred to above.

Unauthorized Personnel:

May not be used by unauthorized personnel.

PRE-APPLICATION DIRECTIONS:

Pretreatment Surveys:

Pretreatment surveys are always made to determine abundance of sea lamprey larvae (*Petromyzon marinus*). All waters in the Great Lakes basin, Lake Champlain system and Finger Lakes that are selected for treatment must first be analyzed on site to determine both the minimum concentration of TFM required to kill sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. "Analysis" constitutes live animal bioassays, or the use of multiple regression curves relating toxicity test results to on-site determination of pH or total alkalinity and conductivity of the body of water.

Lethal Concentration:

The concentration of TFM needed to kill a sea lamprey larvae may vary depending upon water chemistry and temperature. Measure volume or flow rate and add the amount of chemical necessary at rates based on the foregoing analysis. Concentration in the body of water must be monitored by spectrophotometric analysis or high performance liquid chromatography.

APPLICATION DIRECTIONS

Bar Placement: Suspend each bar at least one inch above the bottom of the stream to permit movement of water on all sides.

TFM Delivery Rate: When submerged in water, TFM bars dissolve in approximately 8 to 10 hours at 17 °C and 10 to 12 hours at 12 °C in current velocities 0.09 to 0.12 meter/sec. More rapid velocities will cause the bars to dissolve faster. First, calculate the amount of TFM (grams/hr) needed to supply a lethal concentration to larval sea lampreys in the stream. Then calculate the amount of TFM (grams/hr) released from a TFM bar based on the length of time the bars are expected to last at the prevailing temperature. Divide the amount of TFM needed by the amount released per bar to find the number of bars needed.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: Store only in original container, in a cool (85°F or less) dry place inaccessible to children, pets and domestic animals, and where spills and leakage can be contained. If product becomes soft or liquifies due to high temperatures, cooling to below 85°F will return it to a solid state.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of according to instructions in the application manual, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Offer empty plastic wrappers and packing cartons for recycling if available or dispose of in a sanitary landfill or by incineration, or by other procedures allowed by state and local authorities.

[LEFT PANEL]

RESTRICTED USE PESTICIDE

DUE TO ACUTE HAZARDS TO THE EYE AND SKIN AND TO NON-TARGET ORGANISMS, NEED FOR HIGHLY SPECIALIZED APPLICATOR TRAINING, AND NEED FOR SPECIALIZED EQUIPMENT.

ONLY FOR SALE TO AND APPLICATION BY CERTIFIED APPLICATORS OF THE U.S. FISH AND WILDLIFE SERVICE, FISHERIES AND OCEANS CANADA AND PROVINCIAL AND STATE FISH AND GAME EMPLOYEES

LAMPRECID®
Sea Lamprey Larvicide

Active Ingredient:
TFM, 3-Trifluoromethyl-4-nitrophenol, sodium salt 36.5%
Inert Ingredients: 63.5%
TOTAL: 100.0%
*Equivalent to (33.0%) 3 -Trifluoromethyl-4-nitrophenol

This product contains __ lbs. of TFM per gallon

Batch No. _____ Net Contents ____lbs.

KEEP OUT OF REACH OF CHILDREN

DANGER-POISON

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	• Call a poison control center or doctor immediately for treatment advice • Have person sip a glass of water, if able to swallow • Do not induce vomiting unless told to do so by poison control center or doctor
If on skin or clothing	• Take off contaminated clothing. • Rinse skin immediately, with plenty of water, for 15-20 minutes. • Call a poison control center or doctor immediately for treatment advice.

[LEFT PANEL]

If inhaled	• Move person to fresh air. • If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center or doctor immediately for treatment advice.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor immediately for treatment advice.
Hot Line Number: You may also contact 1-800-858-7378 for health concerns, emergency medical treatment information or pesticide incidents	

SEE LEFT PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-45

EPA Est.______________

[LEFT PANEL]
PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Acute Hazards: Corrosive. Causes irreversible eye damage and skin burns. May be fatal if swallowed. Harmful if absorbed through skin or inhaled.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Avoid breathing vapor. Wear protective clothing as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse. Prolonged or frequent repeated skin contact may cause allergic reactions in some individuals.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:
- Coveralls or rubber apron over long-sleeved shirt and long pants
- Chemical-resistant gloves (such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, or polyvinyl chloride [PVC], Viton)
- Chemical-resistant footwear plus socks
- Protective eyewear (goggles or face shield)

Applicators who apply diluted product must wear:
- Chemical-resistant gloves (such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, or polyvinyl chloride [PVC], Viton)

USER SAFETY REQUIREMENTS:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Non-target organisms may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposal of wastes.

PHYSICAL AND CHEMICAL HAZARDS

Combustible. Do not use and store near open flame.

Not to be used by unauthorized personnel.

[RIGHT PANEL]

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

CATEGORY OF APPLICATOR: Aquatic Pest Control.

USE RESTRICTIONS:

For control of Sea Lamprey Larvae (*Petromyzon marinus*) in the Great Lakes Basin, the Lake Champlain system and the Finger Lakes.

Aerial applications of this product are prohibited.

Local, State, and Provincial Fish and Game Agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Known agricultural irrigators that use streams requiring treatment as a source of irrigation water must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators must turn off their irrigation system for a 24-hour period during and after treatment.

PRETREATMENT DIRECTIONS:

Pretreatment surveys are always made to determine the presence of sea lamprey larvae. All waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes selected for treatment must first be analyzed on site to determine both the minimum concentration of LAMPRECID® required to kill sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. “Analysis” constitutes live animal toxicity tests, or the use of a multiple regression relating toxicity test results to on-site determination of total alkalinity and pH of the body of water.

APPLICATION DIRECTIONS:

When applying this product, do not apply in a way that will cause the concentrated product to contact unprotected workers or other persons, either directly or through drift.

Persons applying LAMPRECID® must follow the Standard Operating Procedures for Application of Lampricides in the Great Lakes Fishery Commission’s Integrated Management of Sea Lamprey Control Program, and ensure that the correct application rates are used. Prior to and during the application of this chemical, take appropriate actions to notify public water users including notification actions specified in this manual.

The concentration of LAMPRECID® needed to kill sea lamprey larvae may vary depending upon water chemistry. Measure volume or flow-rate and add the amount of LAMPRECID® necessary at rates based on the foregoing analysis. Dispense LAMPRECID® by application devices sufficiently accurate to maintain predetermined concentration. Concentration in the body of water must be monitored either by spectrophotometric analysis or high-performance liquid chromatography. LAMPRECID® may be used by itself in the treatment of waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes. At times, however, formulations of Bayluscide (EPA REG. NO. 6704-88) may be used in combination with LAMPRECID® (EPA REG. NO. 6704-45) for control of sea lamprey larvae. Application of Bayluscide may be as a simultaneous addition with LAMPRECID® to reduce the amount of LAMPRECID® required or as a subsequent addition downstream to enhance LAMPRECID® larvicidal activity. Prior to using Bayluscide- LAMPRECID®, pretreatment surveys must be made to determine the presence of larvae. When using Bayluscide in combination with LAMPRECID®, mix in proportions that result in a final

[Front Panel]

RESTRICTED USE PESTICIDE

Due to Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control.

BAYLUSCIDE 3.2% Granular Sea Lamprey Larvicide

Active Ingredient: Niclosamide, Aminoethanol Salt[1] 3.2%
Inert Ingredients: 96.8%
TOTAL: 100.0%
[[1]Niclosamide, Active Equivalent (a.e.) = 2.7%]

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID
Have label with you when obtaining treatment advice.

If swallowed	•Call a poison control center or doctor immediately for treatment advice. •Have person sip a glass of water if able to swallow. •Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes. •Call a poison control center or doctor immediately for treatment advice.
If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. •Call a poison control center or doctor or 1-800-858-7378 immediately for treatment advice.

[Front Panel]

See Left Panel for additional precautionary statements.

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-91

EPA Establishment _____________

Batch No. ___________

Net Contents _____ lbs.

[Left Panel]

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Acute Hazards: Harmful if swallowed. Harmful if absorbed through skin. Causes moderate eye irritation.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Wear protective clothing as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as rubber or made out of any water-proof material, Selection Category A)
- Socks and shoes

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside, then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

[Left Panel]

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget aquatic organisms may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to nontarget organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

[Right Panel]

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL

Read the entire label and Technical Operating Procedures of the Sea Lamprey Control Document No. SLC-92-001 [Manual for Application of Lampricides in the U.S. Fish and Wildlife Service Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with the label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

GENERAL INFORMATION

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget aquatic species are potentially vulnerable to Bayluscide, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS

Use Pattern:

Bayluscide 3.2% Granular Sea Lamprey Larvicide is used in waters of the Great Lakes basin, the Lake Champlain system, and the Finger Lakes. This formulation may be used alone or in conjunction with applications of TFM, or the combination of TFM and Bayluscide 70% Wettable Powder Sea Lamprey Larvicide. Bayluscide 3.2% Granular Sea Lamprey Larvicide may also be used as an assessment tool in deep or turbid water. When applied to a water's surface, the granules fall rapidly to the bottom where they are lethal to sea lamprey larvae.

Pre-application Notification:

Prior to and during the application of this chemical, take all appropriate actions to notify public water users, including notification actions specified in the application manual referred to above.

Permits:

Obtain any permits needed from Local, State, Provincial, and Federal wildlife agencies.

[Right Panel]

Potable Water:

Local, State, and Provincial Fish and Game agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators that use streams requiring treatment as a source of irrigation water must turn off their irrigation systems for a 24-hour period during and after treatment.

Unauthorized Personnel:

May not be used by unauthorized personnel.

PRE-APPLICATION DIRECTIONS

Aerial Application:

Aerial application of this product is prohibited.

Pretreatment Surveys:

Prior to using Bayluscide 3.2% Granular Sea Lamprey Larvicide, pretreatment surveys must be made to determine populations of larvae.

APPLICATION DIRECTIONS

Persons applying Bayluscide 3.2% Granular Sea Lamprey Larvicide must follow Sea Lamprey Control Document No. SLC-92-001, "Standard Operating Procedure for Application of Lampricides in the Great Lakes Fishery Commission's Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program," and ensure that the correct application rates are used. Prior to and during the application of this chemical, take appropriate actions to notify public water users, including notification actions specified in this manual. Determine water temperatures and pH. For best results, apply granules at water temperatures greater than 10 °C and pH greater than 7. Measure the area to be treated (length x width, in feet). Place markers to delineate the plot perimeter. Compute the total surface area to be treated in square feet. Application rate for Bayluscide 3.2% Granular Sea Lamprey Larvicide is 5 lb. AI/Acre. Compute the weight of granules to apply: ***lbs. of formulation required = square feet to be treated x .00359 lbs. formulation/sq. foot***. Use equipment that can be accurately calibrated to distribute the required amount of Bayluscide 3.2% Granular Sea Lamprey Larvicide evenly over the area to be treated.

[Right Panel]

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage and disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals and where spills and leakage can be contained.

SPILLS: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed below. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows:
Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Offer for recycling if available or puncture and dispose in sanitary landfill, or by other procedures approved by state and local authorities. If rinsate cannot be used, follow pesticide disposal instructions. If not triple rinsed, these containers are acute hazardous wastes and must be disposed in accordance with local, state and federal regulations.

concentration of Bayluscide of not more than 2% of LAMPRECID® by weight (based on active ingredient). Bayluscide may be added to LAMPRECID® in two ways:

1. One method of application is to apply both lampricides at the primary application site. LAMPRECID® is metered into the stream while Bayluscide is applied with a separate pump system in amounts calculated to deliver the desired ratio of Bayluscide to LAMPRECID®. Bayluscide is applied separately to provide a uniform application and to enhance control of concentration.

2. A second application method is to apply Bayluscide into an existing LAMPRECID® block. Because a LAMPRECID® block can be diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates are calculated, the toxicity of the block in the stream must be raised by the addition of LAMPRECID® or Bayluscide. The latter may be used in place of LAMPRECID®. In these situations, LAMPRECID® alone is pumped into the stream at the primary application site. Bayluscide is introduced into the LAMPRECID® block at a point or points downstream in amounts calculated to produce the desired Bayluscide to TFM ratio.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets and domestic animals.

SPILLS: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed below. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Offer for recycling if available or puncture and dispose in sanitary landfill, or by other procedures approved by state and local authorities. If rinsate cannot be used, follow pesticide disposal instructions. If not triple rinsed, these containers are acute hazardous wastes and must be disposed in accordance with local, state and federal regulations.

FRONT PANEL

RESTRICTED USE PESTICIDE

Due to Eye Corrosiveness to Humans; Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control.

BAYLUSCIDE 20% EMULSIFIABLE CONCENTRATE

Active Ingredient:
Niclosamide, Aminoethanol Salt[1]…………………………………………..20.3%
Inert Ingredients:……………………..…………………………………79.7%
Total…………………………………………………..100.0%
[1]Niclosamide, Active Equivalent (a.e.) = 17.1%

KEEP OUT OF REACH OF CHILDREN

DANGER

Corrosive to the Eye and Skin Sensitizer

FIRST AID

Have label with you when obtaining treatment advice.

If swallowed	•Call a poison control center or doctor immediately for treatment advice. •Have person sip a glass of water if able to swallow. •Do not induce vomiting unless told to do so by the poison control center or doctor.
If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes. •Call a poison control center or doctor immediately for treatment advice.
If inhaled	•Move person to fresh air. •If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. •Call a poison control center or doctor immediately for treatment advice.

FRONT PANEL

If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. •Call a poison control center or doctor immediately for treatment advice.
NOTE TO PHYSICIAN Probable mucosal damage may contraindicate the use of gastric lavage. No specific antidote is available. Treat symptomatically. See additional PRECAUTIONARY STATEMENTS on Left/Right/Side Panel.	
Hot Line Number: You may also contact 1-800-856-7378 for health concerns or emergency medical treatment information of pesticide incidents.	

EPA Reg. No. 6704-92

EPA Est.______

Manufactured by:

Manufactured for:

Fish and Wildlife Service
United States Department of the Interior
18th and C Streets, NW
Washington, DC 20240

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Acute Hazards: Corrosive. Causes irreversible eye damage. Harmful if absorbed through skin. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Wear protective clothing and protective eyewear as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves [such as barrier laminate, butyl rubber, nitrite rubber, neoprene rubber, or polyvinyl chloride (PVC), Viton]
- Socks and shoes
- Protective eyewear (goggles or face shield)

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining Personal Protective Equipment (PPE). If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget organisms (such as freshwater clams and mussels) may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

PERMITS

Obtain any permits needed from local, State, Provincial, and Federal wildlife authorities.

POTABLE WATER

At least 24 hours prior to application, notify municipalities and known agricultural irrigators that potable and irrigation water will be treated. Known agricultural irrigators must turn off their irrigation systems for a 24-hour period during and after treatment.

UNAUTHORIZED PERSONNEL

May not be used by unauthorized personnel.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL:

Read the entire label and Sea Lamprey Control Document No. SLC-92-001 [Manual for Application of Lampricides in the U.S. Fish and Wildlife Service Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with both label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

Before using this product, obtain all necessary permits.

GENERAL INFORMATION:

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget species are potentially vulnerable to Bayluscide, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS:

Use Pattern:

Baylusicide 20% Emulsifiable Concentrate may be used as an additive in combination with TFM (EPA Reg. No. 6704-45) for control of sea lamprey (*Petromyzon marinus*) in waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes. Application of Bayluscide 20% Emulsifiable Concentrate may be made as a simultaneous addition with TFM to reduce the amount of TFM required or as a subsequent addition downstream to enhance TFM larvicidal activity.

Pre-Application Notification:

Prior to and during the application of this chemical, take all appropriate actions to notify public water users including notification actions specified in the application manual referred to above.

Aerial Application:

Aerial application of this product is prohibited.

Pretreatment Surveys:

Prior to using Bayluscide 20% Emulsifiable Concentrate-TFM, pretreatment surveys must be made to determine populations of larvae. All waters selected for treatment must first be analyzed on site to determine both the minimum concentration of material required to kill lamprey larvae and the maximum concentration that can be applied without causing undue fish mortality. "Analysis" constitutes live animal toxicity tests or the use of a regression established by past toxicity tests and the total alkalinity and pH of the water.

Lethal Concentration:

Lethal concentration may vary depending upon water chemistry and temperature. Carefully calculate stream discharge and add the amount of lampricide necessary to kill lamprey larvae with minimal fish mortality. Use application devices that accurately deliver Bayluscide at calculated rates. Bayluscide concentrations will be monitored by gas chromatography or by high-performance liquid chromatography to insure that minimum lethal concentrations for sea lampreys are maintained and calculated maximum concentrations are not exceeded.

Application Directions:

Prior to and during the application of this chemical, take appropriate actions to notify public water users including notification actions specified in the Sea Lamprey Control Document No. SLC-92-001. When using Bayluscide 20% Emulsifiable Concentrate as an additive in combination with TFM, mix in proportions that result in a final concentration of Bayluscide 20% Emulsifiable Concentrate of not more than 2% of TFM by weight (based on active ingredient). Bayluscide 20% Emulsifiable Concentrate may be added to TFM in two ways:

1. One method of application is to apply both lampricides at the primary application site. TFM is metered into the stream while Bayluscide 20% Emulsifiable Concentrate is applied with a separate pump system in amounts calculated to deliver the desired ratio of Bayluscide to TFM.

2. A second application method is to apply Bayluscide 20% Emulsifiable Concentrate into an existing TFM bank. Because a TFM bank can be diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates are calculated, the toxicity of the bank in the stream must be raised by the addition of TFM or Bayluscide. The latter may be used in place of TFM. In these situations, TFM alone is pumped into the stream at the primary application site. Bayluscide 20% Emulsifiable Concentrate is introduced into the TFM bank at a point or points downstream in amounts calculated to produce the desired Bayluscide to TFM ratio.

RIGHT PANEL

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals.

SPILLS: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed below. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows:
Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Offer for recycling if available or puncture and dispose in sanitary landfill, or by other procedures approved by state and local authorities. If rinsate cannot be used, follow pesticide disposal instructions. If not triple rinsed, these containers are acute hazardous wastes and must be disposed in accordance with local, state and federal regulations.

FRONT PANEL

A Pesticide for Formulation only into a Lampricide for Use in Tributaries to the Great Lakes, Lake Champlain or the Finger Lakes or into a Molluscicide for Use Against Fresh Water Snails

BAYLUSCIDE TECHNICAL

Active Ingredient:
Niclosamide, Aminoethanol Salt[1] 98.4%
Inert Ingredients: 1.6%
TOTAL: 100.0%

[1]Niclosamide, Active Equivalent (a.e.) = 83.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID

Have label with you when obtaining treatment advice.

If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes. •Call a poison control center, doctor or 1-800-858-7378 immediately for treatment advice.
If inhaled	•Move person to fresh air. •If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. •Call a poison control center or doctor immediately for treatment advice.
If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. •Call a poison control center or doctor immediately for treatment advice.

See Left Panel for additional precautionary statements.

FRONT PANEL (continued)

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-88

EPA Establishment No. ___________

Batch No. ____________

Net Contents _____ lbs.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Acute Hazards: Harmful if absorbed through skin or inhaled. Causes moderate eye irritation.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Avoid breathing dust. Wear protective clothing as listed under "Personal Protective Equipment." Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as rubber or made out of any water-proof material)
- Socks and shoes

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Do not discharge effluent containing this product into lakes, streams, pond estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your state Water Board or Regional Office of the EPA.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

A Pesticide for Formulation only into a Lampricide for Use in Tributaries to the Great Lakes, Lake Champlain or the Finger Lakes or into a Molluscicide for Use Against Fresh Water Snails

Not to be used by unauthorized personnel.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals and where spills and leakage can be contained. Spills: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed below. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, rinsate of the manufacturing equipment, containers, and spilled wastes, is a violation of Federal law. If these wastes cannot be discharged under an NPDES permit (See "Environmental Hazards"), properly secure wastes (e.g., in drum tanks) and contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container. Completely empty liner by shaking and tapping sides and bottom to loosen clinging particles. Empty residue into manufacturing equipment. Then offer for recycling if available or dispose of in a sanitary landfill or by incineration. If drum is contaminated and cannot be reused dispose of it in the manner required for its liner.

[Front Panel]

RESTRICTED USE PESTICIDE

Due to Aquatic Organism Toxicity, Need for Specialized Equipment and Highly Specialized Applicator Training.

For retail sale to, and use only by, USDI, FWS, State Fish and Game, Fisheries and Oceans Canada, and Provincial Certified Applicators trained in sea lamprey control or persons under their direct supervision.

BAYLUSCIDE 70% WETTABLE POWDER-SEA LAMPREY LARVICIDE

Active Ingredient:	
Niclosamide, Aminoethanol Salt[1]	70.0%
Inert Ingredients:	30.0%
TOTAL:	100.0%

[1]Niclosamide, Active Equivalent (a.e.) = 59.0%

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID

Have label with you when obtaining treatment advice.

If on skin or clothing	•Take off contaminated clothing. •Rinse skin immediately with plenty of water for 15-20 minutes. •Call a poison control center, doctor or 1-800-858-7378 immediately for treatment advice.
If inhaled	•Move person to fresh air. •If person is not breathing, call an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. •Call a poison control center or doctor immediately for treatment advice.

If in eyes	•Hold eye open and rinse slowly and gently with water for 15-20 minutes. •Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. •Call a poison control center or doctor immediately for treatment advice.

See Left Panel for additional precautionary statements.

Manufactured For:

Fish and Wildlife Service
United States Department of Interior
18th and C Streets, NW
Washington, DC 20240

EPA Reg. No. 6704-87

EPA Est. ________________

Batch No. ___________

Net Contents _____ lbs.

[Left Panel]

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION
Acute Hazards: Harmful if absorbed through skin or inhaled. Causes moderate eye irritation.

Hazard Avoidance: Do not get in eyes, on skin, or on clothing. Avoid breathing dust. Wear protective clothing as listed under "Personal Protective Equipment". Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

PERSONAL PROTECTIVE EQUIPMENT:

Handlers must wear:

- Long-sleeved shirt and long pants
- Chemical-resistant gloves (such as rubber or made out of any water-proof material)
- Socks and shoes

User Safety Requirements:

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions are provided for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

Users should remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

This chemical is toxic to fish and aquatic invertebrates. Nontarget organisms (such as freshwater clams and mussels) may be killed at rates recommended on this label. Directions for use must be strictly followed to minimize hazards to non-target organisms. **Do not** contaminate water by the cleaning of equipment or disposing of equipment washwaters.

[Right Panel]

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ THIS LABEL:

Read the entire label and Sea Lamprey Control Document No. SLC-92-001 [Standard Operating Procedures for Application of Lampricides in the Great Lakes Fishery Commission Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program] for correct rates of application. This product must be used strictly in accordance with both label's precautionary statements and applicable use directions, as well as with all applicable State and Federal laws and regulations.

Before using this product, obtain all necessary permits.

GENERAL INFORMATION:

This product contains a fast-acting fish toxicant which kills sea lamprey larvae in 1-2 hours. The mode of action is uncoupling of oxidative phosphorylation. As many types of nontarget species are potentially vulnerable to Bayluscide, it is necessary to use care and to follow the requirements of this label to minimize impacts.

USE RESTRICTIONS:

<u>Use Pattern:</u>

Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide may be used as an additive in combination with TFM (EPA Reg. No. 6704-45) for control of sea lamprey (*Petromyzon marinus*) in waters in the Great Lakes Basin, the Lake Champlain system, and the Finger Lakes. Application of Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide may be made as a simultaneous addition with TFM to reduce the amount of TFM required or as a subsequent addition downstream to enhance TFM larvicidal activity.

<u>Pre-Application Notification:</u>

Prior to and during the application of this chemical, take all appropriate actions to notify public water users including notification actions specified in the application manual referred to above.

<u>Aerial Application:</u>

Aerial application of this product is prohibited.

Pretreatment Surveys:

Prior to using Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide-TFM, pretreatment surveys must be made to determine populations of larvae. All waters selected for treatment must first be analyzed on site to determine both the minimum concentration of material required to kill lamprey larvae and the maximum concentration that can be applied without causing undue fish mortality. "Analysis" constitutes live animal toxicity tests or the use of a regression established by past toxicity tests and the total alkalinity and pH of the water.

Lethal Concentration:

Lethal concentration may vary depending upon water chemistry and temperature. Carefully calculate stream discharge and add the amount of lampricide necessary to kill lamprey larvae with minimal fish mortality. Use application devices that accurately deliver Bayluscide at calculated rates. Bayluscide concentrations will be monitored by high-performance liquid chromatography to insure that minimum lethal concentrations for sea lampreys are maintained and calculated maximum concentrations are not exceeded.

Application Directions:

Prior to and during the application of this chemical, take appropriate actions to notify public water users including notification actions specified in the Sea Lamprey Control Document No. SLC-92-001. When using Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide as an additive in combination with TFM, mix in proportions that result in a final concentration of Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide of not more than 2% of TFM by weight (based on active ingredient). Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide may be added to TFM in two ways:

1. One method of application is to apply both lampricides at the primary application site. TFM is metered into the stream while Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide is applied with a separate pump system in amounts calculated to deliver the desired ratio of Bayluscide to TFM.

2. A second application method is to apply Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide into an existing TFM bank. Because a TFM bank can be diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates are calculated, the toxicity of the bank in the stream must be raised by the addition of TFM or Bayluscide. The latter may be used in place of TFM. In these situations, TFM alone is pumped into the stream at the primary application site. Bayluscide 70% Wettable Powder-Sea Lamprey Larvicide is introduced into the TFM bank at a point or points downstream in amounts calculated to produce the desired Bayluscide to TFM ratio.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage and disposal.

STORAGE: Store only in original container, in a dry place inaccessible to children, pets, and domestic animals and where spills and leakage can be contained.

SPILLS: Handle and open container in a manner that will prevent spillage. If the container is leaking or material is spilled for any reason or cause, contain spill with a barrier of absorbent material. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed below.
In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 1-800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spilled bait, or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

CONTAINER DISPOSAL: Nonrefillable container. Do not reuse or refill this container.
Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows:
Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Offer for recycling if available or puncture and dispose in sanitary landfill, or by other procedures approved by state and local authorities. If rinsate cannot be used, follow pesticide disposal instructions. If not triple rinsed, these containers are acute hazardous wastes and must be disposed in accordance with local, state and federal regulations.

New York State Department of Environmental Conservation

Division of Fish, Wildlife and Marine Resources, Region 5

Route 86 – P.O. Box 296, Ray Brook, New York 12977

Phone: (518) 897-1333 · **FAX:** (518) 897-1347

Website: www.dec.state.ny.us

MEMORANDUM

To: Ray Brown, Webb Pearsall
From: W. Schoch
Subject: Transporting TFM, Bayluscide and Rotenone.
Date: October 9, 2003

Concern was raised recently that a hazardous materials certification on our drivers licenses may be required to transport TFM. I contacted Bill Bollinger from the Department of Transportation [phone: (518) 424-2015] to determine whether such certification is required. For TFM and rotenone, neither certification nor placarding are required to transport quantities up to 1000 pounds; certification and placarding are required for quantities greater than 1000 pounds (the placarding requirement now applies to government agencies). The 1000 pound threshold is gross weight (product plus container). Placarding and certification are not required for the granular formulation of Bayluscide.

The MSDS for the liquid formulations of TFM and rotenone state that they are "Class 6.1" (see Transportation Data or Transportation Information on the MSDS). Mr. Bollinger reports that Class 6.1 materials that are also classified as "Inhalation Hazard Zone A or B" require placarding and certification to transport any quantity. He also stated that Inhalation Hazard Zone A or B requires a placard that states "Inhalation" in addition to "Poison." Mr. Bollinger further stated that for Class 6.1 materials that are <u>not</u> also classified as Inhalation Hazard Zone A or B, quantities up to and including 1000 pounds can be transported without placarding and without the hazardous materials certification. Certification and placarding are required for quantities greater than 1000 pounds.

The TFM cans state that the appropriate placard is number 3013. Placard 3013 states "Poison" and does not state "Inhalation." Therefore, we can transport up to 1000 pounds of the formulation without placards or certification. (Note that the MSDS for TFM does not list the Hazard Classes, and Mr. Bollinger was not surprised by that. He had no problem with using the required placard as the indicator that TFM does not have the "Inhalation" classification. In explaining the various requirements to me, a few times he referred to "depending on the placard.")

The MSDS for the liquid rotenone formulation states: “DOT Shipping Label: Poison and/or Toxic” (see “Section 14. Transport Information” in the AgrEvo Noxfish MSDS dated 7/28/98). Thus, as for TFM, the Inhalation hazard classification does not apply to the liquid rotenone formulation.

The MSDS for granular Bayluscide states: “DOT Hazard Description: Not regulated as a hazardous material.” Therefore, neither placarding nor certification are issues regardless of the quantity being transported.

Mr. Bollinger stated that the pertinent regulations are found in the Federal Code: CFR Title 49, Parts 100 to 185. Part 172.101 includes Tables A and B; the former specifies that Class 6.1 with the Inhalation hazard classification has no minimum quantity, and the latter specifies the 1000 pound threshold for Class 6.1 without the Inhalation hazard classification. Details on the placarding requirements are in Part 172.500. Note that a CDL license is required to obtain the hazardous material certification.

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Regional Fisheries Manager

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Water Use Advisory Zone Monitoring Plan for Lampricide Treatments of the Poultney/Hubbardton River, Lewis Creek, LaPlatte River, Winooski River, Lamoille River, Stone Bridge Brook, and the Missisquoi River.

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June, 2019

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 Vermont. First, 3-trifluoromethyl 4-nitrophenol (TFM) is used in liquid (TFM-HP) 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, Niclosamide is used in liquid (Bayluscide 20% Emulsifiable Concentrate) formulation. 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 weigh of TFM, Niclosamide can reduce the amount of TFM needed by up to 40 percent.

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

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

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* 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)

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, the public is advised to alter water use within the advisory zone to avoid exposure to lampricides. 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 domestic water use advisory threshold, which is also applied to swimming and agricultural water uses, including irrigation and livestock watering, is set at 100 ppb by the State of Vermont (VTDOH 2019). VT also currently uses 100 ppb as their advisory threshold for other recreational water uses. Once monitoring is initiated, low-level monitoring stations are generally sampled daily until TFM concentrations at all stations fall below 100 ppb.

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), (Smith 2013). 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 Lake Champlain prior to the beginning of the treatment for use in calibrating the analysis equipment and determining background conditions.

Water samples 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 and 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 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 PR4N, then the stations north of Station PR4N would not require analysis.
3. On the first day that all stations are found to have concentrations less than 100 ppb, the recreational water use advisory and the domestic water use advisory can be lifted, following the 24-hour waiting period.

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 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 within the advisory zone are spaced at approximately 1.0 km intervals unless otherwise noted. Sampling station names are determined by distance moving away from the mouth in either direction.

Poultney/Hubbardton rivers

Three water use advisory zones are established for the Poultney/Hubbardton rivers. Zone 1 includes the rivers from application points, downstream to Station 00, the confluence of the Poultney River and the outlet of South Bay. Zones 2 and 3 extend northward and include the lakeshore areas for a distance of 24.6 Km (15.3 mi) to Chipman Point. Zone 2 extends from the confluence to The Narrows and includes Stations 00 through 9.0N; and Zone 3 continuing north from The Narrows to Chipman Point including Stations 12.0N through 24.0N (Figure 10). All lake sampling stations are at 3.0 km intervals northward from outlet of South Bay.

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 24 hours after treatment initiation. Low-level monitoring in Zones 1 and 2 will begin three days after treatment is initiated. Station 00 will be sampled for low-level monitoring of Zone 1 (Figure 10). Zone 3 water use advisories will go into effect no later than 24 hours after TFM is detected at Station 6.0N (Figure 10), and low-level monitoring in Zone 3 will begin at the same time. Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than State-specific advisory thresholds.

Lewis Creek

Two water use advisory zones are established for Lewis Creek. Zone 1 includes the treated portion of Lewis Creek and Zone 2 includes the surrounding lakeshore within 1.6 Km (1.0 mi) north and 2.0 Km (1.2 mi) south of the mouth of Lewis Creek (Figure 2).

Water use advisories in Zone 1 will go into effect at the time the lampricide treatment begins. Advisories in Zone 2 will go into effect at the time of treatment initiation when treating from Ferrisburg Falls, or 24 hours after treatment initiation when treating from Scott's Pond Dam. Stream monitoring Station 9 (Figure 2) will be sampled for low-level monitoring of Zone 1, beginning two days after the treatment is initiated. Low-level monitoring in Zone 2 will begin three days after initiation of treatment. Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than State-specific advisory thresholds.

LaPlatte River

Two water use advisory zones are established for the LaPlatte River. Zone 1 includes the river from the application point downstream to the 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 2.5 km (1.5 mi) to a West-East arc across the Bay from Sled Runner Point (Figure 3). Initial sampling stations are spaced at 0.5 km intervals out to 1.5 km from the mouth. The final sampling stations are located 2.5 km from the mouth.

Water use advisories will go into effect in Zone 1 and Zone 2 at the time the lampricide treatment begins. Low-level monitoring will begin based on results of Lampricide analysis at Stations 3 and 4 in the lower River. Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than State-specific advisory thresholds.

The Champlain Water District's (CWD) water intake is located approximately 4.5 km (2.7 mi) north of the LaPlatte River mouth (Figure 15) 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 (Binkert 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 temporarily operated during the 2016 treatment. PAC will remove TFM (if present) and other organic chemicals from the CWD water supply (Dawson, et al. 1976). Thus, in the extremely unlikely event that low levels of TFM extend to the intake, users of the municipal water system will not be exposed. The PAC system 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 two weeks prior to any lampricide treatment of the LaPlatte River, the treatment supervisor will notify the CWD of the planned treatment date so that the PAC filtration system can be tested and determined operational. One set of raw and finished water samples will be collected at CWD before the day of treatment and used to produce site-specific standards against which treatment samples can be measured. The CWD will be advised as to when the treatment will occur should they wish to operate the PAC system. On the morning of treatment, the treatment supervisor (or designee) will notify the CWD to confirm that the treatment has or has not begun. CWD will be kept informed of any delays and rescheduling of the treatment. CWD will be provided with results of all-low level sampling.

Low-level monitoring samples will be analyzed as soon as possible after collection and results will be reported to CWD daily after the analyses are completed. Low-level monitoring of the CWD intake will be conducted if results show TFM concentrations in excess of 50 ppb at sampling station LP2.5C. If/when sampling begins at CWD, one set of raw and finished water samples will be collected once each day in the morning. Each raw water sample will be analyzed within 2 hours of collection and the results will be reported to the CWD 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.

If monitoring finds a TFM concentration of 100 ppb or greater at the northernmost lake sampling station LP2.5C shown in Figure 13, then the following day's sampling frequency at the CWD intake will increase to twice per day at 12-hour intervals for the remainder of the monitoring period and lake sampling will begin at supplemental station LP3.5C. Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than DOH thresholds.

Winooski River

Two water use advisory zones are established for this treatment based on dye study and plume modeling results (Laible and Fedele 2004) and actual low level monitoring results from four TFM treatments. Zone 1, the upper river advisory zone, includes that portion of the Winooski River from the Winooski One Hydroelectric Facility (lampricide application point) downstream to the Rt. 127 Bridge. Zone 2, includes the lower river and surrounding lakeshore for approximately 3.75 km (2.25 mi) miles south of the Winooski River mouth to Appletree Point and approximately 3.75 km (2.25 mi) miles north of the mouth to Colchester Point (Figure 4).

Water use advisories in Zone 1 will go into effect at the time the lampricide treatment begins, and advisories in Zone 2 will go into effect 18 hours after treatment initiation.
Dividing the two zones at the Route 127 Bridge facilitates reducing the amount of time that river water users will be inconvenienced by the restrictions, since the TFM block will clear the upper portion of the river much faster than in the lower river and lakeshore areas. Winooski River Station 5 (Figure 13) will be sampled for low-level monitoring of Zone 1, beginning two days after the treatment is initiated. Low-level monitoring in Zone 2 will begin no later than three days after initiation of treatment.

The City of Burlington's municipal water intake is located approximately 3.3 km (2.0 mi) southeast of the southern lakeshore advisory zone boundary (Figure 4) at a bottom depth of 50 feet (intake opening is 10 feet off the bottom). The lampricide transport model predicted that TFM concentrations greater than 20ppb will not reach the vicinity of this intake (Laible and Fedele 2004). As an extra precaution, a powdered activated carbon (PAC) filtration system, developed by the Vermont Department of Environmental Conservation's Drinking Water and Groundwater Protection Division, was installed and temporarily operated at the Burlington Water Treatment Facility (BWTF) during the 2004, 2008, 2012, and 2015 treatments. PAC will remove TFM (if present) and other organic chemicals from the Burlington water supply (Dawson, et al. 1976). Thus, in the extremely unlikely event that low levels of TFM extend to the intake, users of the municipal water supply will not be exposed. The PAC system may be operated in a similar manner in conjunction with all future Winooski River treatments, following guidance from the Drinking Water and Groundwater Protection Division.

No less than two weeks prior to any lampricide treatment of the Winooski River, the treatment supervisor will notify the BWTF of the planned treatment date so that the PAC filtration system can be tested and determined operational. One set of raw and finished water samples will be collected at the BWTF before the day of treatment and used to produce site-specific standards against which treatment samples can be measured. The BWTF will be advised as to when the treatment will occur should they wish to operate the PAC system. On the morning of treatment, the treatment supervisor (or designee) will notify the BWTF to confirm that the treatment has or has not begun. The BWTF will be kept informed of any delays and rescheduling of the treatment. The BWTF will be provided with results of all-low level sampling.

Low-level monitoring samples will be analyzed as soon as possible after collection and results will be reported to the Burlington WTF daily after the analyses are completed. Low-level monitoring of the Burlington intake will be conducted if results show TFM concentrations in excess of 50 ppb at sampling station WR4S. If/when sampling begins, one set of raw and finished water samples will be collected once each day in the morning. Each raw water sample will be analyzed within 2 hours of collection and the 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.

If monitoring finds a TFM concentration of 100 ppb or greater at the southernmost lake sampling station WR4S shown in Figure 13, then the following day's sampling frequency at the Burlington intake will increase to twice per day at 12-hour intervals for the remainder of the monitoring period and lake sampling will begin at supplemental stations WR5S-WR6S. If the analyzed TFM concentration in any water sample collected at WR6S is 100 ppb or greater, then an additional station located between Lone Rock Point and the City of Burlington's municipal water intake will be sampled on the following day and continued once daily for the remainder of the monitoring period. Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than DOH thresholds.

Lamoille River

Two water use advisory zones are established for the Lamoille River treatment based on the plume transport modeling results (Binkerd 2009) and actual low-level monitoring following two TFM treatments. Zone 1 includes the river downstream of Peterson Dam (lampricide application point) and Zone 2 includes the lakeshore area extending to the west of the North Mouth for approximately 6.0 km (3.6 mi) to Robinson Point and to the south and east of the South Mouth for approximately 2.0 km (1.2 mi) to Clay Point (Figure 16). Lake monitoring stations in Zone 2 are located at 1.0 km intervals along the shorelines from the mouths (Figure 5).

Water use advisories in Zone 1, will go into effect at the time the lampricide treatment begins and be lifted 24 hours after sampling at the mouth(s) indicate TFM concentration is below DOH advisory thresholds. Advisories in Zone 2 will go into effect no later than 18 hours after treatment initiation and be lifted 24 hours after all lake samples are less than the DOH advisory threshold. Low-level monitoring in Zone 2 will begin three days after initiation of treatment. Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than DOH thresholds.

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 km (0.3mi) radius of the mouth of Stone Bridge Brook (Figure 6).

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 also go into effect at the time of treatment initiation and will be lifted 24 hours after all sampling sites indicate concentrations have fallen below DOH thresholds.

Missisquoi River

Three water use advisory zones are established for the Missisquoi River treatment based on the 2008 and 2012 treatments and plume transport modeling results (Sabbayya et al. 2008); two in the river and one in Missisquoi Bay (Figure 7). These zones encompass the waters where the modeling results indicate the potential for TFM concentrations to temporarily exceed the water use advisory threshold concentrations. Advisory Zone 1 includes the upper part of the Missisquoi River from the application point (AP) at the Swanton dam downstream to the Missisquoi River main stem-Dead Creek fork. Advisory Zone 2 includes the Dead Creek fork to its mouth and the main stem downstream of the fork to its mouth, as well as the southeastern portion of Missisquoi Bay within the Town of Highgate up to the US-Canada border. Advisory Zone 3 includes the remaining affected shorelines of Missisquoi Bay, the eastern shoreline of the bay from the US-Canada border north approximately 7 km (4.2 mi) to the Pike River, and the Town of Swanton shoreline extending south and west from the West Branch mouth approximately 6 km (3.6 mi) to the opening of the West Swanton Bridge.
Zones are established to minimize the length of advisory to the extent possible for all affected landowners and the public.

Water use advisories in Zones 1 and 2 will go into effect at the time the lampricide treatment begins. The Zone 3 advisory will go into effect 24 hours after treatment initiation. Advisories will be lifted in each advisory zone 24 hours after TFM concentrations at all sampling stations in that zone fall below the advisory threshold levels.

The municipal water system for the towns of Philipsburg and Bedford, Quebec is supplied by an intake in Missisquoi Bay at Philipsburg, about 7.6 km (4.7 mi) from the mouth of Dead Creek and 5.6 km (3.5 mi) from the mouth of the Missisquoi River main stem. The plant is equipped with a Powder Activated Charcoal (PAC) filtration system to remove organic chemicals including TFM. Raw and finished water samples will be collected from the plant for background establishment prior to TFM-treated river water entering Missisquoi Bay.

During the course of the low-level TFM monitoring in Missisquoi Bay, if detectable quantities (>1.0 ppb) of TFM are found within 1 kilometer (0.6 mi) of the Philipsburg intake, additional sampling will begin the following day using raw and finished water from within the filtration facility. If TFM is detected in a raw water sample, then its corresponding finished water sample will be analyzed. This monitoring procedure will then continue until TFM is no longer detected in the raw water. We will be in close contact with the Phillipsburg water system operator during the treatment and we will develop a protocol prior to the treatment that describes how and when samples are to be taken at the facility and how they are to be transferred to technicians who will collect them.

Low-level monitoring in the lake advisory zones (2, 3) will begin no later than three days after initiation of treatment. The lake monitoring stations are spaced at 1.0 km (0.6 mi) intervals enveloping the advisory area (Figure 7). Advisories will be lifted 24 hours after sampling indicates TFM concentrations at all sampling stations in the advisory zone are less than advisory thresholds.

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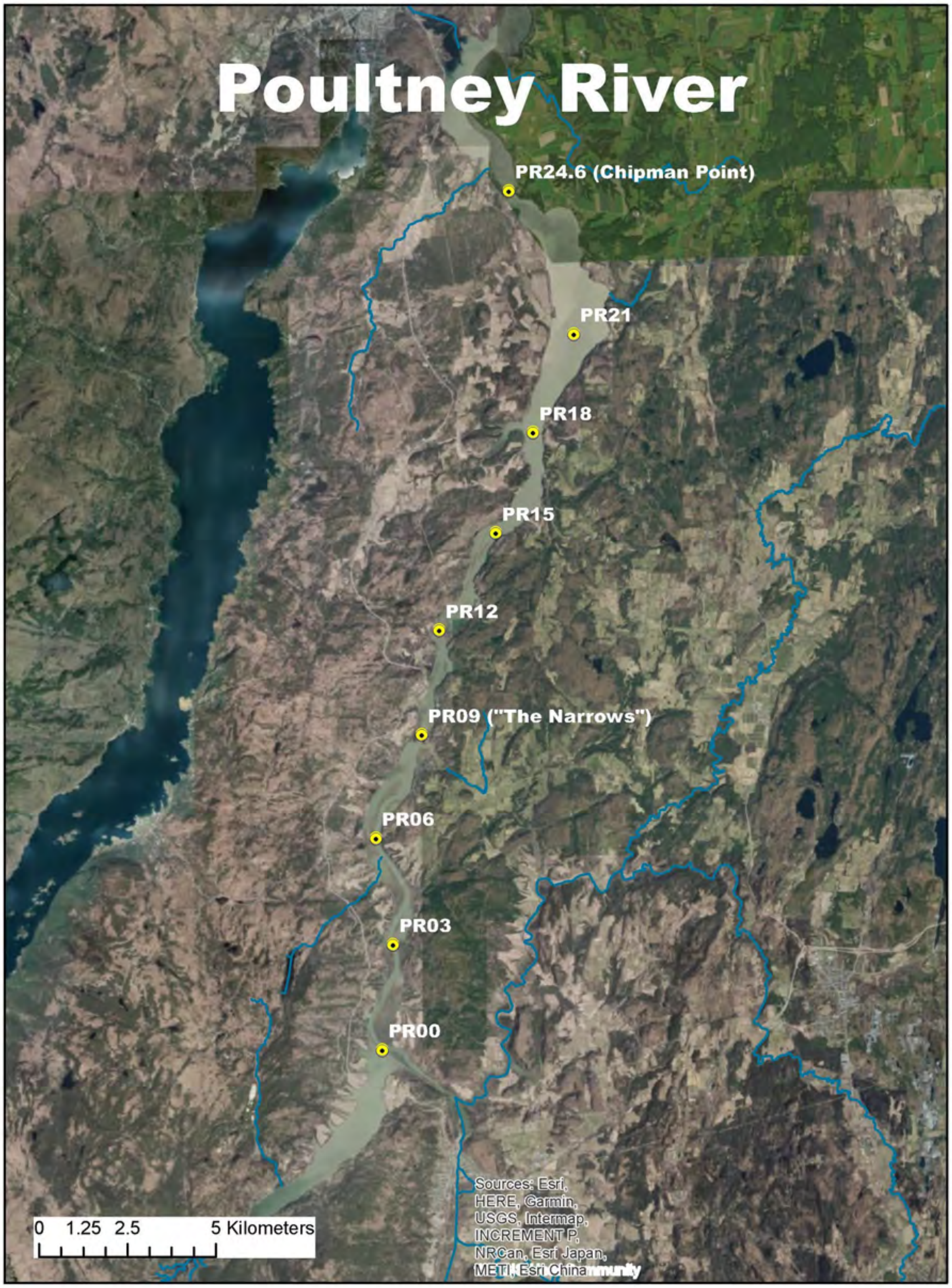

Figure 1. Lakeshore water use advisory zone and TFM monitoring stations associated with the Poultney/Hubbardton River lampricide treatment.

Figure 2. Water use advisory zone and TFM monitoring stations associated with the Lewis Creek lampricide treatment.

Figure 3. Water use advisory zones and TFM monitoring stations associated with the LaPlatte River lampricide treatment.

Figure 4. Water use advisory zone and TFM monitoring stations associated with the Winooski River lampricide treatment.

Figure 5. Water use advisory zone and TFM monitoring stations associated with the Lamoille River lampricide treatment.

Figure 6. Water use advisory zone and TFM monitoring stations associated with the Stone Bridge Brook lampricide treatment.

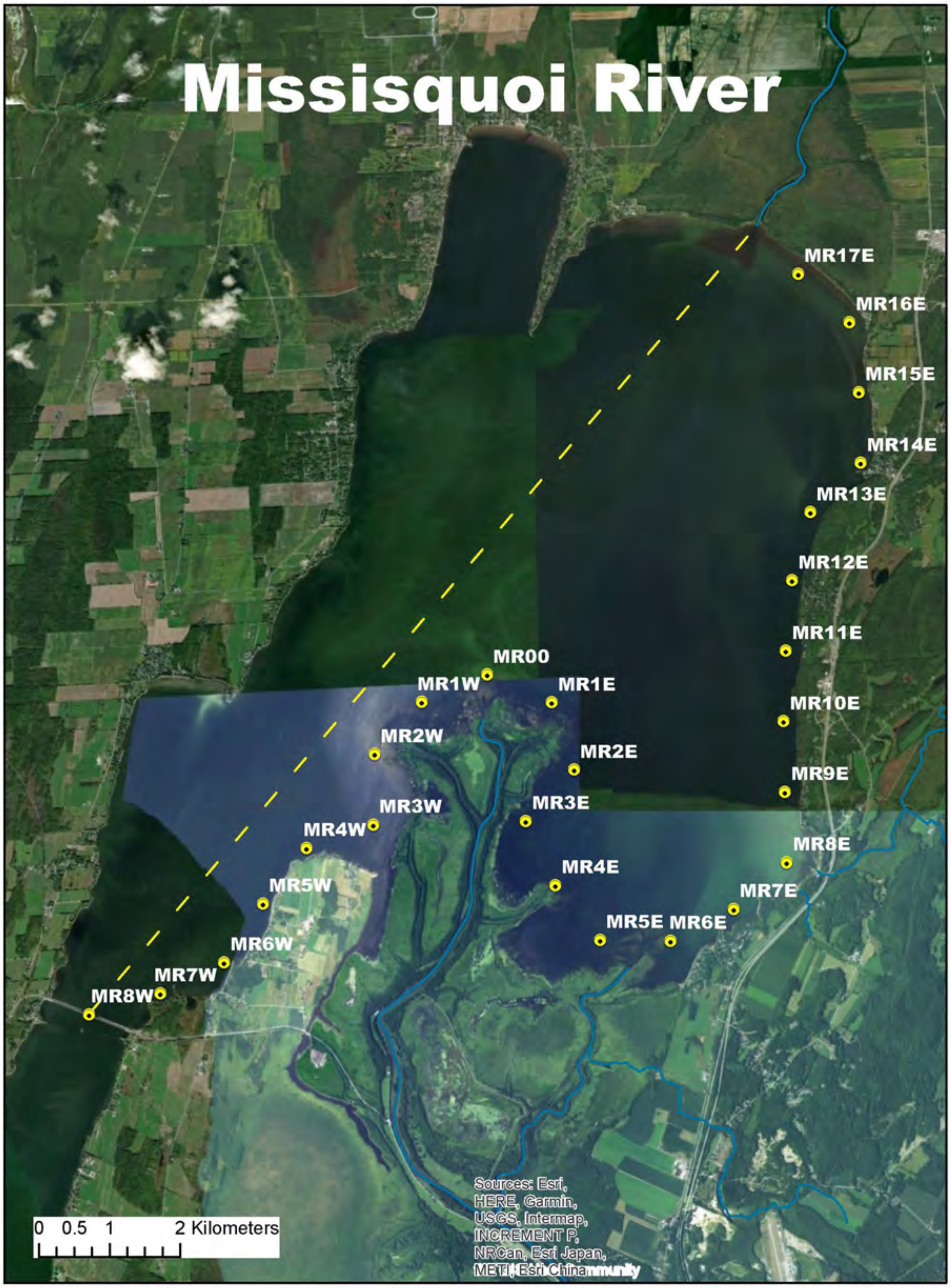

Figure 7. Water use advisory zones and TFM monitoring stations associated with the Missisquoi River lampricide treatment.

PRIOR NOTIFICATION, POSTING AND
WATER SUPPLY PLAN
FOR LAKE CHAMPLAIN LAMPRICIDE APPLICATIONS

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March 2019

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 Lamprecid [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, Niclosamide 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 2.0% by weigh of TFM, Niclosamide can reduce the amount of TFM needed by up to 40 percent. Granular Baylusicde 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.5

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.

Lampricide treatment notification and water supply responsibilities have been transferred from the Vermont Department of Fish and Wildlife and the New York State Department of Environmental Conservation to the U.S. Fish and Wildlife Service (USFWS), effective in 2011. This plan replaces the procedures in Smith (2012, 2013), Chipman (2010) and Durfey (2002, 2007) and details the USFWS plans to provide prior treatment notification to affected riparian landowners and water users; to implement domestic, agricultural and recreational water use advisories; and to provide water for household and agricultural needs during water use advisories in both Vermont and New York during lampricide treatments.

∗ 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)

Water Monitoring Protocol

A detailed description of the water monitoring protocol used to monitor lampricide levels and to impose or lift water use advisories for streams treated during the experimental sea lamprey control program can be found in Neuderfer (1989). The protocol includes numbers and locations of samples to be taken, the timing of the sampling, and the analytical methods used. An updated version of Neuderfer (1989) that includes current lampricide treatment areas is presented as an accompanying document to this notification plan (Smith 2019). It explains current advisory zones for all streams and methodology for sampling. Additional river-specific plans will be created and added to the Water Use Advisory Zone Monitoring Plan for lampricide treatments in Lake Champlain if new streams are determined to be in need of lampricide treatment. This plan may be revised if new data indicate that changes are necessary or advantageous.

The Lake Champlain Sea Lamprey control program conducts operations in the states of Vermont and New York. Because of differing regulatory policies, water use advisory thresholds and restrictions differ between the states. The USFWS conducts treatment operations based on state-specific permit requirements and in the case that treatment effects overlap both states simultaneously; the more conservative of the two sets of conditions are followed.

In New York, the lampricide advisory thresholds are determined by the State Department of Health (NYSDOH). The NYSDOH currently recommends a drinking water standard for TFM of 50 ppb per NYCRR §10 5-1.52. Recreational uses of stream water, including fishing and swimming, will be advised against until 24 hours after TFM concentrations fall below 100 ppb. These advisory threshold concentrations for minimizing human exposure to TFM are 3 to 6 times more restrictive than the USEPA's guidance for drinking water (Lindsay 2004).

As per Grey (1987), advisories following Granular Bayluscide treatments in New York are time-based and have three separate components. Potable water uses will be advised against for four days following treatments, while non-potable household uses will be advised against for two days. For recreational uses the advisory will last two days, with the public being advised that swimming and fishing could be associated with low-level exposure until four days following treatment. Additionally, the public will be advised of the potential for low-level exposure from consuming fish caught in the treated zone for fourteen days following treatment.

In Vermont, TFM advisory threshold concentrations for domestic and recreational water uses are established by the Vermont Department of Environmental Conservation (VTDEC) and included as Aquatic Nuisance Control permit conditions. Recommendations as to under what, if any conditions, the proposed use may result in negligible risk to public health under 10 VSA § 1455(d)(3) may be developed by VTDOH and provided to VTDEC for consideration. Currently VTDEC has set 100 ppb TFM as a drinking water advisory threshold concentration and 100 ppb TFM as a advisory threshold for recreational uses. These advisory threshold concentrations for minimizing human exposure to TFM are 3 times more restrictive than the USEPA's guidance for drinking water (Lindsay 2004). The domestic water use advisory threshold is also applied to agricultural water uses, including irrigation and livestock watering. Recreational and domestic water use advisories are lifted in both states, 24 hours after monitoring indicates that TFM concentrations have declined below their respective threshold levels.

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.

Empirical data collected as part of the chemical monitoring plan dating from 1992 to the present was analyzed to determine the proposed advisory Zones in the Water Use Advisory Zone Monitoring Plan for Lampricide Treatments in Lake Champlain

Description of Riparian Owners

A list of specific riparian landowners who could potentially be impacted by water use restrictions during lampricide treatments will be maintained in a database. Multiple listings of the same individual indicate that the individual owns more than one parcel. The accuracy of these lists must be viewed as temporary, but they will be updated by conducting new landowner searches each year for rivers scheduled for treatment using Town-specific (Vermont) or County (New York) property tax rolls similar to Sausville (1990). In New York, GIS parcel maps are maintained and updated annually by counties. In Vermont, GIS parcel data is available for some Towns, but not all. GIS data, where available, will be accompanied by the most recent Grand List for each Town.

A cover letter and a water supply survey (Attachment 1, 1a) will be sent to every riparian landowner within the advisory zone prior to each scheduled lampricide treatment. In order to facilitate the landowner notification process as well as to conserve government resources, an effort will be made to collect email addresses for all landowners. This request will be made on all surveys. Where email has been obtained, surveys and notification will contain links to an online survey, pesticide labels, and up-to- date information regarding treatment(s) affecting their parcel(s) or private water use. All landowners will continue to have the option to receive paper copies of all correspondence.

Follow-ups will only be done for new landowners who have never completed a water supply survey and for those who rent their properties to others. Efforts will be made to contact and interview non-respondents by follow-up mailings, by telephone, or in person, if necessary. Previously, follow-up mailings were sent via certified, return-receipt-requested mailings to all those who did not return the first water supply survey mailing. However, several complaints were filed from landowners regarding the inconvenience of having to make a special trip to the post office to sign for the mailing. In the past, in an effort to reduce cost and waste of extraneous mailings, landowners were informed that if they did not complete the latest water supply survey but had returned one previously, that we would assume they have made no changes to their water use since their last response and wish the same arrangements (or lack thereof) for alternate water supplies. In reality, the substantial program mailing costs have remained the same due to a self-addressed stamped envelope being included with every survey packet, regardless of landowner cooperation in the survey process. Costs and waste associated with postage, transportation (gasoline and vehicle usage), water purchases (large volumes of water going unused), and labor resources have been elevated due to non-respondents receiving water they requested years ago. To reduce the cost and waste, landowners will be advised that if they need drinking water or services relating to water use restrictions, they **must** notify the USFWS prior to treatment and make requests via the means provided: 1) Water supply survey filled out and returned using the self-addressed, postage paid envelope provided by USFWS, 2) Sea Lamprey Control Toll-Free Hotline, or 3) Email request. All methods are free of charge and convenient to virtually all landowners or water requestors. The survey mailing will be completed at least 1 month prior to a scheduled treatment. The results of the survey will allow us to identify those households within treatment advisory zones where water is used for drinking and household purposes, or for agricultural purposes, and if these households will want bottled or bulk water supplied by the USFWS. Landowners will also be asked for the names and addresses of tenants on their property and those who may have deeded access or other vested rights to the lake or tributary through their property. Tenants will be sent all relevant notifications and will also be contacted to verify their specific water needs. Others with access rights to the water will be verified and sent water supply survey forms and all relevant notifications. Because it is difficult for most people to estimate their water consumption and/or needs, the USFWS will contact personally those households who request water to determine if water is required, if bottled or bulk water is needed, and how much water will be needed during the advisory period.

A list of the riparian owners, their responses to water user surveys, and any required updates will be maintained in the database.

Notifications and Postings

Prior notification of pesticide applications will take two forms: long-term and short-term notifications. As with water-use advisory thresholds, the landowner notification process is slightly different between the States. New York pesticide law requires landowners to be provided with all relevant information to make an informed decision regarding their consent or objection to the water use advisories associated with the proposed treatments. Virtually all of the riparian landowners within New York advisory zones have been sent the information and a consent survey. As new landowners in the advisory area are identified, they will be sent both a consent survey and a water-use survey as described above. In addition, in New York, repeat consent surveys may need to be conducted for all riparian landowners as mandated by the Bureau of Pest Management. In Vermont, long-term notification is accomplished by the initial letter and Water-use survey.

Short-term notifications differ in the following ways. All potentially affected riparian landowners and their tenants, vested water users, and known consumptive water users will be sent a letter by first class mail or by email if previous authorization has been obtained approximately 15 days prior to a scheduled treatment. The short-term notification letter (Attachment 2) will describe our intent to treat and advise the riparian owners or tenants of the impending water use restrictions. It also will include the appropriate pesticide label and a toll free telephone number to call for additional information. In New York, for instances where there is a “multiple dwelling” as defined in ECL 33-0905(5), the owner or his/her agent will be requested to provide this information to the occupants or resident of such “multiple dwellings” at least seven days prior the proposed treatments. The owners/agent of such dwellings will be supplied with multiple copies of the letter for distribution to their tenants. Specific wording in notification letter may be changed to more accurately define the duration of the expected water use advisory.

Those households that withdraw raw lake or river water for drinking and other household or agricultural purposes as determined from the latest water user survey will be notified door to door by USFWS personnel during the week of scheduled treatments. They will be advised of the exact treatment schedule and will be questioned to verify if they need free drinking water to be supplied by the USFWS. If drinking water is requested, the household will be left a supply of drinking water. A written notice (Attachment # 3) will also be given to them, and if no one is home a notice will be left on their door and a supply of bottled water will be left on their doorstep if requested in their water-use survey. Included in the notice are the exact water use advisories and a toll free number to be called for additional drinking water and/or advisory updates and information.

Agricultural users of raw lake or river water will also be contacted personally beginning at least two weeks prior to treatments. They will be advised of the exact treatment schedule, impending water use restrictions, and questioned to see if they are in need of delivery of free livestock water or temporary electric fencing to restrict livestock from accessing treated water. If temporary fencing is required, installation will be completed prior to the day that the specific water use advisory goes into effect.

General public notification of treatments and water use restrictions will be done via newspapers and broadcast media. Several news media outlets will be sent news releases announcing upcoming treatments and associated water use advisories via email at least one week prior to the scheduled treatment date and again within two days of the treatment date. Contact with local TV and radio stations and daily papers will be maintained to provide the public with any changes in the treatment schedule and updates on water use advisories. USFWS personnel will personally notify all household and agricultural water users of changes in water use restrictions. The toll free number providing information regarding treatments and advisories is also included in public announcements.

The posting of advisories at public and private access sites will begin 24-hours prior to actual treatment. Signs (in English and French) will be posted at conspicuous shoreline locations and at access sites within the water use advisory zone. Treatment personnel will patrol the advisory zones when advisories are in effect to check on the signs and replace any missing or damaged signs. All signs will be printed on waterproof material and attached to wooden stakes or other suitable mounting surfaces as individual situations warrant.

A water use advisory sign is shown in Attachment 4. To minimize any public confusion as to the beginning or end of the water use advisory and whether or not the advisory is for drinking, fishing, or other water based activities; the signs will only be removed when a consumptive advisory is lifted, as stated on the sign. The hotline will be updated when recreational advisories are lifted.

During Granular Bayluscide delta treatments a water use advisory sign (Attachment 5) will be affixed to buoys and placed directly around the treatment area. These buoys will be left in place for two weeks to advise the angling public that fish caught in the area could contain traces of Niclosamide for two weeks.

Provision of Water

As stated previously, those persons with impacted potable water supplies who request drinking and cooking water will have commercially bottled water delivered to their households free of charge. Requested water will be left at each household when their “Notice of Treatment” flyer is delivered. Subsequent deliveries will be made depending on individual requests. The bottled water will be obtained from a local supermarket and from a source approved by the VT and NY DOH. During treatment and while water use restrictions are in place, additional deliveries of drinking water will be made upon requests received via the toll-free number. The toll-free “Sea Lamprey Control Hotline” will be monitored during business hours, and equipped with a voicemail box which will be monitored for messages during off hours and weekends while advisories are in effect. Delivery of additional drinking water will be made as soon as possible.

Water for other household uses, if requested, will be provided from centrally located bulk water tankers obtained from the NYS Emergency Management Office or the Vermont Army National Guard. They will be filled with potable water from local municipalities or certified bulk water haulers as close to the treatment area as possible; however, tankers will be posted with signs advising that the bulk water is not to be used for drinking or cooking. Since the number and location of potential users could change through time, actual tanker placements will have to be determined each year of a scheduled treatment based on updated information from the latest water user surveys. Affected households contacted during the door-to-door notifications will be informed of the location of the bulk water tanker closest to them. Special arrangements may be made for potentially affected small public water systems in cooperation with the Vermont DEC Water Supply Division or the NYS DOH.

If, during door-to-door contact separate provisions are requested for delivering household water to any handicapped person, the USFWS will find alternative means of bulk water delivery on an individual basis. Also at this time, if any household is unable to provide any type of their own container for transporting water, the USFWS will also make individual arrangements to assist them.

Water for livestock will be delivered to those who request it via trucks equipped with bulk water tanks or temporary connections to alternate water supplies. The tanks will be filled with water from local municipalities as close to the treatment area as possible or from other suitable sources as individual situations warrant. Stock tanks will also be provided to hold livestock water, as needed.

Notification of Expiration of Water Use Advisories

Recreational and consumptive water use advisories will be lifted 24 hours after the TFM concentrations fall below the respective threshold levels in an advisory zone. The general public will be notified via radio, TV and newspaper announcements when no advisories remain in effect. The shoreline advisory signs will be removed upon expiration of the consumptive advisory. Persons calling the toll free number described above will receive information on the status of each advisory, specifically whether the recreational advisory is still in place or has been lifted. There will be no broadcast public notification of expiration of the recreational advisory. Those households that had use of their domestic or agricultural water supplies affected by treatment will be contacted personally and informed of the advisory expiration. They will be given a notice (Attachment 5) and if no one is home the notice will be left on their door. Potentially impacted agricultural water users will also be personally contacted and informed of the expiration of the water use advisories. Again, if no one is home, a notice will be left on the door. All such notifications will begin as soon as practicable after the monitoring results indicate that advisories can be lifted.

References

Chipman, B. D. 2010. Vermont prior notification and water supply plan for lampricide applications. Vermont Department of Fish and Wildlife, Essex Junction, VT. 9 pp. plus attachments.

Durfey, L. 2002. Prior notification, Posting and water supply plan. Proposed compliance with Lake Champlain sea lamprey control permit conditions and requirements of the NY State Department of Health. NYSDEC, Ray Brook. 25 pp.

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Fisheries Technical Committee. 1999. Comprehensive evaluation of an eight-year program of sea lamprey control in Lake Champlain. Lake Champlain Fish and Wildlife Management Cooperative. 209 pp. plus appendices.

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Sausville, J. V. 1990. Lake Champlain Sea Lamprey Control: Riparian Landowner Consent Plan for Extended Health Advisory Areas, 1990. New York State Department of Environmental Conservation. Ray Brook, NY. 2 pp.

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Smith, S. 2013. Vermont prior notification, and water supply plan for lampricide applications. USFWS Lake Champlain Fish and Wildlife Resource Office. Essex Junction, VT. 9 pp. plus attachments.

Smith, S. 2019. Water Use Advisory Zone Monitoring Plan for Lampricide Treatments in Lake Champlain. USFWS Lake Champlain Fish and Wildlife Resource Office. Essex Junction, VT. 34pp.

USFWS, VTDFW and NYSDEC. 2001. A long-term program of sea lamprey control in Lake Champlain. Final Supplemental Environmental Impact Statement #FES 01-27. Lake Champlain Fish and Wildlife Management Cooperative. 356 pp. plus appendices.

WHO. 2007. WHO model list of essential medicines. World Health Organization, Geneva, Switzerland.

Woldt, A. and W. P. Sullivan. 2014. Standard Operating Procedures for Application of Lampricides in the Great Lakes Fishery Commission Integrated Management of Sea Lamprey (*Petromyzon marinus*) Control Program. http://www.glfc.org/sealamp/sop.php

Attachments

1. **Initial Notification Letter and Water Supply Survey Forms**

   Attachment 1 Cover Letter.docx

   Attachment 1A Water Supply Survey.docx

   Attachment 1B Consent Survey Form

2. **Short-term Treatment Notification Letter**
   Attachment 2 Notice 2-WEEK with Schedule.docx

3. **Pre-Treatment Notice for Household Riparian Water Users**
   Attachment 3 Notice Door.docx

4. **Shoreline Water Use Advisory Poster**
   Attachment 4 Signage with QR code.docx

5. **Delta Treatment Zone Water Use Poster (buoy)**
   Attachment 5 Delta Treatment Area Signage.docx

6. **Notice of Water Use Advisory Expiration**

   Attachment 6 Notice Lift.docx

Attachment 1

United States Department of the Interior

FISH AND WILDLIFE SERVICE

SEA LAMPREY CONTROL PROGRAM

Lake Champlain Fish and Wildlife Conservation Office
11 Lincoln Street, Essex Junction, Vermont 05452

Dear Landowner,

A parcel(s) under your ownership has been identified by municipal records as one that abuts waters where a U.S. Fish and Wildlife Service (USFWS) sea lamprey control treatment is tentatively scheduled for fall 2018, **pending permit approval from the New York Department of Environmental Conservation**. The sea lamprey is a parasitic fish that has affected the trout and salmon populations in Lake Champlain most severely while also depressing the populations of other species such as walleye and the endangered lake sturgeon. Sea lamprey control is essential for restoration of Lake Champlain's fisheries.

TFM and Niclosamide are the active ingredients in chemical lampricides applied to control sea lamprey populations. Whereas TFM is the primary control chemical for river applications; in some high-volume rivers, the addition of 0.5 to 2% Niclosamide by weight of TFM reduces TFM requirements by approximately 40%. The combination reduces lampricide use by volume and provides an additional benefit of shorter water use advisories. Bayluscide® (active ingredient; Niclosamide) is used for delta applications which occur in New York.

A water use advisory will be in effect for approximately 3-7 days during and following a treatment to minimize public exposure. Water within an advisory area should not be used for human consumption and domestic use, swimming, or irrigation and livestock watering. Other recreational use (i.e. fishing, boating) is also advised against. If raw river or lake water is the primary domestic or agricultural water source at an affected parcel(s), the USFWS will provide drinking/cooking water upon request, including arrangements for livestock.

Affected landowners and tenants will be notified of a tentative treatment date approximately two weeks in advance. Landowners that use a surface water intake system will receive an additional door notice the day preceding a treatment and the day that advisories are lifted. Newspapers, radio, television stations, and a toll-free "Hotline" will provide specific treatment dates as well as advisory updates.

Please complete and return the Water Supply Survey (green) within 21 days in the enclosed postpaid envelope. When completed, the form will acknowledge receipt of this notice and inform the USFWS as to whether the parcel(s) water source may be temporarily affected and if an alternate water supply may be needed. If the USFWS does not receive a completed form, we will assume that water supply arrangements are not needed. Information provided will be used only for purposes of the USFWS Sea Lamprey Control Program.

If you OBJECT to the temporary water use restrictions associated with sea lamprey control treatments, please complete and return the Non-Consent Form (blue) to the following address: Bureau of Pest Management, Brian Primeau, 232 Golf Course Road, Warrensburg, NY 12885. If you do not return the form within 21 days, your consent will be assumed. Your consent or objection will be recorded and remain in effect as long as you retain ownership of this property unless it is revoked by you in writing or until we are obliged to conduct a new consent survey.

Although the project is not hazardous, it is only prudent to avoid exposure to the treatment chemicals. The water-use advisories and accommodations for interruption of water use have been developed in cooperation with state and local health officials in New York and Vermont.

- General information about the USFWS Sea Lamprey Control Program:
  https://www.fws.gov/champlainlamprey/
  http://www.dec.ny.gov/animals/6998.html
- Product labels specific to each lampricide: ***https://www.fws.gov/lcfwro/sealamprey/lamprey_control_information_2016.html***
- Tentative treatment schedules: ***https://www.fws.gov/lcfwro/sealamprey/lamprey_control_information_2016.html***

For further inquiries or to request paper copies of the embedded links, please contact:

Aaron L. Keech
Landowner Coordinator
Aaron_Keech@fws.gov
Office: 802-662-5316
Hotline: 888-596-0611

Attachment 1A

LAKE CHAMPLAIN SEA LAMPREY CONTROL PROGRAM
WATER SUPPLY SURVEY

NAME OF RIVER

Please complete this form and return within 21 days using the enclosed postpaid envelope. Listed below is the information USFWS has on file related to parcel owner, parcel address, and contact address (residential/winter). Make any corrections as needed, such as most relevant affected parcel address if multiple tax map numbers are listed.

PARCEL OWNER **PARCEL ADDRESS** **CONTACT ADDRESS**

NEW CONTACT for 2018

Tax Map Number(s):

Telephone Number with Area Code: (Day) ______________________________
(Evening) ___________________________

Email Address(es): **print clearly** ______________________________ ______________________________

- Select preferred correspondence: _____Paper Mail _____Paper and Email _____Email

- Select the **one** category that best describes the parcel(s):

  _____ Residential Home _____Commercial: Apartments / Trailer Park / Motel / Lodge / Restaurant
  _____ Seasonal Home
  _____ Farm _____Other Commercial / Industrial
  _____ Beach / Park / Campsite_____Undeveloped

- Select the water source(s) used for **domestic purposes** at the parcel(s).
  Please clarify in comments section if more than one source is indicated.

  _____ Self-supplied water (bottled / other source)
  _____ Public water supply (Municipal / Fire District / Homeowners Association)
  _____ Well on parcel
  _____ Drilled/driven _____Dug
  Depth __________
  Distance from river bank or Lake Champlain shore __________
  _____ Spring on parcel
  _____ Direct surface water intake from River or Tributary (name) ________________________________
  _____ Direct surface water intake from Lake Champlain

- Does a parcel resident (owner or tenant) use water **obtained directly** from either the river to be treated or Lake Champlain for any of the following purposes?

  Domestic consumption and household use. Yes_____ No _____
  (e.g., drink/cook/bathe/dishes/clothes)
  Livestock water or to clean milking equipment. Yes_____ No_____
  Farm irrigation. Yes _____ No _____

- The water use(s) designated in the previous question are:

ID:
Location:
Reference:

Year round: _____
Seasonal: Month____________________**through** Month ____________________

ID:
Location:
Reference:

- Sea lamprey control treatments result in temporary water-use restrictions for affected parcels. In most cases, these advisories are in effect for 2-7 days.

  WELLS greater than 30ft from affected water bodies ARE NOT AFFECTED. Parcels affected by water-use advisories include ONLY those whose primary water source is a private raw river or raw lake water intake, or water from shallow wells located within 30ft of affected water bodies.

  If you request it, the USFWS will provide water at no cost if your water use is affected. Please select the response(s) which apply to water use needs at the parcel(s):

  _____ Parcel water supply will not be affected.
  _____ Parcel water supply may be affected, but owner will provide own arrangements for water.
  _____ Request for water: Domestic consumption and household use (e.g., drink/cook/bathe/dishes/clothes). *
  _____ Request for water: Livestock water or to clean milking equipment. *

  ** USFWS personnel will contact the parcel owner prior to treatment to determine individual water needs.*

- Is the parcel **rented or leased** to another person(s)? If so, please provide number of rented/leased units: _____

  USFWS will send additional direct notifications to residents of two or less units if contact information is provided. For three or more units, additional notifications will be provided to the parcel owner for distribution.

Name________________________________	Name________________________________
Address ______________________________	Address ______________________________
__________________________ Zip______	__________________________Zip _______
Phone_______________________________	Phone_______________________________
Email _______________________________	Email _______________________________

- Do others have deeded lake access across the parcel for recreation or lake-water supply lines? Yes ____ No____

  USFWS will send additional direct notifications to entities with deeded access if contact information is provided. If three or more entities have deeded access, additional notifications will be provided to the owner for distribution.

Name________________________________	Name________________________________
Address ______________________________	Address ______________________________
__________________________ Zip______	__________________________Zip _______
Phone_______________________________	Phone_______________________________
Email _______________________________	Email _______________________________

Comments and Clarifications:

ID:
Location:
Reference:

- **SIGNATURE ______________________________________** **DATE ___________________**

ID:
Location:
Reference:

LAKE CHAMPLAIN SEA LAMPREY CONTROL PROGRAM
RIPARIAN LANDOWNER NON-CONSENT FORM

INSTRUCTIONS: Please fill out and return this form only if you do not consent to the temporary water use restrictions associated with use of TFM, Bayluscide or a combination of TFM and Bayluscide® during sea lamprey control treatments. If you do not return this form within 21 days, your consent will be assumed. To complete this form, thereby registering your objection, please state your specific objections in the space provided below. Then sign your name, include your telephone number(s), make any necessary corrections to the mailing address, and return the completed form to:

Bureau of Pest Management
Brian Primeau
232 Golf Course Road
Warrensburg, NY 12885

This notification and consent applies to long-term sea lamprey control for Lake Champlain and the use of the lampricides TFM and Bayluscide®. Your consent or objection will be recorded and remain in effect as long as you retain ownership of this property unless it is revoked by you in writing or until we are obliged to conduct a new consent survey.

I OBJECT to temporary restriction of water use while the chemical lampricide TFM or a combination of TFM and Bayluscide® is present in water adjoining my property as a result of said project. **The specific reason(s) for my objection are stated below:**

Print Name: ___________________________________

Signed:____Date: ______________________

Mailing Address: ____

____

Telephone (Daytime): Area Code (   ) ________________

(Evening): Area Code (   ) ________________

Attachment 2

NOTICE

United States Department of the Interior
FISH and WILDLIFE SERVICE

SEA LAMPREY CONTROL PROGRAM
Lake Champlain Fish and Wildlife Conservation Office
11 Lincoln Street, Essex Junction, Vermont 05452

A parcel(s) under your ownership has been identified by municipal records as one that abuts waters where a U.S. Fish and Wildlife Service (USFWS) sea lamprey control treatment is tentatively scheduled. The sea lamprey is a parasitic fish that has affected the trout and salmon populations in Lake Champlain most severely while also depressing the populations of other species such as walleye and the endangered lake sturgeon. Sea lamprey control is essential for restoration of Lake Champlain's fisheries.

TFM and Niclosamide are the active ingredients in chemical lampricides applied to control sea lamprey populations. TFM is the primary control chemical for river applications. In some high volume rivers, Niclosamide is added to the TFM at 1% by weight. The combination reduces TFM use by up to 40% and provides an additional benefit of decreased water use advisory times. Bayluscide® (active ingredient; Niclosamide) is used for delta applications which only occur in New York. A water use advisory will be in effect during and following a treatment to minimize exposure.

RIVER TREATMENTS: River or lake water in the water use advisory area should not be used for **drinking, cooking or other household purposes such as bathing, showering, and dish and clothes washing; or for swimming, irrigation or livestock watering**. Fishing and other water-based recreation activities will also be restricted for a period of time following treatment.

DELTA TREATMENTS: Delta water may contain treatment-level concentrations of Bayluscide®. Water within a delta advisory area should not be used for human consumption for four days after treatment completion, but may be safely used for other domestic, agricultural, and recreational purposes two days after treatment completion.

Treatment Dates (opposite) are subject to change due to stream flows, weather conditions, or technical problems. Advisories will be indicated on signs posted at public access points. Newspapers, radio, and television stations will be provided specific treatment dates, as well as advisory updates. A toll-free hotline (below) will be active for affected water users to call for further information and updates.

Prior to this notification, a water use survey was mailed to you. If you returned and indicated that raw river or lake water is the primary domestic or agricultural water source at your parcel(s) , USFWS personnel will contact you concerning your water use needs. If determined that the water source may be temporarily affected, the USFWS will provide a drinking/cooking water supply upon request, including arrangements for livestock. A centrally located bulk water tank will be allocated to communities as needed for other domestic purposes (bathe, dishes, clothes), but transport containers will not be provided. Landowners that request water, use a surface water intake system, or could not be contacted will receive an additional door notice the day preceding a treatment and the day advisories are lifted. If water is needed and USFWS personnel have not contacted you within 24 hours of a scheduled treatment, please call the hotline. Potable water will remain available until the advisory has been lifted.

WELLS greater than 30ft from affected water bodies ARE NOT AFFECTED. Parcels affected by water-use advisories include **ONLY** those whose primary water source is a private raw river or raw lake water intake, or water from shallow wells located within 30ft of affected water bodies.

Do not rely on your own senses for detection; at the dilute concentrations present in the advisory areas, the treatment chemicals are colorless, odorless, and tasteless. Although the project is not hazardous, it is only prudent to avoid exposure to the treatment chemicals. The water-use advisories and accommodations for interruption of water use have been developed in cooperation with state and local health officials in New York and Vermont.

If the parcel is rented or leased to another person(s), please provide this person(s) with a copy of this notice within one week. If additional copies are needed, please call the hotline.

Aaron L. Keech
Landowner Coordinator
Aaron_Keech@fws.gov

Hotline: 888-596-0611

TREATMENT SCHEDULE OPPOSITE

U.S. FISH and WILDLIFE SERVICE
SEA LAMPREY CONTROL PROGRAM
11 Lincoln Street
Essex Junction, VT 05452

J. J. DOE
P.O. BOX 777
777 STREET
CITY, STATE ZIP

United States Department of the Interior
FISH and WILDLIFE SERVICE

SEA LAMPREY CONTROL PROGRAM
Lake Champlain Fish and Wildlife Conservation Office
11 Lincoln Street, Essex Junction, Vermont 05452

Example
2016 Tentative Treatment Schedule

EFFECTIVE DATE	Name	River/Delta	NY/VT	Lampricide(s)	Miles[a]/Acres[b]	Town/City
Spring	Beaver	River	NY	TFM	2.5 Miles	Westport
Spring	Putnam	River	NY/VT	TFM	5.2 Miles	Crown Point
00 September	LaPlatte	River	VT	TFM	3.3 Miles	Shelburne
00 September	Stonebridge	River	VT	TFM	3.6 Miles	Milton
00 September	Missisquoi	River	VT	TFM/Niclosamide	7.8 Miles	Swanton
00 September	XXXXXXXXXX	Delta	NY	Bayluscide®	XXX Acres	XXXXXXXXXX

[a] River mileage refers to length from application point to mouth.
[b] Delta acreage refers to total area surveyed to determine population distribution. Actual area treated will be substantially reduced to represent only areas of sufficient population density.

Attachment 3

NOTICE

Effective: ____________________

United States Department of the Interior

FISH and WILDLIFE SERVICE

SEA LAMPREY CONTROL PROGRAM
Lake Champlain Fish and Wildlife Conservation Office
11 Lincoln Street, Essex Junction, Vermont 05452

A parcel(s) under your ownership has been identified by county records as one that abuts waters where a U.S. Fish and Wildlife Service (USFWS) sea lamprey control treatment is scheduled. The sea lamprey is a parasitic fish that has affected the trout and salmon populations in Lake Champlain most severely while also depressing the populations of other species such as walleye and the endangered lake sturgeon. Sea lamprey control is essential for restoration of Lake Champlain's fisheries.

TFM and Niclosamide are the active ingredients in chemical lampricides applied to control sea lamprey populations. TFM is the primary control chemical for river applications. In some high volume rivers, Niclosamide is added to the TFM at 1% by weight. The combination reduces TFM use by up to 40% and provides an additional benefit of shorter water use advisories. Bayluscide® (active ingredient; Niclosamide) is used for delta applications which only occur in New York. A water use advisory will be in effect during and following a treatment to minimize exposure. Although lampricide concentrations in the water will be very low, **you should not use the treated water for drinking and cooking; or for other household purposes such as bathing, showering, and clothes or dish washing; or for swimming, fishing, irrigation and watering of livestock**.

Do not drink the water from your private lake or river water supply or use such water for the other purposes listed above until you are notified that the advisory has been lifted. U.S. Fish and Wildlife Service (USFWS) personnel will deliver free commercially bottled water for drinking and cooking if requested by landowners whose potable water supply will be exposed to lampricides.

WELLS greater than 30ft from affected water bodies ARE NOT AFFECTED. Parcels affected by water use advisories include **ONLY** those whose primary water source is a private raw river or raw lake water intake, or water from shallow wells located within 30ft of affected water bodies.

If you need more drinking water, please call our toll-free number listed below Monday through Friday from 7:30 am - 4:30pm. You may also leave a message at this number at other times as USFWS personnel will be checking for voice messages frequently during the water use advisory period. You will be personally notified when lampricide concentrations have dissipated and you can resume normal use of your water supply.

Do not rely on your own senses for detection; at the dilute concentrations present in the advisory areas, the treatment chemicals are colorless, odorless, and tasteless. Although the project is not hazardous, it is only prudent to avoid exposure to the treatment chemicals. The water use advisories and accommodations for interruption of water use have been developed in cooperation with state and local health officials in New York and Vermont.

Aaron L. Keech
Landowner Coordinator
Aaron_Keech@fws.gov
Hotline: 888-596-0611

Attachment 4

WARNING

SEA LAMPREY CONTROL PROJECT
AQUATIC PESTICIDE IN USE

The water in this area may contain TFM, a combination of TFM/Niclosamide, or Niclosamide alone; used to control a parasitic fish, the sea lamprey, to help restore fish populations in Lake Champlain. TFM formulations also contain the solvent isopropanol, the main ingredient in rubbing alcohol.

☐ TFM or TFM+Niclosamide
River Application (VT/NY)

☐ NICLOSAMIDE
Delta Application (NY)

THE FOLLOWING ADVISORIES APPLY
TO THE WATER IN THIS AREA

EFFECTIVE:________________________**TIME:** ___________

NO DRINKING — NO DOMESTIC USE
NO FISHING — NO SWIMMING
NO IRRIGATION — NO WATERING LIVESTOCK

UNTIL THIS SIGN IS REMOVED

UNITED STATES FISH and WILDLIFE SERVICE
For further information: **1-888-596-0611**

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

1

Sign reference #

Attachment 5

Treatment Date: ______________________________

SEA LAMPREY CONTROL PROJECT

Parasitic Sea Lamprey are being treated with Bayluscide in this area to protect and improve the fishery of Lake Champlain

THE FOLLOWING ADVISORY APPLIES TO THE WATER IN THIS AREA:

UNTIL TWO DAYS AFTER THE TREATMENT DATE

NO FISHING
NO SWIMMING,
NO LIVESTOCK WATERING
AND NO IRRIGATION

IN ADDITION, SWIMMING AND FISHING IN THE TREATMENT AREA MAY BE ASSOCIATED WITH LOW-LEVEL EXPOSURE TO BAYLUSCIDE FOR FOUR DAYS FOLLOWING THE TREATMENT DATE AND THE CONSUMPTION OF FISH FROM THE TREATMENT AREA MAY RESULT IN LOW-LEVEL EXPOSURE TO BAYLUSCIDE FOR 14 DAYS FOLLOWING THE TREATMENT DATE

U. S. Fish and Wildlife Service

For further information call 1-888-596-0611

NOTICE

United States Department of the Interior
FISH and WILDLIFE SERVICE

SEA LAMPREY CONTROL PROGRAM
Lake Champlain Fish and Wildlife Conservation Office
11 Lincoln Street, Essex Junction, Vermont 05452

The water use advisory for this area has been lifted.

EFFECTIVE IMMEDIATELY, WATER USE AT THIS PARCEL MAY RESUME FOR ANY DOMESTIC, AGRICULTURAL, OR RECREATIONAL PURPOSE

For further information call 1-888-596-0611

State of Vermont
Department of Health
Environmental Health Division
108 Cherry Street-PO Box 70
Burlington, VT 05402-0070

[phone] 800-439-8550

Agency of Human Services

MEMORANDUM

TO: Misha Cetner, Department of Environmental Conservation

FROM: Sarah Vose, State Toxicologist, Department of Health

SUBJECT: Aquatic Nuisance Control Permits, TFM

DATE: May 29, 2020

==

The United States Fish and Wildlife Service (USFWS) has requested an aquatic nuisance control permit to treat portions of the Lamoille and Missisquoi Rivers with the aquatic pesticide products TMF HP and TFM Bar (both with active ingredient 3-Trifluoromethyl-4-nitrophenol, henceforth referred to as TFM) under a five year permit in an effort to control the Sea Lamprey larvae population. Per the request of the Vermont Department of Environmental Conservation (DEC), the Vermont Department of Health (Department) reviewed the applications to evaluate the risk to public health.

In 2019, the Department received the final report on the 90-day oral toxicity study on TFM. The study was conducted according to the design agreed to by the TFM workgroup and meets the EPA Office of Pesticides 90-day guideline. This study was used to derive an updated drinking water health advisory of 100 ppb, as well as an updated recreational water value of 3.9 ppm for TFM. A description of the study and the process to derive the drinking water health advisory follows:

> Male and female rats were given TFM at target doses of 1, 3, 10, 30 and 100 mg/kg/day in drinking water for 90 days and allowed to recover for 28 days. Data were collected on a comprehensive set of endpoints: body weight, functional observation battery and grip strength, locomotor activity, estrus cycle, ophthalmology, clinical pathology, clinical chemistry, hematology, coagulation, urinalysis, macroscopic findings, organ weights, and microscopic findings. There were no adverse findings during the study, and no TFM-related changes in any endpoint. In other words, there was no toxicity observed at the highest achieved dose levels in male or female rats (86.5 and 77.2 mg/kg/day, respectively).
>
> Therefore, the highest no observed adverse effect level (NOAEL) is 77.2 mg/kg/day based on the absence of toxicity in female rats after 90 days of exposure to TFM in drinking water. Standard procedure for developing an oral reference dose (RfD) was

followed by dividing the NOAEL by uncertainty factors. The following uncertainty factors are applied to the NOAEL to derive an oral reference dose: UF_A= 10 to account for interspecies variation; UF_H= 10 to account for intraspecies variation; UF_S= 3 to account for the use of a subchronic study; UF_D= 10 to account for database uncertainty. The composite UF is 3,000. The NOAEL of 77.2 mg/kg/day divided by the composite UF of 3,000 yields an RfD of 0.02573 mg/kg/day.

In accordance with the Health Department's process for deriving a drinking water health advisory, the RfD is combined with a body weight adjusted water intake rate of 0.175 L/kg/day. A factor of 1000 is used to convert from milligrams per liter (ppm) to micrograms per liter (ppb). A Relative Source Contribution (RSC) of 70% is employed for TFM. There are potential sources of exposure to TFM other than drinking water, such as recreational exposure. The use of 70% RSC leaves 30% of the estimated RfD (mg/kg/day) to come from these other sources of exposure. The equation is: (0.02573 mg/kg/day) x (1/0.175 L/kg/day) x 1000 x 0.7 = 103 ppb ≈ 100 ppb. The drinking water health advisory for TFM is 100 ppb.

Based on the evaluation of impacts to public water systems conducted by the applicant and by DEC, no public water systems in Vermont are expected to exceed 100 ppb of TFM due to the proposed applications. The applicant proposes to notify riparian landowners to offer bottled water if their water source is from the treated rivers. Swimming should not occur in treated waters until the TFM concentrations are below 3.9 ppm.

Thus, the proposed treatments of the two rivers with TFM are expected to result in negligible risk to public health. Based on a review of the confidential statements of formulation, it is reasonable to conclude that human exposure to the inert compounds contained in TFM at the concentrations that would result under the conditions proposed by the applicants is not likely to result in an increase in the level of concern for public health.

A Long-term Program of Sea Lamprey Control in Lake Champlain

Final Supplemental Environmental Impact Statement

Fisheries Technical Committee
Lake Champlain Fish and Wildlife Management Cooperative

FES 01-27

FINAL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

A LONG-TERM PROGRAM OF SEA LAMPREY CONTROL IN LAKE CHAMPLAIN

Prepared by: U.S. FISH & WILDLIFE SERVICE
in cooperation with
VERMONT DEPARTMENT OF FISH & WILDLIFE
and
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

for further information:

David C. Nettles and Nicholas R. Staats
U.S. Fish & Wildlife Service
Lake Champlain Fish and Wildlife Resources Office
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Essex Junction, Vermont 05452
Telephone (802) 872-0629

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Essex Junction, Vermont 05452
Telephone (802) 878-1564

Lawrence J. Nashett
NYS Dept. of Environmental Conservation
Region 5 Field Office
Route 86, P.O. Box 296
Ray Brook, New York 12977-0296
Telephone (518) 897-1333

Approval for Release:

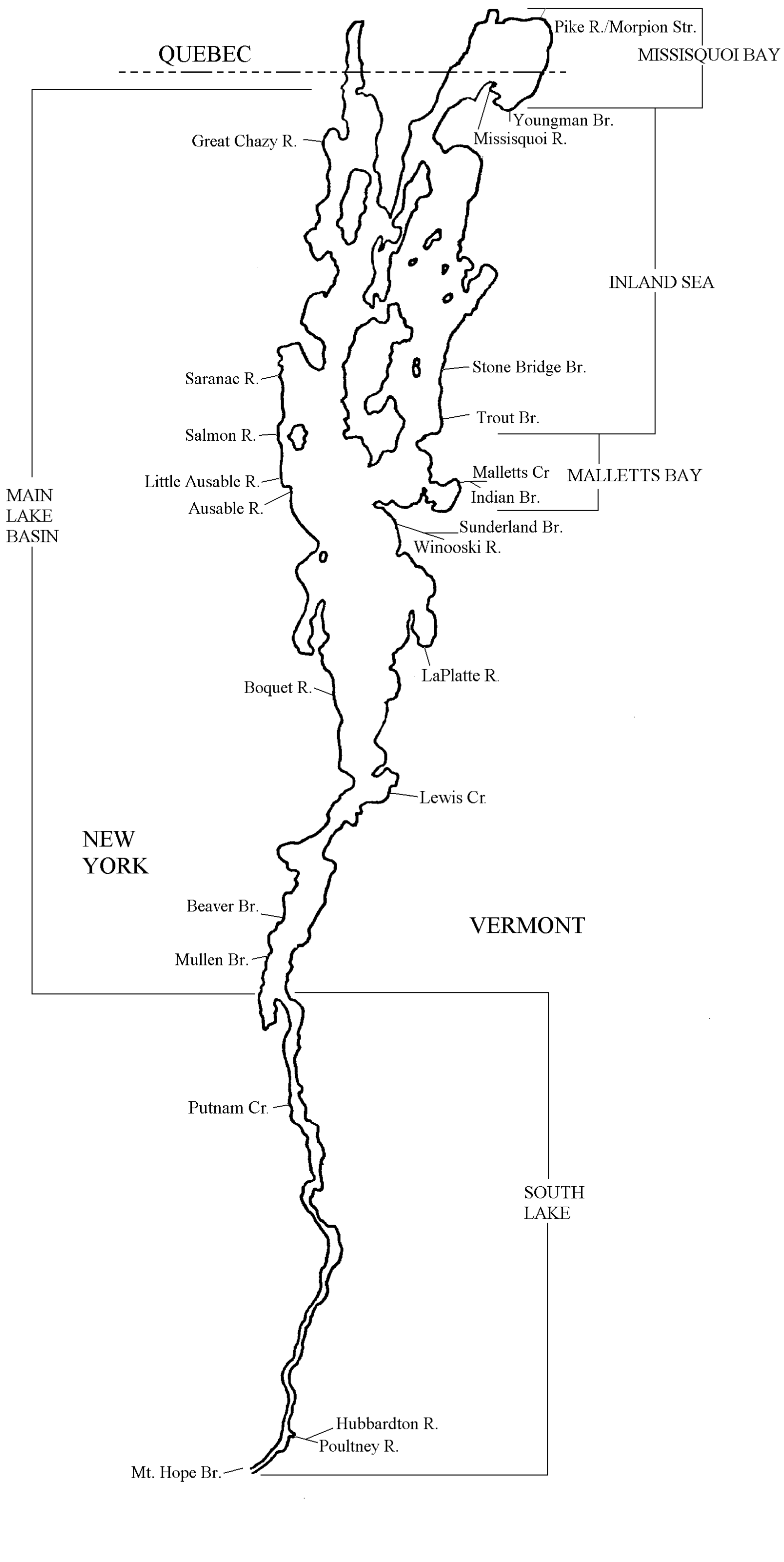
____
Regional Director
Region 5
U.S. Fish & Wildlife Service

____
Commissioner
Vermont Department of Fish & Wildlife
Agency of Natural Resources

____
Director
Division of Fish, Wildlife and Marine Resources
NYS Dept. of Environmental Conservation

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
August 2001

Lake Champlain, Showing Major Basins and Tributaries



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EXECUTIVE SUMMARY

This Supplemental Environmental Impact Statement (SEIS) is written pursuant to the National Environmental Policy Act (NEPA) requirements regarding implementation of a long-term sea lamprey control program for Lake Champlain. This proposed program will be subject to the NEPA public review and comment process before federal funding and federal personnel will be committed to the project.

Lake Champlain sea lamprey control began in 1990 as an eight-year experimental program (NYSDEC et al. 1990), and was initiated after the completion of an Environmental Impact Statement (EIS). This document is written as a "supplement" to the experimental program Final Environmental Impact Statement (FEIS). Extensive evaluation of the experimental program was conducted and presented in *A Comprehensive Evaluation of an Eight Year Program of Sea Lamprey Control in Lake Champlain* (Fisheries Technical Committee 1999). The experimental program was considered successful, meeting the majority of evaluation standards adopted to gauge sea lamprey control success. The experimental program represented an effort to enhance sport fish populations through the limited applications of the lampricides TFM and niclosamide (niclosamide is the active ingredient in Bayluscide) to selected streams and deltas to target and control larval sea lamprey populations.

The proposed sea lamprey control program would integrate additional control methods. Specifically, these are application of a more efficient TFM/niclosamide combination lampricide requiring smaller total amounts of active ingredient to target larval sea lamprey in some larger streams; establishing barriers to isolate upstream migrating adults from spawning sites; and trapping of adult spawning-phase sea lamprey to both augment control by other methods and prevent the redistribution of adults encountering barriers to spawning areas in nearby streams. The proposed program would target additional sea lamprey infested areas untreated during experimental control and use integrated techniques to achieve a greater level of sea lamprey control and an enhanced fishery response to control. A screening process is introduced where each location identified for sea lamprey control is scrutinized for application of currently feasible sea lamprey control methodology. The degree of sea lamprey infestation, technical feasibility of the method, the potential nontarget, human and habitat impacts, and the monetary costs of method implementation are considered during the sea lamprey control method selection process.

Recognition of a changing environment, the changing nature of sea lamprey infestations and evolving sea lamprey control technology requires that adaptability and flexibility be built into a proposed sea lamprey control program. Sea lamprey control techniques under development (sterile male releases, pheromone attractants) are recognized and will be scrutinized for application to the Lake Champlain environment if and when they become feasible for use as part of a Lake Champlain sea lamprey control program.

Three plausible alternatives are presented and discussed in this SEIS:

Alternative 1. Initiate an extensive, integrated, long-term control program for sea lamprey in Lake Champlain (Proposed Action). This alternative features a tributary-specific approach where viable control techniques are screened for applicability in each infested stream system. This Proposed Action represents an expansion of sea lamprey control beyond the limited scope of the experimental sea lamprey control program to include new locations and additional sea lamprey control techniques. Associated fishery and economic gains would be expected to surpass those realized as a result of experimental sea lamprey control.

Alternative 2. Maintain reduced sea lamprey wounding rates attained during the experimental period by applying chemical lampricides. This program would be similar to that of the experimental sea lamprey control program, relying heavily on the use of TFM and niclosamide, for maintaining reduced sea lamprey numbers, as opposed to the fully integrated program proposed in Alternative 1. The program would be restricted primarily to the streams and deltas targeted during experimental sea lamprey control. This alternative ignores additional techniques and many locations included in the proposed program that may offer improved sea lamprey control. Success with this program would achieve similar levels of sea lamprey control reached during the experimental program.

Alternative 3. Abandon sea lamprey control as a fisheries management tool for Lake Champlain (No Action Alternative). This is a "no sea lamprey control" option, where all sea lamprey control activities would be discontinued and the fisheries benefitting from sea lamprey control are allowed to degrade under unrestrained sea lamprey parasitism. Levels of sea lamprey parasitism would revert to levels experienced prior to the initiation of the eight-year experimental sea lamprey control program.

This SEIS provides a detailed description of the environmental setting of Lake Champlain emphasizing water quality and basin characteristics, known sea lamprey distributions and the human environment. Inventories of state and federal-listed endangered and threatened species and their habitats, and non-listed species are provided in respect to anticipated sea lamprey control activities.

Also noted are anticipated impacts of each alternative. Impacts to water, humans, wetlands, endangered and threatened species, plants, invertebrates, fish, amphibians, reptiles, birds, and mammals are discussed. Anticipated user conflicts are scrutinized for each alternative. Mitigating measures are proposed for water and each biological category listed above. Unavoidable adverse impacts, beneficial impacts, irreversible and irretrievable commitments of resources and growth-inducing impacts are discussed by alternative.

The Proposed Action (Alternative 1) features an adaptable sea lamprey control program initially targeting 20 Lake Champlain stream systems for possible sea lamprey control activities. The

Proposed Action represents an expansion of techniques, and an expansion of control effort extending beyond the 13 stream systems and 5 deltas that received lampricide applications under the experimental program. Strategies for control at each location are developed using a screening process, culminating in the development of a prioritized list of potentially employable sea lamprey control methodologies designed to achieve the greatest practical integrated sea lamprey control and mitigate adverse environmental consequences. A summary of proposed sea lamprey control strategies and specific developmental discussions for possible control technique implementation in each tributary is located in Section VIII.

INTRODUCTION

This document supplements the Final Environmental Impact Statement (FEIS) entitled *Use of Lampricides in a Temporary Program of Sea Lamprey Control in Lake Champlain with an Assessment of Effects on Certain Fish Populations and Sportfisheries* (NYSDEC et al. 1990). It has been prepared by the Lake Champlain Fish and Wildlife Management Cooperative (Cooperative), comprised of the United States Fish and Wildlife Service (the Service), the New York State Department of Environmental Conservation (NYSDEC) and the Vermont Department of Fish and Wildlife (VTDFW).

A brief review of Lake Champlain fish population changes and management actions helps one understand the purpose, goal and objectives of the action proposed in this Final Supplemental Environmental Impact Statement (FSEIS).

Landlocked Atlantic salmon[1] were once abundant in the northern lake, but habitat degradation and over-fishing destroyed the native population by 1850. Lake trout populations were also in decline. Sporadic stockings of both species in the late 1800s failed to restore populations or fisheries. Native lake trout were gone by 1929. No further restoration attempts were made until 1958 when Vermont and New York began stocking small numbers of lake trout, and in the early 1960s when New York began stocking a few salmon fry (NYSDEC et al. 1990). Results of these stockings, the formation of the Cooperative, and the Cooperative's early accomplishments are further described in Section III.A.

The Cooperative was able to produce limited, recreational fisheries for lake trout, landlocked Atlantic salmon, brown trout and steelhead/rainbow trout through coordinated stockings, but soon it determined the nonnative sea lamprey was exerting a major adverse impact on their populations and associated recreational fisheries (Gersmehl and Baren 1985; Plosila and Anderson 1985). Sea lamprey attacks were also evident on other important species such as walleye (NYSDEC, Ray Brook, New York, unpublished data). These impacts had social and economic consequences for the surrounding communities. It became apparent that sea lamprey control would be needed to achieve fishery management objectives (Anderson, J. K. et al. 1985) and improve the economic gains from recreational fishing.

In 1990, the Service, NYSDEC, and VTDFW initiated an eight-year experimental sea lamprey control program on Lake Champlain to abruptly and dramatically reduce parasitic-phase sea lamprey abundance; assess effects of this reduction on the characteristics of certain fish populations, the sport fishery and economics of the region; and to facilitate formulation of long-range policies and management strategies (NYSDEC et al. 1990).

The experimental control program was based on the use of two lampricides on 13 tributary systems and 5 deltas. Liquid formulation TFM was used in stream treatments and a Bayluscide

---

[1] All scientific names (genus/species) not listed in text appear in Tables VI-1 through VI-7.

5% Granular formulation was used on the deltas. Most tributaries and deltas received two rounds of treatment, four years apart. Evaluation of the eight-year experimental program was based on criteria relating to sea lamprey reduction, sport fishery response, and forage fish assessment (Engstrom-Heg et al. 1990; Fisheries Technical Committee 1999). Results of the experimental program are summarized in Section III.B. These results indicate the experimental control program successfully reduced sea lamprey parasitism, resulted in minor and manageable nontarget and environmental impacts and successfully mitigated impacts of greatest concern such as threatened and endangered species. These results provide justification for continuing sea lamprey control on Lake Champlain. However, the experimental program concluded at the end of 1997, and use of federally administered Sport Fish Restoration grants and other federal funding, equipment and personnel for sea lamprey control ceased at that time. Since then NYSDEC issued a Negative Declaration of Significance under the State Environmental Quality Review Act (SEQRA) for sea lamprey control treatments with TFM on previously treated streams entirely within New York State jurisdiction, and has conducted these treatments on selected tributaries without using federal funds. These New York treatments were intended as a temporary measure to maintain some of the earlier gains achieved in fishery quality until long range policies and sea lamprey management strategies were formulated.

The large scope and complexity of the proposed Lake Champlain sea lamprey control program requires that NEPA be addressed. An outcome of the NEPA process in favor of continued sea lamprey control in Lake Champlain would allow renewed expenditures of federal services and funds for that purpose. The absence of federal funding does not preclude sea lamprey control efforts by the states of New York and Vermont within respective jurisdictions and governed by the regulatory requirements within each state. Similarly, completion of the NEPA process does not in and of itself, authorize the sea lamprey control program. Long-term sea lamprey control activities would be subject to compliance with appropriate national (US and Canada), state, provincial and local laws and regulations. Permits required for all regulated sea lamprey control activities will be obtained and the Cooperative will abide by their conditions.

I. PURPOSE AND NEED

A. Purpose

The purpose of this SEIS is to examine impacts associated with providing a continued, coordinated sea lamprey control program and enabling the resumption of use of federally administered Sport Fish Restoration grant monies, other federal funds, federal equipment and participation by federal staff in implementation of a Lake Champlain sea lamprey control program. The purpose of the preferred alternative, or the Proposed Action, is to achieve and maintain the greatest practical reductions in Lake Champlain sea lamprey populations. The experimental sea lamprey control program clearly provided important benefits to the Lake Champlain fishery, the area's economy and the basin's aquatic ecosystem. For instance, anglers caught substantially more and larger lake trout, and their fall catches of one-lake-year landlocked Atlantic salmon from the Saranac River doubled. It also generated a favorable 3.48:1 economic benefit:cost ratio with benefits of approximately $29.4 million and costs of about $8.4 million (Gilbert 1999a). Lake-wide continuation of sea lamprey control is expected to replicate or surpass these benefits.

Sea lamprey management is a tool to protect and enhance the Lake Champlain ecosystem while providing for public benefits through the reestablishment of native fish populations. Decreasing the deleterious effects of sea lamprey, a non-native invasive species, is critical to the natural resource conservation management effort to improve the form, function, and structure of the Lake Champlain ecosystem.

These fishery and economic gains were closely associated with reduced sea lamprey wounding rates on important fish species (Fisheries Technical Committee 1999). Reduced wounding rates in key species would serve as reasonable and readily monitored indicators of parasitic-phase sea lamprey abundance and provide objectives for future sea lamprey control efforts. Examination of fish in specific size ranges from samples collected during selected periods would facilitate year-to-year comparison.

Goal:

The goal of the proposed Lake Champlain sea lamprey control program (the Proposed Action) is to achieve or surpass the fish population, recreational fishery and economic benefits realized during the 1990-97 experimental sea lamprey control program.

Objectives:

- Achieve and maintain lamprey wounding rates at or below:
  - 25 wounds per 100 lake trout
    (ideally 10 wounds per 100 lake trout);
  - 15 wounds per 100 landlocked salmon
    (ideally 5 wounds per 100 landlocked salmon); and
  - 2 wounds per 100 walleye
    (ideally less than 1 wound per 100 walleye).

- Attain target wounding rates within five years of full implementation of the Proposed Action. Full implementation is defined as application of optimal sea lamprey control strategies on all tributaries that are identified in the Proposed Action and are known to warrant sea lamprey control measures.

These objectives are based on further reducing wounding rates observed before and after the eight-year experimental program, on fish species for which ample data sets existed as outlined in Table I-1. For comparison purposes, fish in particular size ranges and captured during specific seasons would be used. Lake trout wounding rates on fish in the 533-633 mm (21.0-24.9 in.) size interval will be monitored by summer gill netting or fall nearshore electrofishing surveys. Landlocked Atlantic salmon wounding rates would be based on fall collections of salmon in the 432-533 mm (17.0-21.0 in.) size interval from fishways such as the Willsboro Fishway and the Winooski One Fish Lift and from nearshore and tributary electrofishing surveys. Walleye wounding rates among fish in the 534-634 mm (21.0-25.0 in.) size interval would be based on electrofishing surveys during spring spawning runs. Other acceptable and consistent sampling strategies may be substituted by the Cooperative for collection of comparative data if deemed necessary or more efficient.

During the development of these objectives the Cooperative considered the objectives of the Great Lakes sea lamprey control program administered by the Great Lakes Fishery Commission (Klar and Schleen 2001). Two Great Lakes, Erie and Ontario, use lake trout wounding rates as part of their sea lamprey management objectives. Lake Erie has as a sea lamprey control objective: less than 5% wounding on lake trout 533-633mm in length. Lake Ontario has as a sea lamprey control objective: less than 2 fresh wounds per 100 lake trout over 431mm in length. These Great Lakes objectives use slightly different but comparable criteria to Lake Champlain objectives. All five Great Lakes have sea lamprey control objectives including a component regarding lake trout population rehabilitation among its fishery objectives.

The Lake Champlain wounding rate objectives were developed to allow favorable conditions for the rehabilitation of lake trout and other important fish populations. However, Great Lakes wounding objectives are more optimistic regarding the ability to reduce sea lamprey predation. Lake Erie had attained their wounding rate objective but experienced an increase in wounding to 15 wounds/100 lake trout in 2000. Lake Ontario has experienced fluctuations between 1 and 3 wounds per 100 lake trout since 1985 (Brian Lantry, NYSDEC 2001, personal communication).

About 8% of tributaries in the Great Lakes produce sea lamprey (Morman et al. 1980), compared to approximately 20% of the tributaries in the Lake Champlain drainage. Also, the ratio of drainage area to surface area is over five times greater in Lake Champlain than any of the Great Lakes (Marsden et al. in review). These differences translate to higher densities of parasitic-phase sea lamprey in Lake Champlain compared to the Great Lakes, and suggest that it would not be realistic to expect to achieve wounding rates equal to those sought on the Great lakes. The objectives developed for the Lake Champlain Proposed Action established salmonid wounding rates using the best available information and are based on the wounding rates achieved during experimental sea lamprey control. These objectives represent the Cooperative's best expectations if the proposed program is fully employed.

During development of the walleye objective the Cooperative considered the historical wounding rates seen before, during and after experimental sea lamprey control as indicated by annual Poultney River electrofishing assessments. This data set represents the best Lake Champlain information regarding sea lamprey wounding during this period. Wounding rates achieved during experimental sea lamprey control ranged from 0 - 9 wounds per 100 fish of the selected index size (VTDFW, Pittsford, Vermont, unpublished data). An improvement in wounding consistently at 2 wounds or less per 100 walleye is achievable with an effective, long-term sea lamprey control program.

Table I-1. Sea lamprey wounding rates pre-sea lamprey control (reflects the no action alternative), post-eight-year experimental sea lamprey control (reflects Alternative 2) and acceptable and ideal sea lamprey wounding rate objectives for long-term sea lamprey control (Proposed Action) on selected fish species. Wounds per 100 fish have been rounded to the nearest whole number.

Species	Mean number of lamprey wounds per 100 fish			
	Pre-control	**Post-eight-year control**	**Acceptable Objective**	**Ideal Objective**
Lake trout[a]	55	38	25	10
Landlocked salmon[b]	51	22	15	5
Walleye[c]	13	4	2	<1

[a] Pre-control (1982-92) and post-control (1993-97) data from mid-summer New York and Vermont Main Lake gill netting surveys for lake trout in the 533-633 mm (21.0-24.9 in.) length interval.

[b] Pre-control (1985-92) and post-control (1993-98) data from fall sampling of Main Lake spawning-phase salmon captured at the Willsboro Fishway in the 432-533 mm (17.0-21.0 in.) length interval.

[c] Pre-control (1988-1992) and post-control (1993-1998) data from spring electrofishing surveys of Main Lake and South Lake walleye captured in the Poultney River in the 534-634 (21.0-25.0 in.) mm length interval.

B. <u>Need</u>

Lamprey belong to a primitive group of vertebrates (class Agnatha) known as "jawless fishes." Lamprey are eel-like in shape and unlike other more advanced fishes, have a skeleton made of cartilage instead of bone. The sea lamprey is common on both sides of the Atlantic Ocean; in the east from Norway south to the Mediterranean Sea and in the west from Greenland south to Florida. The anadromous form, the largest and most predacious of the world's lamprey with lengths to almost three feet, is generally not regarded as a serious threat to marine fish stocks. In contrast, the decline of valuable freshwater fish stocks in the Great Lakes occurred subsequent to the invasion of the sea lamprey. The presence of the landlocked sea lamprey was documented in Lake Ontario in 1835 (Lark 1973), in New York's Finger Lakes in the late 1800s (Wigley 1959), and in Lake Champlain in 1929 (Greeley 1930).

<u>Lamprey Species in Lake Champlain</u>

Of the 31 recognized species of lamprey, four have been recorded in the Lake Champlain Basin. Two of these species, the sea lamprey and the silver lamprey, are parasitic. The other two species, the American brook lamprey and the northern brook lamprey, are non-parasitic.

<u>Sea Lamprey Life History</u>

Lamprey have a complex life history involving a total of four or more years. After hatching from the egg, the sightless, elongated larval form, sometimes called an ammocoete, burrows into soft bottom deposits found in slower stretches of streams. They spend an average of three to six years living in bottom deposits and feeding largely on algae. Larvae which have attained a minimum critical size undergo dramatic physiological and morphological changes. During this period of metamorphosis, which occurs from mid to late summer, the larvae transform into a miniature version of an adult lamprey equipped with functional eyes and a cup-shaped sucker-mouth, armed with teeth. Soon after transformation, the sea lamprey migrate out of the streams and begin their parasitic phase.

Recently metamorphosed sea lamprey (transformers) outmigrate from streams starting in the late autumn and immediately seek a host if prey are available. Parasitic-phase lamprey obtain nourishment by attaching to the host fish and feeding on their body fluids. Sea lamprey will also attach to fish or inanimate objects as passive transport mechanisms. Transformers actively migrate to deeper waters and as growth occurs during parasitic feeding, adults move shoreward to shallower waters during the following autumn (Scott and Crossman 1973). Parasitic-phase sea lamprey are known to engage in inter-basin migrations reaching distances up to 389 miles on the Great Lakes (Applegate and Smith 1951; Smith and Elliot 1952; Moore et al. 1974; Heinrich et al. 1985). Scott and Crossman (1973) cite sea lamprey stream migrations of up to 49 miles in landlocked populations and 200 miles in sea run populations. The period of sea lamprey parasitic feeding varies from 12 to 20 months, depending on the timing of outmigration from streams (fall to spring). Following the variable period of parasitism, the lamprey attain sexual maturity and migrate up tributaries to spawn. The spawning period occurs in spring and is followed by the death of the animals.

Historical Accounts of Sea Lamprey in Lake Champlain

The first published account of the positive identification of the sea lamprey in Lake Champlain appeared in Section II of *The Biological Survey of the Champlain Watershed*, in which Greeley, (1930) stated that *Petromyzon marinus*, known locally as the lake lamprey, was moderately common in Lake Champlain. Greeley was referring, presumably, to the parasitic-phase specimens which were attached to fish netted during the survey from the waters of the lake, as very little was known about the distribution or abundance of larval populations in streams. Sea lamprey larvae were collected (dug from the bottom sediments) from only one river during the 1929 survey, Putnam Creek at Crown Point. However, this distribution reflects a minimal sampling effort; according to the report, only two streams were sampled for lamprey larvae: Putnam Creek and the Ausable River.

Origin of Lake Champlain Sea Lamprey

Although the historical evidence does not rule out endemicity of the sea lamprey in Lake Champlain, it appears unlikely. A probable dispersal route of the sea lamprey from the ocean into Lake Champlain was through the Hudson-Champlain Canal. The waterway, completed in 1819, provided a connection between the Hudson River, which has natural runs of anadromous sea lamprey, and the lake. Although Greeley (1930) thought the sea lamprey may have invaded from the north, he felt that other species of fish, including the carp, may have invaded Lake Champlain from the south via the canal route. More recently, anadromous sea lamprey have been captured in a tributary of the St. Lawrence River located just opposite the mouth of the Richelieu River which drains Lake Champlain; thus a sea lamprey invasion route from the north cannot be ruled out.

For additional information on the different lamprey species, taxonomy, life history and historical accounts of sea lamprey in Lake Champlain, see Appendix I of the FEIS.

Sea Lamprey Impacts on Salmonids and Sportfisheries

Prior to the eight-year experimental sea lamprey control program, the sea lamprey was having a major impact on the salmon, brown trout and steelhead rainbow trout populations and sportfisheries in Lake Champlain, and a significant impact on lake trout (Anderson, J. K. et al. 1985). Surrounding communities experienced associated social and economic consequences.

Total harvest of salmonids before sea lamprey control was far below the estimated Lake Champlain production capability. Historic records indicate significant populations of landlocked Atlantic salmon and lake trout once inhabited the lake. Water quality and habitat are suitable for salmonids. However, substantial salmonid stockings by New York and Vermont were not providing a high quality fishery. Lake Champlain's salmonid yield was low, and a considerable body of evidence indicated parasitism by sea lamprey to be the cause. It was estimated that salmonid harvest and number of angler trips in 1985 was only 45 percent of the numerical targets stated in *A Strategic Plan for Development of Salmonid Fisheries in Lake Champlain*, the salmonid fisheries plan adopted and implemented in 1977 by the Lake Champlain Fish and Wildlife Management Cooperative.

Lake Trout:

Over 2.8 million lake trout had been stocked in Lake Champlain between 1972 and 1985, of which 90 percent were planted in the Main Lake (Plosila and Anderson 1985). Although a good lake trout fishery developed in the Main Lake in the area of Westport, New York and north to Willsboro Point, New York, only a small fishery resulted in the northern Main Lake Basin. Estimated lake-wide annual harvest in the early 1980s was about 5,000 lake trout averaging 5.3 pounds. This estimate was one-third of the annual lake trout harvest objective of 18,000 and only 20 percent more than the estimated harvest of 4,000 lake trout in Lake George, New York (Miller and Lantiegne 1984). By comparison, Lake Champlain's potential lake trout habitat was 4.5 times greater than Lake George's.

Further evidence that sea lamprey were negatively affecting the lake trout fishery was indicated by gill net catch rates. Gill net catch rates of 6 to 13 lake trout per 1000 feet of net, indicated an exceptionally sparse lake trout population in the Main Lake (Anderson, J. K. et al. 1985) as compared to Lake Ontario (60-70) or Cayuga Lake (45-66). This low catch rate was despite Lake Champlain's stocking rate of 1.6 yearling lake trout per acre. This stocking rate was similar to Cayuga's (1.7) and three times greater than Ontario's (0.5).

Sea lamprey wounding data collected from Lake Champlain lake trout also suggested sea lamprey were causing serious impacts to the fishery. Total incidence of attack (wounds and scars) for all sizes of lake trout during 1978-1984 averaged nearly 85 percent while the wounding rate averaged about 50 percent (Anderson, J. K. et al. 1985). In Lakes Michigan and Superior, control of sea lamprey was considered adequate when incidence of fresh wounding was less than 4 percent on lake trout 21.0-33.0 inches (533-838 mm) total length. Mortality of lake trout attributed to sea lamprey attacks has been estimated for Lakes Michigan and Superior. In Lake Michigan, fresh wounding rates of 1, 3 and 8 percent were associated with lamprey-induced mortality rates of 5, 15 and 31 percent (Wells 1980). A similar correlation was observed in Lake Superior where 2 and 10 percent spring wounding rates were associated with 7 and 32 percent annual rates of mortality (Pycha 1980). Prior to sea lamprey control, wounding rates in lake Champlain ranged from about 20 percent for lake trout in the 13.0-16.9 inch (330-492 mm) size group to about 50 percent for fish in the 25.0-28.9 inch (635-734 mm) size group (Anderson, J. K. et al. 1985) suggesting significant sea lamprey-induced mortality.

Landlocked Atlantic Salmon:

Over 3.1 million landlocked Atlantic salmon of various sizes had been stocked in Lake Champlain between 1972 and 1984, of which 82 percent were planted in the Ausable, Boquet, Saranac and Winooski Rivers and Lewis and Otter Creeks (Plosila and Anderson 1985).

Estimated lake-wide annual harvest in the early 1980s was about 2,500 salmon averaging 3.6 pounds. This estimate was 20 percent of the annual salmon harvest objective of 12,200 stated in *A Strategic Plan for Development of Salmonid Fisheries in Lake Champlain*. Similarly to lake trout, this estimate was far below the estimated annual harvest in Lake George (4,000 salmon). Again, by comparison, Lake Champlain's potential salmon habitat was 4.5 times greater than Lake George's.

Sea lamprey attack rates and fisheries for landlocked Atlantic salmon varied among the three Lake Champlain Basins. From 1978-1981, salmon from the Main Lake, Malletts Bay and the Inland Sea Basins had total attack rates of 48, 43 and 28 percent, respectively (Anderson, J. K. et al. 1985). The quality of the salmon fishery was found to vary inversely with attack rates. The highest attack rates in the Main Lake related to a relatively poor salmon fishery, while lowest attack rates in the Inland Sea related to a relatively better salmon fishery. However, a low proportion of large, older-age salmon in angling and in sampling gear catches indicated poor survival in all three lake basins. Survival estimates for Malletts Bay salmon were calculated to be 37.5 percent for ages 2-3 and 20.4 percent for ages 3-4 (1979 and 1980 year classes) (Anderson, J. K. et al. 1985). Estimated survival for Inland Sea salmon of the 1980 year class was 57.7 percent for ages 2-3 and 5.2 percent for ages 3-4. Survival for the 1981 year class in the Inland Sea decreased to 12.5 percent for ages 2-3 and remained relatively stable at 6.7 percent for ages 3-4. Increased mortality for the 1981 year class was believed to be lamprey-related as wounding rates on the Inland Sea salmon increased substantially from 1982 through 1984.

Steelhead Rainbow Trout and Brown Trout:

Over 1.1 million steelhead and 435,000 brown trout of various sizes were stocked in Lake Champlain from 1972 to 1984 (Plosila and Anderson 1985). The majority of the steelhead were planted in the Saranac and Winooski Rivers and Lewis Creek. Most of the brown trout were stocked in the Main Lake. Both species provided only limited fisheries. Steelhead were caught in the tributaries, while the Inland Sea produced the best returns of brown trout to the angler.

Insufficient numbers of both steelhead and brown trout were collected to calculate survival estimates, however, survival of age 3 and older fish appeared to be very low. Attack rates ranged from 17 percent for steelhead to 69 percent for brown trout in the Main Lake, but again, few individuals of both species were examined (Anderson, J. K. et al. 1985). Sea lamprey predation was presumably the cause of the lack of older fish.

Other Fishes:

Sea lamprey attack rate estimates on other fishes in Lake Champlain are available for lake whitefish, walleye and northern pike. Prior to sea lamprey control, total incidence of attack for lake whitefish was 2-21 percent for the Inland Sea, 20-35 percent for the Main Lake and 43-51 percent for Malletts Bay (Anderson, J. K. et al. 1985). Sea lamprey wounding rates on walleyes ranged from 10-25 percent. In 1984, 92 percent of the fish larger than 23.6 inches (599 mm) were females and had a wounding rate of 34 percent, raising concerns of the impacts to recruitment (Nettles in review). Sea lamprey wounding on northern pike in various areas of the lake was less than salmonids (10-17 percent) but appeared to be increasing annually.

Anticipated effects of Sea Lamprey Reduction

The above data on Lake Champlain's salmonids show several similarities to Lake Ontario prior to effective sea lamprey control. Sea lamprey control on Lake Ontario has produced dramatic improvements in the fishery and major economic benefits to the area's tourist industry. The same pattern was observed earlier in the Upper Great Lakes, and in the New York Finger Lakes where control was initiated in 1982. Thus, in situations similar to Lake Champlain, sea lamprey control has been successful and beneficial.

A variety of biological, ecosystem, social, and economic benefits are expected from sea lamprey control. Biologically, survival would increase among salmonids and other fish species which serve as prey for the sea lamprey and whose survival is adversely affected by sea lamprey parasitism. This was indeed the case as a result of the eight-year experimental sea lamprey control program. For example, survival of age 3-4 lake trout improved 25 percent and pre- and post-treatment creel surveys revealed a 76 percent increase in estimated lake trout catch.

Relative to social benefits, more and larger salmonids would provide greatly improved fishing and decreased lamprey attack rates would improve the appearance of fish. The tributary fisheries for landlocked Atlantic salmon would be a particularly unique and highly prized angling opportunity, while many nonanglers would have the opportunity to observe migrating salmonids at fishways and falls. Other water-based recreationists would experience fewer lamprey attachments to themselves and their equipment.

Substantial economic benefits would accrue if the proposed program is enacted. Estimated benefits and costs of the eight-year experimental sea lamprey control program indicated a favorable benefit:cost ratio of 3.48:1. Continuation of sea lamprey control on Lake Champlain would be expected to generate up to an additional 1.2 million days of fishing and $42.2 million in fishing-related expenditures, as well as an estimated $59.3 million in additional water-based recreation expenditures each year (Gilbert 1999a).

In addition to the above benefits, the proposed program responds to the specific objective of the eight-year experimental sea lamprey control program, as described in its associated FEIS, which was to:

“...formulate long-range policy and management strategies for minimizing the effects of sea lamprey in Lake Champlain. Strategies would include a combination of best available techniques which would provide optimum results in terms of fish resource and fishery benefits as well as environmental compatibility, cost-effectiveness and economic benefits.”

II. PRECEDENTS, LEGAL AND RELATED REQUIREMENTS

A. Precedents

1. Great Lakes

A program to control the invasive sea lamprey began in the upper Great Lakes in the early 1950s with the construction of mechanical and electrical barriers on tributaries in attempts to block sea lamprey spawning migrations. These control measures were not considered effective until the discovery and use of the selective lampricide, ∝,∝,∝,-Triflouromethyl-4-nitro-cresol, sodium salt (3-trifluoromethyl-4-nitrophenol or TFM) in 1958, which resulted from an extensive screening of over 6000 chemicals (Smith and Tibbles 1980). Barriers were largely phased out by 1970, with a few remaining ones maintained primarily for monitoring spawning runs (Smith and Tibbles 1980). The Great Lakes Fishery Commission (GLFC) renewed interest in developing barrier dams and established a barrier program in 1975 as part of an integrated sea lamprey control program. There are currently 61 barriers maintained by GLFC throughout the Great Lakes Basin (Lavis et al. in review). Today, a product named Lamprecid® with the active ingredient TFM (also known as TFN) is the primary lampricide registered by the United States Environmental Protection Agency (EPA) for the control of sea lamprey. Niclosamide, 5-Chloro-N-(2-chloro-4-nitrophenyl) 2-hydroxybenzamide compound (1:1), is the active ingredient present in three formulations registered by EPA for the use as lampricides under more limited circumstances: Bayluscide 70% Wettable Powder (EPA Registry Number 6704-87), Bayluscide 5% Granular Sea Lamprey Larvicide (EPA Registry Number 6704-90), and Bayluscide 3.2% Granular Sea Lamprey Larvicide (EPA Registry Number 6704-91) (NRCC 1985). The chemical name, 2',5-dichloro-4'-nitrosalicylanilide is an alternative name for niclosamide. Bayluscide is also known as Bayer 73 or clonitralid. Sea lamprey control within the Great Lakes Basin is under the jurisdiction of the GLFC with the actual control operations conducted under contract by the Service and the Department of Fisheries and Oceans, Canada. The history of chemical lampricide use in the Great Lakes is summarized on pages 68-70 of the FEIS.

In New York State, chemical lampricides were first used for sea lamprey control in 1971 in conjunction with the GLFC program in Lake Ontario. These treatments have continued, and today, streams are treated when sea lamprey larvae reach transformation size, normally every three to five years. Treatments of most sea lamprey-inhabited tributaries of the Oneida Lake system were initiated in 1984, resulting in further suppression of the Lake Ontario sea lamprey population and a corresponding increase in Lake Ontario lake trout survival (Elrod et al. 1995).

2. New York Finger Lakes

The NYSDEC, Division of Fish and Wildlife, used TFM and Bayluscide in a five-year field trial of sea lamprey control in the Seneca Lake system. The program was undertaken only after a thorough review of need and feasibility, a comprehensive analysis of environmental impacts and extensive public review (Jolliff et al. 1980, 1981). The first of two treatments was completed in 1983 and the second was conducted in the fall of 1986. Sea lamprey control was very effective in Seneca Lake, significantly reducing lamprey-induced mortality in salmonids and improving salmonid survival; average annual lamprey-induced mortality on age 3-15 lake trout declined from 14.4 percent in 1977-82 to 1.4 percent in 1986-88 (Engstrom-Heg and Kosowski 1991). Following an assessment of management alternatives, a long-term sea lamprey control program was developed to maintain the improved Seneca Lake fishery (Kosowski and Hulbert 1993).

In 1986, NYSDEC initiated TFM treatments in Cayuga Inlet to control sea lamprey in the Cayuga Lake system, that was unsuccessfully challenged by opponents of the program. A summary of the legal issues surrounding the Cayuga Lake program and the resulting adjudicatory decision are presented in pp. 69-70 and Appendix H of the FEIS. The program resulted in a 98.7 percent reduction in sea lamprey abundance and dramatic improvements in salmonid fishing quality, including a 69 percent increase in catch rate for trophy-sized salmonids (Bishop and Chiotti 1996). Unique features of Cayuga Inlet allowed the implementation of an integrated pest management approach using both mechanical and chemical methods for long-term sea lamprey control (Chiotti 1996).

3. Lake Champlain

NEPA Compliance:

The history of the Lake Champlain salmonid fishery restoration program and development of the eight-year experimental sea lamprey control program and FEIS is summarized in Section III.A. of this document. The FEIS was published on July 19, 1990 and the Record of Decision was issued on September 11, 1990.

The Cooperative also prepared an Environmental Assessment (EA) for the proposed 1996 Poultney River treatment in accordance with NEPA and the Federal Aid in Sportfish Restoration Act (Fisheries Technical Committee 1996). This was due to the minor change in scope of the Proposed Action as described in the FEIS, stemming from potential impacts to recently state-listed species and the expectation of controversy surrounding the treatment. The Service issued a Finding of No Significant Impact regarding the Proposed Action described in the EA on October 1, 1996.

In addition to meeting NEPA requirements, NYSDEC and VTDFW were required to obtain permits to conduct lampricide applications during the experimental program from their respective state regulatory agencies (See Section II.E.).

New York Permits:

New York's Region 5 Fisheries Unit obtained four permits authorizing use of TFM and Bayluscide 5% Granular in New York waters; three were issued by NYSDEC on August 29, 1990. These included a Freshwater Wetlands Permit relevant to wetlands outside of the Adirondack Park boundaries and two Permits to Use Chemicals for the Control and Extermination of Undesirable Fish. The latter two are also known as Pesticide Use Permits. One was for use of TFM in streams and the other was for Bayluscide applications on stream deltas. The above permits collectively were assigned identification number DEC #5-9905-00002/00001-0. The fourth permit was an Adirondack Park Agency Freshwater Wetlands permit (#88-1014) issued on September 7, 1990 relevant to wetlands within the Adirondack Park boundaries.

Early in 1992, the Region 5 Fisheries Unit requested modification of specific conditions in the NYSDEC Freshwater Wetlands and TFM Pesticide Use Permits. Schedule changes were requested to allow treatment of the Great Chazy and Poultney Rivers in 1992 and 1996, because planned 1991 treatments were cancelled due to technical concerns related to low flows. More flexibility in allowing such schedule changes without formal permit modification was requested. A request was made for deletion of a specific Poultney River condition requiring attenuation of TFM concentrations to 0.8 MLC below Coggman Bridge. Additional requests were made for the deletion of in-situ eastern sand darter bioassay mortality requirements, including a stop-work trigger and development of a recovery plan. Date changes were allowed and some minor relief from the 0.8 MLC attenuation requirement was granted by allowing the TFM concentration not to exceed “an average of 0.80 MLC with a maximum variation of +0.10 MLC...” However, most of the requests were denied in the modified permits issued on March 19, 1992.

Typographical errors were discovered in the schedule of treatment dates for Beaver Brook and Putnam Creek in the modified TFM Pesticide Use Permit issued March 19, 1992. New York’s sea lamprey control project manager filed a request for their correction, and these were revised with another permit modification issued on March 21, 1994.

The Cooperative documented the results of the largely ineffective 1992 treatments on the Poultney and Hubbardton Rivers, and New York’s project manager again requested modification of the NYSDEC Freshwater Wetlands and TFM Pesticide Use Permits. Requests for modification were filed on October 26, 1995 and December 7, 1995. On April 22, 1996, the permits were modified to allow treatment of the Poultney River with TFM at a mean treatment level of 1.0 MLC as determined by bioassay techniques with no attenuation requirement at Coggman Bridge, and to allow simultaneous treatment of the Poultney and Hubbardton Rivers.

In October 1996, additional modifications were requested to allow treatment of the Poultney and Hubbardton Rivers at water temperatures less than 45 degrees Fahrenheit, and to change the last allowable date of treatment of these and other waters from October 30 to October 31. Modified permits containing these changes were issued on October 25, 1996.

No modifications were requested throughout the experimental program for the NYSDEC Bayluscide Pesticide Use Permit.

The expiration date of the NYSDEC Freshwater Wetlands Permit was designated as December 31, 1996. No definitive expiration date was listed for NYSDEC Pesticide Use and the Adirondack Park Agency Freshwater Wetlands Permits, but the conditions contained in the permits essentially resulted in their expiration at the same time.

In April 1998, the New York Region 5 Fisheries Unit initiated the State Environmental Quality Review Act (SEQRA) process to be eligible to obtain new permits for, and continue independent TFM treatments on, the nine known sea lamprey-producing tributaries totally contained within New York's borders. Because of its shared status with Vermont, the Poultney River was not included in this assessment process. The assessment culminated in the issuance of a Negative Declaration of Significance on April 29, 1998 that was published in the New York State Environmental Notice Bulletin on May 6, 1998. In brief, the negative declaration determined that the proposed Lake Champlain sea lamprey control consisting of TFM stream treatments would not have a significant, adverse environmental impact. It described the action as involving the control of the abundance of sea lamprey in Lake Champlain by application of chemical lampricides to the Great Chazy, Saranac, Salmon, Little Ausable, Ausable and Boquet Rivers, Beaver Brook, Putnam Creek, and Mount Hope Brook. The project would continue the stream treatments and fundamental mitigation strategies first initiated in 1990 pursuant to the FEIS.

Applications were submitted for a new NYSDEC Freshwater Wetlands Permit, a new Permit to Use Chemicals for the Control and Extermination of Undesirable Fish, and a new Adirondack Park Agency Freshwater Wetlands permit.

In response, the Adirondack Park Agency issued Permit #97-213 on June 12, 1998, designating it as an amendment to Permit #88-1014.

In order for NYSDEC to issue its TFM Pesticides Use Permit, the requirements of 6NYCRR § 328.1(b) had to be met regarding riparian user consent to the project. During February and March, 1998, in accord with this regulation, the regional Fisheries Unit conducted a survey of affected riparian property owners to determine if landowners consented to temporary restriction of water use while TFM was present in the water adjoining their property. Staff mailed surveys for 1391 parcels, and 1151 (83%) were returned. An overwhelming majority of responses (1090 or 95%) consented to the temporary restrictions. A few (26 or 2%) objected. Thirty-five responses (3%) neither consented or objected.

The standard set forth in 6NYCRR § 328.1(b) was as follows: "For the protection of riparian uses, no such permit shall be issued except where the applicant has certified that the affected riparian users have agreed to temporary curtailment of their uses incidental to treatment or unless the applicant demonstrates to the satisfaction of the commissioner that any non-consenting riparian users will not be significantly adversely affected by the use of the chemicals subject to such limitations as are set forth in the permit."

A consent survey conducted in 1990 before the original Lake Champlain treatments yielded similar proportions of consenting and non-consenting responses, and all required NYSDEC permits were issued. Previously, on April 22, 1986, Commissioner Langdon Marsh addressed the issue of non-consenting riparian landowners in the matter of the application of the Bureau of Fisheries for permits to apply lampricide to certain tributaries of Cayuga Lake by stating, "Non-consenting riparian owners will suffer only a temporary loss of use of lake water for potable purposes and will be provided free bottled water for the duration of the TFM treatment." He directed Department staff to issue the required permits for that project.

On August 26, 1998, Commissioner John P. Cahill determined that "Non-consenting riparian owners have raised no substantive issues and will be affected only temporarily due to a loss of use of stream or lake water. Further, any essential water needs during that period will be satisfied by Region 5 Fisheries staff as outlined in the Prior Notification, Posting and Water Supply Plan (June 1998). Accordingly, I hereby direct Department staff to issue the required permits with conditions appropriate for protecting environmental resources." NYSDEC issued its new Freshwater Wetlands and TFM Pesticide Use Permits on September 10, 1998 and collectively assigned identification number DEC #5-9905-00002/00003 to them.

There were no legal challenges specific to the permits or their modifications in New York.

Vermont Permits:

VTDFW obtained its Aquatic Nuisance Control Permit (C-90-01) on March 4, 1990, authorizing TFM treatments of all of the Vermont tributaries proposed in the FEIS, except for the Poultney/Hubbardton River system. The permit also authorized the use of Bayluscide 5% Granular sea lamprey larvicide for larval sea lamprey population surveys. On October 4, 1990, VTDFW requested its permit be amended to enable TFM treatment in the Poultney and Hubbardton Rivers in 1991 and 1995. These permit amendments were granted by the Vermont Department of Environmental Conservation (VTDEC) on April 4, 1991 (permit C-90-01 Amendment), but the 1991 treatment was cancelled due to unfavorable river flows.

VTDFW obtained five modifications to the amended permit, which were granted in a new permit (C-92-01) on March 17, 1992, including changing the initial year for treatment of the Poultney and Hubbardton Rivers to 1992 and extending the permit to allow the second treatment in 1996. The Poultney River Committee, a local citizens group, filed an appeal of permit C-92-01 with the Vermont Water Resources Board (WRB) on April 15, 1992, with intent to enjoin the entire permit. The WRB issued a preliminary order on August 11, 1992, ruling that only the most recent five amendments could be appealed. The Poultney River Committee appealed the WRB ruling to the Rutland Superior Court, and the Court ruled in favor of the WRB ruling on February 3, 1994 (Docket No. S0693-92RcCa). Since the appeal itself did not stay the actions authorized in the permit, treatments of the Poultney and Hubbardton Rivers took place on September 24 and 25, 1992. On the day before the treatments, the Poultney River Committee unsuccessfully sought to obtain a Rutland Superior Court Order to stop the treatments until the WRB heard the appeal. The appeal case finally reached the Vermont Supreme Court (Docket No. 94-165), where it agreed with the WRB's ruling and issued its decision on June 26, 1995. On August 23, 1995 the Poultney River Committee indicated to the WRB that it still intended to proceed with the appeal of permit C-92-01. The WRB granted a request by VTDFW to withdraw permit C-92-01 and subsequently dismissed the Poultney River Committee's appeal on November 1, 1995. By withdrawing permit C-92-01, VTDFW gave up its authorization to conduct the second treatments of the Poultney and Hubbardton Rivers until it obtained a new permit authorizing the treatments.

Restrictive conditions in the permits allowing the 1992 Poultney River treatment rendered the treatment ineffective; therefore, VTDFW, like NYSDEC, requested less restrictive conditions to increase the effectiveness of the second experimental treatment scheduled for 1996. The conditions were granted to VTDFW in a new Aquatic Nuisance Control Permit (C-96-06) on October 10, 1996. After the previous permit (C-92-01) was granted, one new aquatic species inhabiting the Poultney River was added to the Vermont threatened and endangered species list and proposed listing of other Poultney River species were in the rule-making process in 1996 (see Section VI.D. for currently listed species); this required VTDFW to apply for a Threatened and Endangered Species Permit, which was issued by the Vermont Agency of Natural Resources on September 13, 1996.

The second Poultney and Hubbardton River TFM treatment was conducted on October 30, 1996. The Poultney River Committee appealed the VTDFW permit (C-96-06) and filed a Motion to Stay with the WRB on October 25, 1996. The WRB denied the motion, concluding that it had no authority to issue Stays, and that it could not meet to hear and rule on the appeal prior to the scheduled treatment.

4. Summary

The precedent for using the chemical lampricides TFM and Bayluscide for control of sea lamprey has been established by over 40 years of effective and safe use in the Great Lakes in a program administered by GLFC. More recently, this precedent has been expanded by the addition of control programs in Seneca and Cayuga Lakes which are administered by NYSDEC, and the experimental program in Lake Champlain administered by the Cooperative. The 1990 decision to use TFM and Bayluscide in the Lake Champlain Basin followed careful review of a massive scientific and legal record, which included the Seneca and Cayuga Lakes decisions. This, in conjunction with the scientific findings of the eight-year experimental program evaluation and related legal record from the Lake Champlain program, along with continuing advancements in sea lamprey control technology through research sponsored by GLFC (See Section IV), provides a strong basis for continued use of these lampricides, integrated with use of barriers and other alternative control methods where feasible, for sea lamprey control in the Lake Champlain Basin.

B. Statutory Authority

Statutory authority to control sea lamprey within the U.S. portion of the Lake Champlain Basin rests with governmental agencies having broad responsibilities for the management of fish and wildlife resources. In New York, this authority is vested within the New York State Department of Environmental Conservation, while in Vermont, it is within the Vermont Department of Fish and Wildlife. The Service is authorized by federal statutes to cooperate with state agencies in such programs. Specific authority for each agency is summarized below.

1. New York

Articles 11 and 13 of the Environmental Conservation Law (ECL) direct NYSDEC in management of the fish and wildlife resources of the state.

2. Vermont

Authority to control sea lamprey in Vermont waters of Lake Champlain is provided in Subchapter 2, Section 4081 and Subchapter 3, Section 4081 and Subchapter 3, Section 4138 of Title 10 of Vermont Fish and Wildlife Laws and Regulations.

3. U.S. Fish and Wildlife Service

NEPA requires that an environmental impact statement be prepared for federal actions which significantly affect the human environment. The Service is directly involved in this proposal through: 1) the actions of Service employees who conduct sea lamprey control; 2) because funding the proposal will involve use of Federal Aid in Sportfish Restoration Act funds administered by the Service and used by the states of Vermont and New York, as well as other federal funds; and 3) because of the potential for lampricides to be applied within the Missisquoi National Wildlife Refuge.

The Service is authorized by 16 U.S.C. Section 661-666 (Fish and Wildlife Coordination Act) to provide assistance to federal, state, and other agencies in development, protection, rearing, and stocking of fish and wildlife and controlling losses thereof.

Further authority to control sea lamprey in Lake Champlain was specifically granted to the Service through Section 304 (c) paragraph (2) of the Lake Champlain Special Designation Act of 1990 (P. L. 101-596): "To accomplish the purposes of paragraph (1), the Director of the United States Fish and Wildlife Service is authorized to carry out activities related to -

(A) controlling sea lampreys and other nonindigenous aquatic animal nuisances;..."

The *Lake Champlain Special Designation Act Statement of Legislative Intent* clarified this authority: "Recognizing that aquatic nuisance species are causing great damage to the fishery resources in the basin, the Secretary of the Interior (Secretary) is given clear authority to conduct sea lamprey control activities and other salmonid restoration work. The Secretary should also use, as appropriate, equipment purchased with funds provided through the Great Lakes Fishery Commission."

C. <u>EPA Registration, Labels, Use Patterns, and Tolerances</u>

Before the use of any pesticide, such as TFM or Bayluscide, is permitted, the sponsor must first obtain the approval of the EPA. The EPA has developed a well-defined set of guidelines, regulations, and data requirements that must be provided to obtain approval for use. These EPA mandates require the sponsor to demonstrate that use of the pesticide has no long-term effect on the environment or nontarget organisms, does not leave persistent residues, does not break down into other toxic substances, does not pose a health hazard to applicators, and does not have unanticipated long-term effects on human or animal life. EPA issues a registration number for each pesticide approved. A change in the pesticide formulation requires approval from EPA which is granted through an amendment to the registration and product label.

EPA often establishes tolerances for pesticides. A tolerance is the legal maximum residue of a pesticide or chemical allowed to remain in or on a food, or a particular class of food, after treatment with an approved compound, usually following an appropriate interval after application. EPA has not established tolerances or carried out dietary risk assessments for lampricides because these compounds are considered to be non-food and because no lampricide residues are expected to occur in and on food/and or feed or in drinking water, based on current use patterns (EPA 1999).

1. TFM (Lamprecid®)

The use of a liquid TFM formulation has been approved by the EPA as a lampricide. In the United States, this approval carries EPA Registration Number 6704-45. The current TFM product label permits its use for sea lamprey control in the Lake Champlain system (see Appendix B). The treatment procedures proposed for use in Lake Champlain are consistent with the use pattern described on the label and detailed in GLFC standard operating procedures (Klar and Schleen 1999). Liquid TFM formulation contains approximately 36 percent active ingredient; isopropanol is presently used as the carrier or solvent for the liquid TFM, and is the primary inert ingredient.

TFM is also available in a solid bar formulation and its use as a lampricide has been approved by the EPA (Registration Number 6704-86). The bars are water soluble, containing approximately 22 percent active ingredient. They are used to treat small tributaries entering treated streams and are formulated to dissolve at a precise, constant rate in flowing water. The proposed use of bars containing TFM is consistent with the use patterns described on the label (see Appendix B) and detailed in GLFC standard operating procedures (Klar and Schleen 1999).

2. Bayluscide 3.2% Granular Sea Lamprey Larvicide

Bayluscide 3.2% Granular sea lamprey larvicide has been approved by the EPA for larval sea lamprey population surveys, and for control of sea lamprey larvae in waters of the Great Lakes Basin and the Lake Champlain system. This approval carries EPA Registration Number 6704-91. Since the former EPA-approved label for the previous formulation of Bayluscide 5% Granular only allowed its use for larval sea lamprey population surveys, NYSDEC issued a supplemental label which permitted its use for control of sea lamprey larvae in lakes by aerial application. This supplemental label, now expired, carried the Special Local Need Registration No. NY-900002 (EPA Registration Number 6704-91).

NYSDEC's issuance of a supplemental label for Bayluscide 5% Granular followed a major research effort in Seneca Lake, New York in 1982 to meet information requirements by its Bureau of Pesticides Management and the New York State Department of Health. Required studies dealt with niclosamide residues in water and fish, efficacy for sea lamprey control and impacts on fish survival. Results were reported by Engstrom-Heg (1983) and Ho and Gloss (1987).

The use pattern for Bayluscide 3.2% granules as proposed for Lake Champlain is consistent with the EPA label (see Appendix B), and detailed in GLFC standard operating procedures (Klar and Schleen 1999). Since the current Bayluscide 3.2% label prohibits aerial application, widespread delta sea lamprey infestations identified for treatment will be treated using surface application methodology. Should delta populations become distributed over areas so large they cannot feasibly be treated using standard surface methodologies, an emergency exemption from label instructions may be sought from the EPA to allow aerial application.

3. Bayluscide 70% Wettable Powder

Bayluscide 70% Wettable Powder has been approved by the EPA as a lampricide in combination with TFM in stream treatments. The approval carries the Registration Number 6704-87. During treatments of selected larger streams, the wettable powder formulation is applied concurrently with TFM to reduce the required amount of TFM by up to 50 percent. When used in combination with TFM, niclosamide typically constitutes 0.5 percent to 2 percent of the total active ingredient on a weight-to-weight ratio (Klar and Schleen 1999). The use patterns for Bayluscide 70% Wettable Powder as proposed for use in Lake Champlain are consistent with EPA labels (Appendix B) and are described in Klar and Schleen (1999).

4. Bayluscide 20% Emulsifiable Concentrate

A liquid Bayluscide formulation containing about 20 percent active ingredient (niclosamide) is currently under development (Klar and Schleen 1999), and has been field tested and evaluated by Great Lakes sea lamprey control units (Bills et al. 1998). This formulation, which is not currently registered, would be intended for use in combination with TFM similar to the current use of Bayluscide 70% Wettable Powder. Successful registration of this emulsifiable concentrate will simplify the procedure for applying TFM and niclosamide in combination to selected tributaries.

D. Permits and Related Requirements

1. New York

Requirements for lampricide application in New York State waters include the following:

- Compliance with the New York State Environmental Quality Review Act (SEQRA).

- Permits from NYSDEC to Use Chemicals for the Control and Extermination of Undesirable Fish, sometimes called Pesticide/Aquatic Use Permits pursuant to ECL Article 15 and 6NYCRR, Part 328.

- Freshwater Wetlands Permits pursuant to ECL Article 24, and within the Adirondack Park pursuant to Executive Law, §§809 (14), 810. One is necessary from the NYSDEC for waters with regulated wetlands outside of the Adirondack Park, and one is necessary from the Adirondack Park Agency (APA) for waters with regulated wetlands within the Adirondack Park.

- State registration of TFM and Bayluscide for sea lamprey control purposes, and Bayluscide for sea lamprey population survey purposes, by NYSDEC.

- An Emergency Exemption from the EPA would be required if an aerial application of Bayluscide 3.2% Granular should become necessary for sea lamprey control purposes.

- A Beaver Dam Removal Permit from NYSDEC for each beaver dam which is to be breached or removed in conjunction with treatment operations. An APA freshwater wetlands permit may also be required for beaver dam removal within the Adirondack Park.

- Compliance with regulations pertinent to eligibility for pesticide applicator certification, as specified by 6NYCRR §325.8. That is, anyone applying these pesticides must be a New York State certified applicator in Commercial Category 5C, Aquatic Pest Control, or a certified commercial technician or commercial pesticide apprentice under the on-site, direct supervision of a certified commercial pesticide applicator.

Requirements for construction of sea lamprey barriers in New York State waters include the following:

- Compliance with SEQRA.

- Freshwater Wetlands Permits pursuant to ECL Article 24, and within the Adirondack Park pursuant to Executive Law, §§809 (14), 810 if regulated wetlands are involved. One is necessary from the NYSDEC for waters with regulated wetlands outside the Adirondack Park, and one is necessary from the APA for waters with regulated wetlands within the Adirondack Park.

- Permission from private landowners to remove any Protected Native Plants, if present, in compliance with 6NYCRR Part 193.3. The removal of Protected Native Plants from state land may only be performed if the state issues a Temporary Revocable Permit in accord with Education Law § 233 .

- Water quality certifications from NYSDEC under Section 401 of the Clean Water Act if applicable.

- Meeting of Dam Safety requirements pursuant to ECL Article 15.

- Construction in Flood Hazard Areas review pursuant to ECL Article 36 and 6NYCRR, Part 502.

- Individual permits from the U.S. Army Corps of Engineers pursuant to Section 404 of the Clean Water Act if applicable.

- New York State Historic Preservation Act review, if the project affects sensitive archeological areas.

- Review in accordance with New York State Wild and Scenic and Recreational Rivers Act.

- Property easements or fee title purchase of barrier site.

- Local building permits if applicable.

2. Vermont

Requirements for lampricide application in Vermont waters include the following:

- Permits from VTDEC to control aquatic nuisances pursuant to Title 10 V.S.A., Chapter 47, Section 1263a.

- Permits from VTDEC to use the tracer dye Rhodamine WT in conjunction with lampricide application pursuant to Section 2-03-B.2 of the Vermont Water Quality Standards.

- Registration of lampricides with the Vermont Department of Agriculture for use within the state.

- Compliance with Vermont regulations for control of pesticides in accordance with 6 V.S.A. Chapter 87. Anyone handling lampricides must be a certified applicator in Non-Commercial Category 5C, Aquatic Pest Control, or under direct supervision of a Vermont certified applicator in Non-Commercial Category 5C.

- Endangered and threatened species permit(s) from the Vermont Agency of Natural Resources pursuant to Title 10 V.S.A., Chapter 123, Section 5408, to apply lampricides to certain streams inhabited by sea lamprey if state-listed endangered and threatened species are also present and could potentially be affected by lampricide treatment.

Requirements for construction of sea lamprey barriers in Vermont waters include the following:

- Permits from VTDEC to control aquatic nuisances pursuant to Title 10 V.S.A., Chapter 47, Section 1263a.

- Stream Alteration Permits from VTDEC pursuant to Title 10 V.S.A. Chapter 41, Subchapter 2.

- Permits to obstruct the passage of fish from VTDFW pursuant to Title 10 V.S.A. Chapter 111, Section 4607.

- Endangered and threatened species permit(s) from the Vermont Agency of Natural Resources pursuant to Title 10 V.S.A., Chapter 123, Section 5408, to construct barriers on certain streams inhabited by sea lamprey if state-listed endangered and threatened species are also present and could potentially be affected by a barrier.

- Wetlands Conditional Use Determinations from VTDEC may be required pursuant to 10 V.S.A. Chapter 37, Section 905 (7-9), if the project will impact wetlands.

- Individual permits would likely be required from the U.S. Army Corps of Engineers pursuant to Section 404 of the Clean Water Act.

- Water quality certification from VTDEC would likely be required under Section 401 of the Clean Water Act.

- Review by the Division of Historic Preservation if the project affects sensitive archeological areas.

- Permission must be granted from all landowners whose land is impounded by the project. Property easements or purchase of barrier site is recommended.

- Local building permits may be required.

Utilization of alternative sea lamprey control techniques other than lampricides or barriers may also require permits from VTDEC to control aquatic nuisances pursuant to Title 10 V.S.A., Chapter 47, Section 1263a.

3. U.S. Fish and Wildlife Service

The proposed sea lamprey control activities would potentially involve one area under the jurisdiction of the Service. Lampricide application to the Missisquoi River, affecting Missisquoi National Wildlife Refuge, would require a Special Use Permit issued by the Refuge Manager should treatment of this tributary become necessary. The Department of the Interior requires the filing of a "Pesticide Use Proposal" 60 days prior to the application of a pesticide.

The Service will comply with its responsibilities under Section 106 of the Historic Preservation Act.

4. Quebec

Requirements for lampricide application in Quebec waters include the following:

- Using lampricides in Quebec requires a Certificate of Authorization according to the Environment Quality Act (R.S.Q. Q-2).

- A copy of a map showing land use/land cover must be supplied along with a certificate from the clerk or secretary/treasurer of the local municipality stating the realization of the project does not violate any municipal by-laws.

- Quebec Directive 017 form must be submitted.

- Article 32 of the federal law on Fisheries in Canada forbids the cause of death of fish by means other than fishing unless authorized. Subsequent forms must be sent to the Chief of Protection de l'habitat du poisson, Pêches et Océans Canada.

- Anyone handling lampricides must be certified in Quebec and the people participating in the operation must be formed (educated) by Quebec's school system. If not educated in the Quebec system, applicant must demonstrate their competency in applying pesticides.

Requirements for construction of sea lamprey barriers in Quebec waters include the following:

- Building a dam or similar barrier structure in Quebec requires a Certificate of Authorization according to the Environment Quality Act (R.S.Q. Q-2). A copy of the zone or use of the territory concerned must be supplied along with a certificate from the clerk or secretary/treasurer of the local municipality stating the realization of the project does not violate any municipal by-laws.

E. Protection for Endangered and Threatened Species

1. Federal

Under the Endangered Species Act of 1973 as amended (16 U.S.C. 1531 et seq.), statutory protection is afforded to endangered and threatened wildlife at the national level. Administration and enforcement of this Act is the responsibility of the U.S. Department of Interior, Fish and Wildlife Service. The purpose of the Endangered Species Act is to conserve "the ecosystem upon which endangered and threatened species depend" and to conserve and recover listed species. Under the law, species may be listed as either "endangered" or "threatened." Endangered means a species is in danger of extinction throughout all or a significant part of its range. Threatened means a species is likely to become endangered within the foreseeable future. All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened.

Section 9 of the Endangered Species Act makes it unlawful for a person to "take" a listed species. The Act says "the term take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." The Secretary of the Interior, through regulations, defined the term "harm" in this passage as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering."

Based on the current lists, 50 CFR 17.11 (wildlife) and 50 CFR 17.12 (plants), no federally-listed or proposed threatened or endangered species under the jurisdiction of the Service are known to occur in the project area, with the exception of endangered Indiana bats (*Myotis sodalis*) and resident or transient bald eagles. No nesting bald eagles are known to exist within the project area. The Proposed Action is not likely to adversely affect these species.

Preparation of a Biological Assessment or further consultation under Section 7 of the Endangered Species Act is not required as proposed sea lamprey control will not affect federally-listed species. Should project plans change, or additional information on listed or proposed species become available, this determination may be reconsidered.

2. New York

Section 11-0535 of New York's Environmental Conservation Law prohibits "the taking, importation, transportation, possession or sale of any endangered or threatened species of fish, shellfish, crustacea or wildlife, or hides or other parts thereof, or the sale or possession with intent to sell any article made in whole or in part from the skin, hide or other parts of any endangered or threatened species of fish, shellfish, crustacea or wildlife... except under license or permit from the department."

Section 9-1503 of Environmental Conservation Law permits NYSDEC to list protected plants by Rule and Regulation and also prohibits any person from knowingly picking, plucking, severing, removing, damaging by the application of herbicides or defoliants or carrying away any protected plant. New York's rare plants are legally protected only if they are listed under the U.S. Endangered Species Act of 1973 or in the Protected Native Plants list (6NYCRR 193.3).

In New York, an endangered species is one which has been determined to be in imminent danger of extinction or extirpation in the state, or is federally-listed as endangered. A threatened species is one that is likely to become endangered within the foreseeable future in the state, or is federally-listed as threatened. A special concern species is a native species not yet recognized as endangered or threatened, but for which a welfare concern or risk of endangerment has been documented. Special concern species are not protected by law. All determinations of special designations in New York are made by NYSDEC and are listed in 6NYCRR §182.6.

3. Vermont

Authority for protection of endangered species of plants and animals in Vermont is provided in Chapter 123, Section 5403 of Title 10 of Vermont Fish and Wildlife Laws and Regulations. This Section provides that "(a) Except as authorized under this Chapter, a person shall not take, possess or transport wildlife or plants that are members of an endangered or threatened species" and "(b) The Secretary may, with advice of the endangered species committee, adopt rules for the protection and conservation of endangered and threatened species."

The Vermont Endangered Species Committee submitted a list of recommended species on September 24, 1986, to the Secretary of the Agency of Environmental Conservation for his approval. The Secretary approved these lists on November 3, 1986, and they were submitted for formal adoption as a rule under the Administrative Act as outlined under Title 3, Section 801 et seq. The lists became legally binding in 1987. Listing changes are recommended through the Endangered Species Committee and legally revised through rulemaking.

In Vermont, an endangered species is any species whose continued existence as a viable component of the state's wild flora or fauna is determined to be in jeopardy including endangered species listed under the Federal Endangered Species Act. A threatened species is one which appears likely to become endangered within the foreseeable future or is determined to be a threatened species under the Federal Endangered Species Act. Scientific Advisory Groups maintain unofficial lists of species of special concern for periodic consideration by the Vermont Endangered Species Committee (Vermont Endangered Species Committee 1986).

4. Quebec

Canada currently does not afford legal protection to endangered and threatened species at the federal level. Canadian legislation to protect species at risk has recently been introduced, but has not been adopted into law.

The Quebec provincial government passed *An Act respecting threatened or vulnerable species* (R.S.Q. E-12.01) in 1989. This Act established a framework for legal designations of threatened and vulnerable plant and wildlife species, and for protection of designated plant species. Protection of threatened and vulnerable wildlife (vertebrate) species designated under this Act are protected under jurisdiction of *An Act respecting the conservation and development of wildlife* (R.S.Q. C-61.1).

In Quebec, the “threatened” designation is defined as a species which is likely to disappear (similar to “endangered” in the United States); the “vulnerable” designation is defined as a species whose survival is precarious even if it is not likely to disappear (similar to “threatened” in the United States). There is also the legal designation of “susceptible”, that indicates a species in a precarious situation, but in need of further study in order to decide whether or not it should be designated as threatened or vulnerable (Beaulieu 1992; Jean Dubé, Société de la Faune et des Parcs du Quebec, Longueuil, Quebec, personal communication).

Applications for permits required to conduct sea lamprey control in Quebec (described in Section II.D.4.) would be reviewed with greater caution and permit conditions may be more restrictive if the authorized activities may affect threatened, vulnerable or susceptible species (Jean Dubé, Société de la Faune et des Parcs du Quebec, Longueuil, Quebec, personal communication; Daniel Savoie, Ministere de l'Environment, Longueuil, Quebec, personal communication).

III. HISTORY/DEVELOPMENT OF 1990-1997 EXPERIMENTAL PROGRAM

A. Background

Lake Champlain supported indigenous populations of landlocked and/or sea run Atlantic salmon and lake trout during its early settlement. The FEIS states both species were rapidly depleted as development in the area progressed during the 1800s. In the late 1950s and early 1960s, New York and Vermont began annually stocking lake trout and landlocked salmon that produced a limited fishery. Encouraged by this success, in 1973, New York, Vermont, and the Service formed the Lake Champlain Fish and Wildlife Management Cooperative. A major goal of this cooperative was to develop and maintain a diverse salmonid fishery. *A Strategic Plan for Development of Salmonid Fisheries in Lake Champlain* was adopted and implemented in 1977 by the Cooperative's Fisheries Technical Committee (Fisheries Technical Committee 1977). The objectives of this program were to re-establish a lake trout and landlocked Atlantic salmon fishery, establish a rainbow (steelhead) trout fishery, and maintain the existing harvest of rainbow smelt. Each objective established a predicted sustainable harvest and a number of angler trips to be generated for each species under consideration. The Strategic Plan also identified sea lamprey control as a potential future need to achieve these objectives.

An aggressive approach to investigating the impact of sea lamprey parasitism on salmonid populations and fisheries, a "Lake Champlain Salmonid Assessment Program," was developed and implemented in 1982 by the Fisheries Technical Committee (Fisheries Technical Committee 1981). Important objectives of this program were to assess sea lamprey abundance and distribution in the lake, the salmonid populations and fisheries, and the feasibility of establishing sea lamprey barriers on major sea lamprey-producing tributaries to Lake Champlain.

In 1985, the Salmonid/Sea Lamprey Subcommittee (a subset of the Fisheries Technical Committee) reviewed and assessed findings of the three studies: *Lake Champlain Salmonid Assessment Report* (Plosila and Anderson 1985), *Lake Champlain Sea Lamprey Assessment Report* (Gersmehl and Baren 1985) and *Preliminary Feasibility Study for Sea Lamprey Barrier Dams on Lake Champlain Tributary Streams* (Anderson, B. E. et al. 1985). The total harvest of salmonids was found to be lower than estimates of Lake Champlain's production capability. Large, old-aged fish were scarce, an unexpected condition given their superior growth rates and light exploitation. Based on these studies, the Cooperative determined that sea lamprey parasitism was hampering the development of the salmonid fishery in Lake Champlain. Program alternatives for future management of the lake's salmonids and sea lamprey were developed and analyzed in *Salmonid-Sea Lamprey Management Alternatives for Lake Champlain* (Anderson, J. K. et al. 1985). The Salmonid/Sea Lamprey Subcommittee recommended an eight-year experimental sea lamprey control program. Objectives included the reduction of sea lamprey through two rounds of lampricide treatments and an evaluation of responses by the sea lamprey population and salmonid sport fishery. The recommendation was reviewed and adopted by the Lake Champlain Fish and Wildlife Management Cooperative's Policy Committee.

Pursuant to NEPA and New York SEQRA guidelines for preparation of a Draft EIS (DEIS), four public scoping meetings were held in New York and Vermont during October 1985. The purpose of those meetings was to review the proposed sea lamprey control program, and to allow public input concerning issues that should be addressed in the environmental impact statement. The DEIS, *Use of Lampricides in a Temporary Program of Sea Lamprey Control in Lake Champlain with an Assessment of Effects on Certain Fish Populations and Sportfisheries* (NYSDEC et al. 1987) was released for public review in September 1987.

Three more studies were conducted before the FEIS was released. These studies, *Evaluation of the Potential Impact of Lampricides (TFM and Bayer 73) on Lake Champlain Wetlands* (Gruendling and Bogucki 1986), *Analysis of Rhodamine WT Dye Plume Studies on Lake Champlain, New York* (Myers 1987a) and *Evaluating Lampricide Transport in Lake Champlain* (Laible and Walker 1987), provided plume dilution and dispersion data required to develop mitigation plans to avoid human and/or wetlands exposure to TFM.

The Cooperative published the FEIS for the eight-year experimental sea lamprey control program in July 1990. The FEIS discussed six program alternatives including a Proposed Action alternative. Four alternatives addressed sea lamprey control and continuation of salmonid stocking; one, designated as the "No Action Alternative," discussed no sea lamprey control and reduced stocking; and one considered termination of the salmonid program and no sea lamprey control.

Four of the alternatives received in-depth analysis including the Proposed Action, Alternative 1, which provided for a major, but temporary reduction in sea lamprey abundance through application of the lampricides TFM and Bayluscide, while assessing the impacts and benefits of that action. Lampricides were to be applied twice in the most infested areas as part of an eight-year experimental program. Information gathered during this program was expected to support an informed decision concerning the desirability of continuing salmonid stocking and long-term sea lamprey control. This alternative was implemented in 1990.

Alternative 2 assumed that long-term control of sea lamprey was desirable and proposed a permanent program including salmonid stocking and full-scale permanent sea lamprey control. Although this program would probably have produced substantial benefits similar to the Great Lakes and Finger Lakes programs, it was rejected in favor of Alternative 1 as it would not provide the scientific evaluation as described above.

Both Alternative 3, continue salmonid stocking at reduced levels in Lake Champlain without sea lamprey control, and Alternative 4, abandon any efforts to control sea lamprey and terminate the salmonid program, were deemed unacceptable. These four alternatives are described in more detail on pages 18-41 of the FEIS.

B. The Eight-Year Experimental Sea Lamprey Control Program

The eight-year experimental sea lamprey control program, Alternative 1, initiated in September 1990, focused on scheduled lampricide application to Lake Champlain tributaries and deltas infested with larval sea lamprey (NYSDEC et al. 1990). Several deviations occurred during the experimental sea lamprey control program which modified the original plan of control (Fisheries Technical Committee 1999):

- A TFM treatment initially recommended for Indian Brook was withdrawn before implementation of the experimental program to protect the northern brook lamprey listed as endangered in Vermont.

- Trout Brook was not treated with TFM during the first round of treatments because permit conditions requiring capture and transfer of American brook lamprey listed as threatened in Vermont, could not be satisfied.

- The second of two scheduled lampricide TFM treatments was cancelled in Beaver Brook (1994) and in Stone Bridge Brook (1995) because slow recolonization following initial treatments resulted in low numbers of lamprey found in each stream.

- Assessment activities on the Little Ausable River Delta indicated that insufficient recolonization had occurred to warrant a second round of Bayluscide treatment in 1995.

- The second round of TFM application to the Saranac River did not occur in 1996 because sea lamprey assessment indicated insufficient sea lamprey recolonization had occurred to warrant treatment.

During the experimental program two physical barriers to adult sea lamprey access to spawning habitat were established.

- An opportunity to rehabilitate a dam on the Great Chazy River at river mile 7.5 culminated in a new concrete dam with a projecting steel lip affixed to the crest. With some additional work this barrier will eliminate the need to treat 14 miles of river above the barrier.

- A dam was rehabilitated on Lewis Creek which maintained that site as a sea lamprey barrier at river mile 9.5.

A Comprehensive Evaluation of an Eight Year Program of Sea Lamprey Control in Lake Champlain (Fisheries Technical Committee 1999) compared results of the program to evaluation standards set forth in *A Comprehensive Plan for Evaluation of an Eight Year Program of Sea Lamprey Control in Lake Champlain* (Engstrom-Heg et al. 1990). The evaluation assessed the efficacy of lamprey reduction and its effects on the characteristics of certain fish populations, the sport fishery and the area's economy. A summary of this evaluation follows:

<u>Sea Lamprey</u> - Sixteen of 24 TFM treatments resulted in a reduction in catch rate of sea lamprey larvae at index stations to less than 10 percent of pre-treatment levels. Treatment-zone, live-cage mortality in eight of the nine delta treatments conducted with Bayluscide exceeded 85 percent.

Spawning-phase sea lamprey were monitored throughout the eight-year control program through adult trapping and by conducting nest counts in index sections of ten tributaries. There were substantial (80 to 90%) reductions in the number of animals trapped compared to pre-control levels. Nest count data revealed a reduction in the number of sea lamprey nests to 43 percent of pre-control levels.

Nontarget Species - Of the three species of native, nontarget lamprey (northern brook lamprey, silver lamprey, and American brook lamprey) affected by both TFM and Bayluscide treatments, American brook and silver lamprey experienced heavy mortalities. Yet similar or greater native lamprey mortalities were found during the second round of treatments in most streams where they were negatively affected during the first round, demonstrated their populations persisted.

Excluding native lamprey, TFM-related nontarget fish losses were minimal among most species. Routine post-treatment survey crews also observed mortality among 12 groups of nontarget invertebrates and amphibians after TFM treatments. Presence of the same species among affected nontargets in both rounds of treatments on most streams, suggests population effects were not permanent. Following Bayluscide treatments, post-treatment survey crews observed substantial mortality among banded killifish, mimic shiner, spottail shiner, and fish which were not identified to species (generally small fish in sections where visual estimates were made) that were most likely cyprinids or killifish. Cumulative biomass was low, however, and judged to be insignificant at the population level.

Numerous special studies showed little or no adverse effects on nontarget fish and macroinvertebrate populations and communities. The greatest adverse effects attributed to the eight-year program were documented in a study following the 1991 Bayluscide treatments of the Ausable and Little Ausable Deltas. Community sampling documented significant declines in density for four of eight Little Ausable and five of eight Ausable macroinvertebrate groups following Bayluscide treatments. However, when the next sampling was conducted four years after the treatment, they had recovered to pre-treatment or near pre-treatment levels.

Lake Trout - Based on gill netting data, survival of age 3-4 lake trout improved 25 percent over pre-control levels. Age 3-6 survival improved and an increase in survival of older lake trout, fully recruited to the fishery, also occurred. Sea lamprey wounding rate and accumulated scar reductions were evident for all size classes of lake trout.

Pre- and post-treatment creel surveys revealed a 76 percent increase in estimated lake trout catch with an increase of 7 percent in average weight of harvested lake trout. The proportion of lake trout larger than 635 mm (25 inches) in the estimated post-control harvest increased 50 percent over pre-control levels.

Landlocked Atlantic Salmon - In the Main Lake Basin, post-treatment (1993-98) wounding rate declines ranged from 40 to 74 percent for three size groups of salmon returning to the Willsboro Fishway (Boquet River) and wounding rates declined 42 percent from 1990 rates for harvested salmon checked during the 1997 Main Lake creel survey.

Improved survival of adult salmon was evident from increased numbers returning to Main Lake tributaries. The median annual number of 1-lake-year and 2-lake-year salmon captured at the Willsboro Fishway increased from 5 to 29 and 1 to 8.5, respectively, in the post-treatment period. Improvements were also found in Saranac River fall creel survey results in 1996 versus 1991, with a doubling in estimated numbers of 1-lake-year fish caught. Greater gains were estimated in 2- and 3-lake-year fish caught from the Saranac, and catches of 4-lake-year fish, absent in 1991, were recorded in 1996.

The post-treatment, Main Lake tributary catch per equivalent smolt stocked, estimated by fall Saranac River creel surveys, increased 3.2 times. The in-lake fishery responded similarly with a 3.1-fold increase, exceeding the standard of at least a doubling in catch per equivalent smolt stocked.

Steelhead Rainbow Trout/Brown Trout - Changes in wounding rates for steelhead and brown trout could not be adequately evaluated due to lack of sufficient pre-control data. These species are stocked in relatively low numbers and offer a minor contribution to the salmonid fishery. The limited data available suggest, however, that these fisheries were improving.

Forage Fish - The experimental sea lamprey control program did not adversely impact the rainbow smelt population in Lake Champlain. Variability in smelt population parameters from midwater trawl surveys and smelt angler catch rates did not appear to be related to improvements in predator survival (i.e., increased prey consumption) arising from sea lamprey control.

Benefit:cost - Anglers and participants in water-based recreation placed a very high value on the Lake Champlain eight-year experimental sea lamprey control program and indicated they would substantially increase their activities if the program continued (Gilbert 1999a). Estimated benefits and costs of the eight-year program indicated a favorable benefit:cost ratio of 3.48:1. Continuation of sea lamprey control on Lake Champlain would be expected to generate up to an additional 1.2 million days of fishing and $42.2 million in fishing-related expenditures as well as an estimated $59.3 million in additional annual water-based recreation expenditures each year (Gilbert 1999a).

Overall, the Lake Champlain experimental sea lamprey control program met or exceeded the majority (21 of 30) of pre-established evaluation standards. Substantial salmonid population and fishery improvements occurred primarily in the Main Lake Basin. Relatively little fishery response was noted in the Inland Sea or Malletts Bay; however, termination of sea lamprey control on Lake Champlain would result in a resurgence of the sea lamprey population to pre-treatment levels within approximately four years and rapidly lead to diminished quality in the lake's salmonid fishery. Conversely, long-term integrated sea lamprey control would be expected to further enhance lake-wide benefits which have accrued to important fish populations, the recreational fishery and the economy.

IV. DEVELOPMENT OF A LONG-TERM SEA LAMPREY CONTROL PROGRAM

Experience gained from the 1990-1997 experimental sea lamprey control program and new information from the Great Lakes sea lamprey program provide guidance for developing specific control strategies for streams and delta areas. Knowledge of sea lamprey distributions and abundance, recolonization of treated areas, efficacy and longevity of control processes, assessment techniques and applicability of control techniques have contributed to the development and refinement of sea lamprey control methodologies.

Information gathered during the experimental sea lamprey control program has indicated the need to adjust the future program to target additional sea lamprey infestations:

- Sea lamprey populations in the Main Lake were reduced dramatically, but comparable reductions were not attained in the Inland Sea and Mallets Bay. Presence of Vermont-listed northern brook lamprey (endangered), resulted in withdrawn treatment proposals in the only two sea lamprey-producing tributaries of Malletts Bay. The Pike River and its tributary Morpion Stream (Canada) discharge into Missisquoi Bay at the northern extreme of the Inland Sea. This system remains a major untreated sea lamprey producer, and should be included in future sea lamprey control plans.

- Larval sea lamprey were first found in the LaPlatte River in 1993, and recent surveys in the Winooski River (1996-97 and 2000) indicated expanding sea lamprey infestations. Further investigations are planned to assess potential sea lamprey control needs in these two rivers.

Sea lamprey may colonize new locations in response to environmental changes. Effective control must include the ability to target these new populations as determined by larval assessment. Flexibility will be an important component of an effective control program because sea lamprey distribution and production are not static. When new sea lamprey populations requiring control are identified, additional environmental review documentation and permit application procedures will be completed whenever necessary, prior to their inclusion as targeted sea lamprey control locations.

A. Acceptable Sea Lamprey Control Techniques

Attention to research and current and evolving applications of sea lamprey control techniques has yielded a choice of methodologies for use as components in a long-term sea lamprey control program for Lake Champlain. The techniques discussed below provide a range of effectiveness and applicability depending on physical, environmental and social conditions at proposed sea lamprey control locations. Control techniques will be scrutinized for applicability through a screening process that will yield the treatment strategy proposed for use on a location-by-location basis.

1. TFM

TFM is used to control sea lamprey larvae in stream habitats (see Appendices B and C). Generally, TFM applications are scheduled to occur in each stream once every four years to minimize levels of parasitic-phase sea lamprey entering the lake. A four-year treatment cycle was chosen during experimental control to take advantage of the rate of sea lamprey development, precluding transformation from non-parasitic to parasitic stage (Gersmehl and Baren 1985; NYSDEC et al. 1990). The four-year cycle of treatment used in the experimental sea lamprey control program has proven effective and where appropriate would be continued during long-term control. Results of ongoing growth data analysis may suggest that in some streams where growth is slow, a treatment interval in excess of four years may be appropriate. Longer treatment intervals may be recommended if a particular stream shows slow recolonization or slow recruitment of sea lamprey into the parasitic-phase. Shorter TFM treatment intervals may be proposed if downstream lamprey migration data indicates more frequent treatments can eliminate the need to chemically treat associated delta regions at stream mouths, or if significant numbers of parasitic phase sea lamprey are seen to be produced within the four-year treatment interval.

TFM treatments will follow the Standard Operating Procedures (SOP) developed for the Great Lakes Fishery Commission's sea lamprey control program (Klar and Schleen 1999). TFM applications typically consist of liquid formulation TFM metered into a stream at a rate necessary to achieve up to 1.5 times the Minimum Lethal Concentration (MLC) for a period of 12 hours. MLC is defined as the minimum concentration of TFM predicted necessary to kill 99.9% of sea lamprey in a 9-hour period. The chemical TFM attenuates with time, distance, substrate, and vegetative densities, and TFM toxicity changes with water chemistry. Predictive TFM toxicity/water chemistry charts based on varying pH and alkalinity parameters (toxicity varies with pH and alkalinity; Appendix D) and/or toxicity test results mimicking stream treatment conditions, are used to determine stream-specific MLC's. Treatment times are usually 12 hours in duration and TFM is applied at concentrations at or near 1.5 times MLC to compensate for expected chemical attenuation and achieve the necessary 9 hours of MLC exposure over the available sea lamprey habitats. If TFM concentrations are expected to attenuate to levels below MLC before all sea lamprey habitats are exposed, then maintenance (boost) applications must occur to maintain the target concentration. At primary application points, and at maintenance application points on larger streams, the lampricide is usually diluted with stream water and applied to the stream using a spreader system of perforated hose suspended across the channel, and is designed to minimize elevated concentrations of lampricide at the point of application. On very small streams, small amounts of TFM may be metered directly to the receiving water. Rapid mixing of TFM and receiving water is always desired at application points. Stream TFM concentrations are monitored at regular intervals during treatments and the application rate is adjusted to maintain target concentrations. Similarly, any feeder streams or ground water inputs must be recognized and considered for supplemental applications to maintain the integrity of TFM toxicity during treatments. Backwater areas of larval habitat isolated from the mainstream chemical block of lampricide must often be treated by a team following the lampricide block downstream and hand spraying these backwater areas. Nontarget mortality assessment following

TFM treatments will follow the SOP protocol established by Klar and Schleen (1999).

Bar (solid) TFM may be used to prevent feeder stream dilutions to mainstem streams and to prevent feeder streams from being utilized as refugia for sea lamprey attempting to escape lethal TFM concentrations in mainstem streams during TFM treatments. TFM bars are a water soluble, solid formulation designed to dissolve at a precise rate in flowing water (Gilderhus 1985).

Maximum Allowable Concentrations (MAC) are predicted from charts and/or toxicity test results using a moderately sensitive nontarget species to determine a level at which excessive nontarget mortality may occur. Concentrations producing 25 percent mortality among brown trout and burrowing mayfly (*Hexagenia* sp.) larvae are noted on the charts and are often used as MAC's (see Appendix D). MAC's represent a lampricide threshold below which treatment concentrations must remain.

Riparian water-use advisories are issued for TFM treated streams and affected lake areas until lampricide concentrations subside to trace levels.

2. TFM and Niclosamide in Combination

In some cases it may be possible to significantly reduce the amount of lampricide used through the simultaneous application of TFM and niclosamide (see Appendices B and C) in infested stream systems. Great Lakes sea lamprey treatment teams have found that simultaneous treatment using both lampricides can reduce the total lampricide usage for specific treatments by up to 50 percent with the same target effect (Klar and Schleen 1999). The treatment process and considerations are very similar to those described in the preceding section regarding application of TFM alone. Separate application delivery systems would be used for each chemical to achieve an appropriate, target concentration of the lampricide mix. Bayluscide is added at a rate so that niclosamide constitutes between 0.5 to 2.0 percent of the overall concentration of active ingredient.

TFM/niclosamide treatments might be employed where high stream discharges require large amounts of TFM to reach target concentrations. In these situations, reductions in the overall amount of lampricide formulation used can be substantial. Such combination treatments would necessitate use of more personnel than for a TFM treatment, to accommodate simultaneous lampricide applications and more sophisticated analysis procedures for monitoring and control of both active ingredient concentrations in the stream. The Bayluscide 70% Wettable Powder formulation is currently used for combination treatments, and is metered into the stream mixed with water to form a slurry (Klar and Schleen 1999). In the future, the Bayluscide 20% Emulsifiable Concentrate formulation may be used for these treatments if registered for use by the EPA.

This combination technique may not be suitable for locations where suspended clay and or clay substrate predominates because of the affinity of niclosamide to adsorb to clay particulates. In stream systems where clay substrates predominate, the niclosamide component of the lampricide mixture may attenuate too quickly for effective use. Applications of Bayluscide slurry are not recommended in streams with low flows due to the difficulty with application of extremely small amounts of wettable powder slurry necessary for precise application rates. As with TFM treatments, riparian water-use advisories are issued for treated streams and affected lake areas until lampricide concentrations subside to trace levels.

3. Bayluscide Granules

Bayluscide granules have been the lampricide used for delta sea lamprey treatments, and for test plot sea lamprey assessment on delta regions and some deepwater areas of Lake Champlain tributaries. New sea lamprey assessment tools (deepwater electrofishers) may prove effective in defining the densities, locations and extent of sea lamprey larval populations. Sea lamprey infestations may now be targeted to potentially limit Bayluscide application to defined areas of infestation without exposing the entire delta to lampricide. Formerly, application rates were 100 pounds of 5 percent active ingredient, Bayluscide granules per acre of habitat (5 pounds active ingredient per acre). The Bayluscide formulation has since changed to a 3.2 percent active ingredient micro encapsulated granule, resistant to dusting and wind drift, thus, application rates approximating 156 pounds per acre of habitat will be necessary. Sea lamprey assessments using deepwater electrofishing methodologies may reduce or eliminate the need for assessment using Bayluscide on delta survey plots. Bayluscide may be applied to delta areas and other deep water habitats using aircraft pending Special Local Needs registration and EPA approval, or by boat when practical.

Experience with experimental sea lamprey control demonstrated that estuarine portions of some rivers are not logistically nor cost-effectively treated with TFM. Bayluscide 3.2 percent granules may provide an effective means of treating these areas. Crews in boats or on foot may effectively apply Bayluscide directly to known sea lamprey larval concentrations in these estuarine reaches of river otherwise difficult or costly to effectively treat with TFM. This methodology may prove more cost effective and reduce use of TFM in a given stream system. If Bayluscide treatments are to occur at corresponding river deltas, estuarine Bayluscide application would be scheduled at the same time. In a situation where this type of treatment would eliminate the need for a separate TFM treatment, an added benefit may result because only a single water-use advisory would be required over each approximately four-year period compared to separate advisories associated with TFM stream applications and Bayluscide delta treatments within the same interval.

4. Barriers

In situations with favorable conditions, barriers may offer a proven and effective alternative to lampricide treatment (Lavis et al. in review). Studies have addressed the applicability of sea lamprey barriers on several Lake Champlain tributaries. A report entitled *Preliminary Feasibility Study for Sea Lamprey Barrier Dams on Lake Champlain Tributary Streams* (Anderson, B. E. et al. 1985) projected the potential and engineering feasibility for use of sea lamprey barriers on 15 Lake Champlain tributaries. More definitive feasibility studies have since been pursued. New York streams being investigated for the potential construction of sea lamprey barriers are the

Salmon River, Little Ausable River, Putnam Creek and Beaver Brook. In Vermont, feasibility studies on Stone Bridge Brook and Lewis Creek indicated that at the time of the studies, the barriers were environmentally unacceptable or cost prohibitive (Staats 1993, 1994). In view of developing technologies in sea lamprey barrier design and the possibility for future changes regarding site access and landowner cooperation at potential barrier sites, feasibility of barrier dam construction at individual sites will periodically be revisited. Additional investigations have been conducted for sea lamprey barriers on the Poultney and Hubbardton Rivers and on the Pike River and Morpion Stream, Quebec (Walrath and Swiney 2001).

Sea lamprey barriers vary by construction and methodology but all are intended to prevent sea lamprey from reaching spawning grounds. Vertical-drop barriers are the most widely used. Water velocity barriers and electronic barriers are under development. In many streams, provisions must be made to accommodate migratory fish passage while preventing upstream passage of sea lamprey adults.

The GLFC recently developed protocols for engineering, cost estimation, operation and environmental effects mitigation to enhance their barrier program (Sea Lamprey Barrier Transition Team 2000). These protocols will provide guidance for development of barriers in the Lake Champlain Basin.

5. Trapping

Spawning-phase sea lamprey can be trapped during upstream spawning migrations in tributaries. Traps are strategically placed where migrating adults concentrate in the stream channel, usually along the face of a weir, dam or waterfall. Portable traps are either fyke nets or rigid box traps with a fyke entrance and are used with or without wing extensions designed to block the channel and/or steer the sea lamprey to the trap. Sea lamprey enter the trap where they are unable to find an exit and are periodically removed. Sea lamprey traps are particularly useful in conjunction with sea lamprey barrier structures and in constricted stream channels where adults concentrate. Trapping at barriers limits the redistribution of spawning-phase sea lamprey to alternative streams where they might otherwise successfully spawn. Trapping is labor-intensive, and traps must be maintained for the duration of the spawning run. Trapping would be used as a supplemental control method except where the physical stream conditions make trapping an effective primary technique or where other control techniques are not feasible. Upstream escapement of relatively few adults could repopulate available nursery habitat resulting in little or no reduction of the sea lamprey produced in the stream. The smallest sea lamprey spawning streams with small numbers of spawning sea lamprey and high trap efficiency provide the most potential for control by adult trapping alone.

B. Sea Lamprey Control Techniques Under Development

There are emerging techniques currently being developed by managers and researchers in the Great Lakes where the extensive resources of the Great Lakes Fishery Commission are available. Emerging techniques, in different stages of development, range from untested ideas to methods that have received extensive experimental field testing. These potential methodologies are not currently available for use by the Lake Champlain sea lamprey control community but are mentioned here to recognize their potential for future use and to focus some attention on methods that may become available in a long-term sea lamprey control program for Lake Champlain.

1. Sterilized Male Sea Lamprey Releases

This method of sea lamprey control targets the spawning population of sea lamprey in specific tributaries. If female sea lamprey pair and spawn with sterile males, non-viable eggs are released to the substrate. For this technique to be effective, male sea lamprey must be captured, sterilized and introduced to the targeted spawning population. The expectation is that the reproductive potential of a spawning lamprey population will be reduced in proportion to the ratio of sterile to nonsterile male sea lamprey present. This method can only be effective if the spawning population has already been reduced by other means, and sufficient numbers of sterile males can be introduced to overwhelm the nonsterile male population competing for spawning female sea lamprey. Logistics necessary to implement this control strategy are formidable. Unless a sterilization facility can be developed and staffed at a nearby location, sea lamprey males would have to be captured in Lake Champlain tributaries, transported to the sterilization facility in Michigan, then returned and released into the target sea lamprey population prior to the onset of spawning activities. Sterilization is accomplished by injecting male sea lamprey with the chemical Bisazir under a strict hygiene protocol and using sophisticated chemical recapture techniques (Twohey et al. 1997, 2000). Bisazir is a highly toxic and mutagenic compound and requires careful handling. Relatively small numbers of males are available from Lake Champlain sea lamprey adult trapping efforts; therefore, application of this method would be appropriate only where the adult sea lamprey population is known to be very small or where lampricide treatment is prohibited. It is important to note that this method of potential sea lamprey control is still under evaluation in the Great Lakes. Any initial use of sterile male technology as a sea lamprey control method for Lake Champlain would be proposed only as an experimental effort.

An alternate or complimentary sea lamprey sterilization technique to Bisazir proposes using a protein-based gonadotropin analog as a sterilant (Sower et al. in review). This methodology is currently being researched, and if sufficiently developed, may offer a nontoxic method of sterilization employable locally or even streamside.

2. Attractants

Attracting sea lamprey to inappropriate habitats where survival and propagation are unlikely, and/or to traps for removal from streams could provide a useful control mechanism. Conversely, repellents might exclude sea lamprey from favorable habitats. However, the current limited knowledge regarding attractants prevents their use for management applications. The most promising current research includes the investigation of the attractant effect of larval sea lamprey pheromones, including two identified bile salts on adults migrating to stream spawning areas. It has been shown (Li et al. 1995; Vrieze 1999) that larval sea lamprey produce bile salts which are excreted as metabolic byproducts and act as an attractant to adult sea lamprey searching for suitable spawning habitats. If sea lamprey pheromones or bile salts can be reproduced or mimicked in sufficient quantities, they might be used to attract adults to traps or to inappropriate areas where spawning is unsuccessful. Alternatively, native lamprey or sea lamprey larvae might be used through strategic stocking or placement of caged animals to provide natural pheromone/bile salt odors to act as spawning sea lamprey attractants.

Sea lamprey sex pheromones are also being investigated for potential applications for sea lamprey control (Li et al. in review). If male sex pheromones can be manipulated to provide a super competitive male and those males are sterilized, then reproductive success might be reduced due to increased spawning interference. Alternatively, production of sex pheromones might also be utilized to disrupt spawning behavior, or used as an attractant to entice female lamprey to traps or to unsuitable habitats.

The use of pheromones for sea lamprey control is not currently considered to be a viable option and will not be discussed as a control method for individual streams. Should developments produce effective attractant techniques, then their applicability to sea lamprey control at individual streams would be re-evaluated and incorporated where feasible.

V. ALTERNATIVES

A. Alternative 1. Initiate an Extensive, Integrated, Long-term Control Program for Sea Lamprey in Lake Champlain. (Proposed Action)

Alternative 1 embodies implementation of extensive, long-term sea lamprey control based on the principals of integrated pest management (Sawyer 1980). It features a tributary-specific approach in which viable sea lamprey control techniques are screened for use in each infested stream system and considers using integrated methods to achieve desired control objectives. Sea lamprey control under the Proposed Action would include several previously untreated streams in New York, Vermont, and Quebec, Canada, in addition to those formerly included in the experimental sea lamprey control program (Figure V-1). Many infested stream systems will require treatment with lampricides, but reliance on lampricides will be reduced in other streams through the use of barriers and/or traps. The Proposed Action promotes the expansion of the sea lamprey control program beyond the limited scope of the experimental program and includes non-chemical control options.

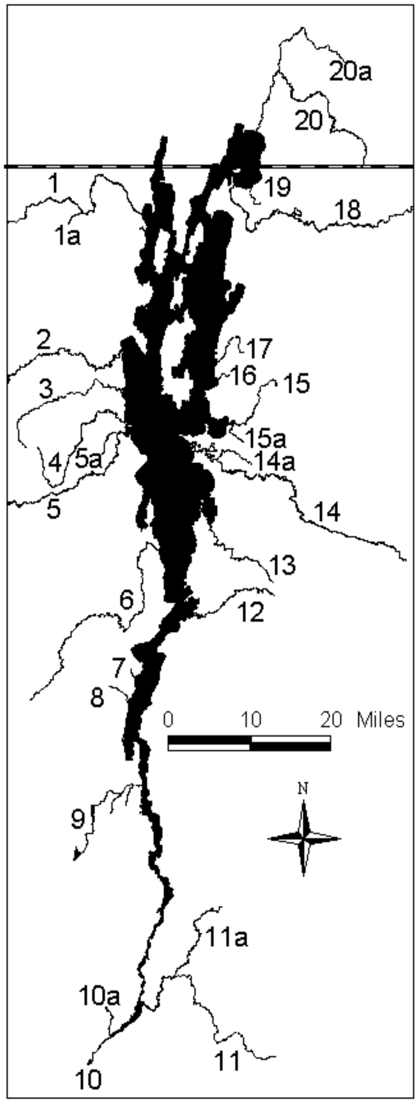
Information specific to screened tributaries is listed in Table V-1. Sea lamprey transformation, technical considerations, nontarget concerns, human impacts, habitat impacts, and costs will be considered for each potential control technique at each site. Varied physical and environmental conditions at different locations will influence how to effectively apply the available control methodologies to achieve desired levels of sea lamprey population control. Regular communication among Lake Champlain sea lamprey control staff and other sea lamprey control professionals (Great Lakes, New York Finger Lakes), and scrutiny of available information will produce sea lamprey control strategies for individual locations through an adaptive management approach. Screening processes will consider research results, sea lamprey control experience gained, new techniques and applications as they become available. In the long-term program, managers will periodically reevaluate streams as sea lamprey populations and environmental conditions change. Public briefings regarding the program, and opportunity for public input will occur on an approximate five-year cycle subsequent to program implementation. The process is illustrated in Figure V-2.

Figure V-1. Sea lamprey-producing streams and their tributaries considered for inclusion in a proposed Lake Champlain sea lamprey control program.

Number	Stream/*Tributary*
1	Great Chazy R. †
1a	*Bullis Bk.*
2	Saranac R. ‡
3	Salmon R. ‡
4	L. Ausable R. ‡
5	Ausable R. ‡
5a	*Dry Mill Bk.* †
6	Boquet R. ‡
7	Beaver Bk. †
8	Mullen Bk.
9	Putnam Ck. †
10	Mt. Hope Bk. †
10a	*Greenland Bk.* †

† Stream included in the experimental sea lamprey control program.

‡ Stream and delta included in the experimental sea lamprey control program.



Number	Stream/*Tributary*
11	Poultney R. †
11a	*Hubbardton R.* †
12	Lewis Ck. †
13	LaPlatte R.
14	Winooski R.
14a	*Sunderland Bk.*
15	Malletts Ck.
15a	*Indian Bk.*
16	Trout Bk. †
17	Stone Bridge Bk. †
18	Missisquoi R.
19	Youngman Bk.
20	Pike R.
20a	*Morpion Str.*

Table V-1. Sea Lamprey-infested stream systems listed by lake basin and state or province with associated county, town (city), mean September discharge, mean May discharge, and sea lamprey accessible distance information.

Lake Basin	Stream - *Tributary*	County	Town (City)	Sept. Mean Flow (cfs)[a]	May Mean Flow (cfs)[a]	Access (miles)
Main Lake NY	Great Chazy R	Clinton	Mooers/ Champlain	87	375	20.6
	- *Bullis Bk.*	Clinton	Mooers	(< 10)		unknown
	Saranac R.	Clinton	(Plattsburgh)	491	1366	3.3
	Salmon R.	Clinton	Plattsburgh	22	69	4.0
	L. Ausable R.	Clinton	Peru	21	64	6.1
	Ausable R.	Clinton - Essex	Peru/Ausable/ Chesterfield	339	1377	7.0
	- *Dry Mill Bk.*	Clinton	Peru	(< 10)		0.5
	Boquet R.	Essex	Willsboro	108	541	2.6
	Beaver Bk.	Essex	Westport	(< 10)		2.5
	Mullen Bk.	Essex	Westport/ Moriah	(< 10)		1.0
South Lake NY	Putnam Crk.	Essex	Crown Point	14	100	5.2[b]
	Mt. Hope Bk.	Washington	Fort Ann/ Dresden	(5 - 10)		1.3
	- *Greenland Bk.*	Washington	Fort Ann	(< 10)		0.6
South Lake NY-VT	Poultney R.	NY - Washington, VT - Rutland	Hampton/ Whitehall, West Haven	92	319	10.5
	- *Hubbardton R.*	VT - Rutland	West Haven	(10 - 25)		2.0

[a] Flow values were obtained from USGS mean monthly gauge records unless otherwise indicated. Parenthetic flow values were derived from the best available information. Less than 10 cfs (<10) indicates the stream is very small and is unlikely to reach 10 cfs during the period indicated.

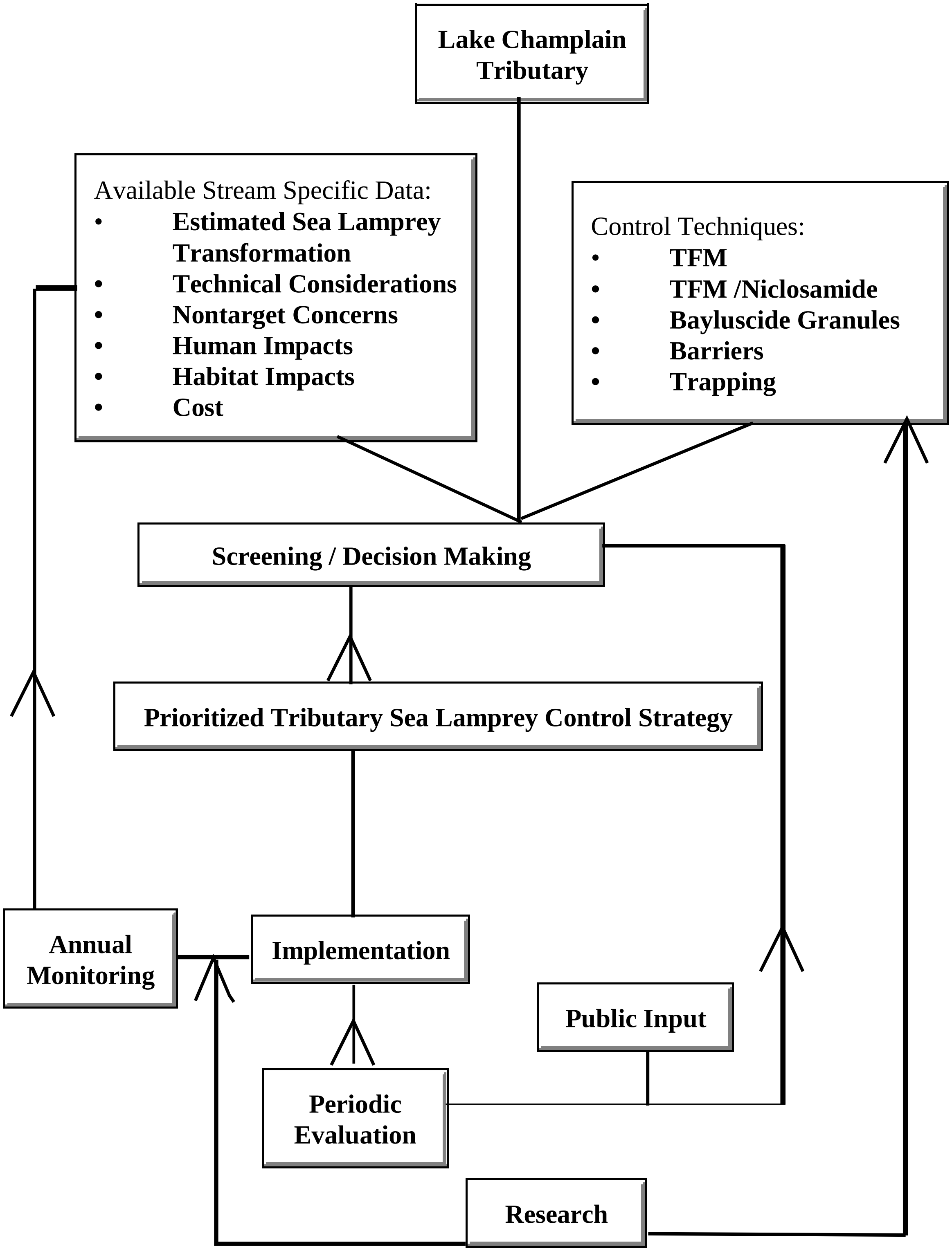
[b] Treatment milage includes 0.3 miles of tributary Brevoort Brook and 0.1 miles of tributary Ranney Brook.

Table V-1 (continued).

Lake Basin	Stream - *Tributary*	County	Town (City)	Sept. Mean Flow (cfs)[a]	May Mean Flow (cfs)[a]	Access (miles)
Main Lake VT	Lewis Crk.	Addison	Ferrisburg	42	114	9.5
	LaPlatte R.	Chittenden	Shelburne	14	51	3.3
	Winooski R.	Chittenden	Winooski/ Burlington/ Colchester	720	2789	11.0
	- *Sunderland Bk.*	Chittenden	Colchester	(< 10)		3.2
Malletts Bay VT	Malletts Crk.	Chittenden	Colchester	(5 - 10)		1.7
	- *Indian Bk.*	Chittenden	Colchester	(5 - 10)		2.7
Inland Sea VT	Trout Bk.	Chittenden	Milton	(< 10)		1.3
	Stone Bridge Bk.	Chittenden	Milton	4	10	2.7
	Missisquoi R.	Franklin	Highgate/ Swanton	640	1765	8.0
	Youngman Bk.	Franklin	Highgate	(5 - 10)		1.1
Inland Sea Quebec	Pike R.	Brome-Missisquoi	Notre-Dame de Stanebridge	73[c]	216[c]	8.2
	- *Morpion Str.*	Brome-Missisquoi	Notre-Dame de Stanebridge	(5 - 15)		17.1

[a] Flow values were obtained from USGS mean monthly gauge records unless otherwise indicated. Parenthetic flow values were derived from the best available information. Less than 10 cfs (<10) indicates the stream is very small and is unlikely to reach 10 cfs during the period indicated.
[c] Source: Environment Canada, Water Survey Canada.

Figure V-2. Screening process flow chart for proposed sea lamprey control at a given location.



Definitions of the variables considered and questions raised in the screening process are as follows:

- Estimated sea lamprey transformation - the number of sea lamprey expected to transform from the non-parasitic larval stage to the parasitic adult stage. Does the level of transformer production warrant implementation of sea lamprey control? The number of sea lamprey transforming from a tributary will be estimated from quantitative assessment sampling (QAS) data (Klar and Schleen 1999) if available, or from transformer mortality counts after initial TFM treatments (Fisheries Technical Committee 1999). The number of sea lamprey transforming from non-wadeable waters (i.e., deltas or deeper stream areas) will be estimated from deep-water quantitative assessment sampling (DQAS) data. (Klar and Schleen 1999)

- Technical considerations - an evaluation of the ability to use a technique or techniques. Can chosen methods produce the desired outcome? Are they technically feasible?

- Nontarget concerns - the unintended biological consequences of the use of sea lamprey control techniques. Are the expected nontarget effects acceptable?

- Human impacts - the effect, if any, the chosen control methods have on human activities. Are social and cultural effects acceptable?

- Habitat impacts - the effects the chosen control methods have on the in-stream and riparian habitat. What are the positive and negative consequences of sea lamprey control to affected habitats?

- Cost - an estimate of the monetary cost of control by technique for each location. Cost information is not currently presented as a decision-making factor, but is instead, a high-end estimate of the setting-specific cost should that method be employed. Technical, environmental or regulatory factors are likely to dictate sea lamprey methodology applications under most circumstances, thus, cost may not be a determining factor in the choice of control technique. The estimate presented is not an attempt to provide a benefit:cost analysis. Costs will be evaluated further, subsequent to the final selection of strategies found applicable to each location.

Consideration of all these factors and applicability of available sea lamprey control methodologies will lead to a prioritized list of proposed control strategies for each location. Some locations considered may result in a single preferred sea lamprey control option, whereas other locations may be suited to several prioritized choices. Actual screening discussions for individual sites based on currently available information can be found in Section VIII of this document. Specific sea lamprey control strategies proposed for use at specific sites are detailed there.

Eventually, Lake Champlain fishery managers plan to implement an adaptation of the Empirical Stream Treatment Ranking (ESTR) model currently used in the Great Lakes sea lamprey control program (Christie et al. in review). Application of such a model would incorporate QAS data, cost, and treatment effectiveness information to rank streams for lampricide treatment during a given period by the projected cost per sea lamprey juvenile killed. Budgetary resources available would determine the selection threshold between streams chosen for treatment and those to remain untreated.

B. Alternative 2. Maintain Reduced Sea Lamprey Wounding Rates Attained During the Experimental Period by Applying Chemical Lampricides.

Alternative 2 mirrors the completed eight-year experimental program. This alternative and its methodologies would rely on the use of lampricides for maintaining reduced sea lamprey numbers, and restrict the program primarily to those rivers and deltas that were treated in the experimental program (See Figure V-1) (NYSDEC et al. 1990; Fisheries Technical Committee 1999). This alternative ignores additional techniques and locations included in Alternative 1 that may offer improved sea lamprey control. TFM and Bayluscide treatments would be conducted on lamprey-infested streams and deltas. Sea lamprey colonization surveys may locate new infestations in deltas and streams that have never been treated, but will require treatment to maintain reduced sea lamprey abundance levels achieved during the experimental program. Site-specific permits would be required if and when such streams were added to the program. Lampricide treatment of each stream or delta would be scheduled according to sea lamprey larval transformation rates, or in most cases, every fourth year.

C. Alternative 3. Abandon Sea Lamprey Control as a Fisheries Management Tool for Lake Champlain. (No Action Alternative)

Under this alternative there would be no federal involvement in sea lamprey control. This alternative may be chosen if the benefits achieved by implementing sea lamprey control require unacceptable increases in program costs, or if impacts associated with a sea lamprey control program are determined to be undesirable.

D. Alternatives Considered but Dismissed

The evaluation of alternatives for the proposed project was conducted based on the best available knowledge and professional judgment of the Cooperative. The possibilities were discussed at length regarding each alternative’s potential for meeting the project goal and objectives for reducing sea lamprey abundance. All alternatives meeting the project objectives which were practical from a technical, social and economic standpoint have been considered. The range of alternatives was eventually narrowed to three possibilities including the Proposed Action and No Action alternatives. The following is a summary of the alternatives eliminated from further analysis.

1. No Sea Lamprey Control; No Salmonid Stocking

This alternative would abandon all efforts to control sea lamprey, terminate all salmonid stocking and eliminate efforts to monitor sea lamprey and salmonids. All federal and state involvement and activities associated with the salmonid restoration and development program would terminate.

Implementation of this alternative would not be appropriate unless: a) projected benefits from salmonid restoration with sea lamprey control were inadequate relative to program costs and environmental impacts; b) significant benefits from maintaining a salmonid management program could only be achieved through strategies such as sea lamprey control; requiring unacceptable increases in program costs; and/or c) sea lamprey control is necessary only because salmonid stocking is the cause of increased sea lamprey numbers by providing sea lamprey with an abundance of preferred prey.

This alternative was dismissed because experimental sea lamprey control has indicated that program benefits outweigh program costs (Gilbert 1999a). Also, environmental and nontarget impacts due to the experimental sea lamprey control program were minimal in relation to program benefits. With intensive stocking and little or no additional overall propagation costs compared to present day levels, a moderate quality lake trout fishery and an inconsistent landlocked Atlantic salmon fishery were established before sea lamprey control was initiated in 1990. Terminating salmonid stocking would likely result in total collapse of the salmonid fishery since natural salmonid reproduction is presently limited. The angling public has grown to expect a salmonid fishery in Lake Champlain. Therefore, this alternative would be socially unacceptable.

Sea lamprey abundance is not necessarily linked to salmonid abundance (NYSDEC et al. 1990). Increased habitat availability for sea lamprey spawning and larval sea lamprey nursery areas due to improved water quality in Lake Champlain tributaries is probably the factor most important to increased sea lamprey populations. In the absence of sea lamprey control, the Lake Champlain sea lamprey population would probably remain at high levels, and predation would shift to other fish species known to be targeted by parasitic sea lamprey (lake whitefish, lake herring, burbot, white and redhorse suckers, walleye and northern pike, etc).

2. Barriers and Trapping Only

This alternative would develop and maintain barrier dams and/or trapping operations on as many Lake Champlain sea lamprey-producing tributaries as is feasible. Stocking targets for lake trout, landlocked Atlantic salmon, steelhead and brown trout would remain at the present level of 512,000 yearling/smolt equivalents per year (400,000 Main Lake; 112,000 Malletts Bay/Inland Sea). Assessment work would continue at a reduced scale. Background for the development and dismissal of this alternative is given in the FEIS. A major expenditure for the construction of sea lamprey barriers and spawning-phase sea lamprey trapping operations would not achieve a substantial reduction in sea lamprey abundance. Barriers also may have negative effects on fish communities within stream environments (Noakes et al. 2000) and as a result, are only proposed for Lake Champlain tributaries where such effects are acceptable, or can be mitigated. Trapping is not considered an effective control technique except in situations where entire sea lamprey spawning populations can be blocked and intercepted with traps. This has only been possible in small streams where other migratory aquatic species would not be affected. Therefore, construction of barriers and/or establishing trapping operations only where feasible in sea lamprey-producing tributaries as an exclusive means of controlling sea lamprey has been dismissed.

Studies of Stone Bridge Brook and Lewis Creek, Vermont (Staats 1993, 1994) concluded that barrier dam development on these two tributaries, listed as potential barrier dam candidates in an earlier study (Anderson, B.E. et al. 1985), was not considered feasible. The proposed Lewis Creek barrier would not eliminate the need to control sea lamprey below the barrier, and an annual cost ratio of 2.4 to 1 was projected for TFM and barrier development versus TFM treatment alone. It was further determined that barrier dam development at Lewis Creek would interfere with important fish migrations. A Stone Bridge Brook barrier would likewise not eliminate the need to control sea lamprey below that barrier. Although this barrier was initially deemed not feasible, its applicability is being reevaluated (see Section VIII, Stone Bridge Brook). As with the Stone Bridge Brook barrier study, the conclusions reached as a result of these and other investigations will periodically be reevaluated to incorporate changing conditions over time. Additional ongoing or planned feasibility studies will determine the applicability of sea lamprey barrier technology on several New York streams.

3. Sub-basin Approach - Partial sea lamprey control through treatment of individual portions of Lake Champlain

This alternative explores the feasibility of treating individual sub-basins of Lake Champlain (i.e., Inland Sea, Main Lake, Malletts Bay, South Lake), while leaving others untreated. Stocking targets would be maintained at 512,000 salmonid yearling/smolt equivalents per year, and assessment activities would continue at a reduced scale. This scenario could be effective only if sea lamprey infestations were localized within sub-basin limits and would not colonize controlled areas through migration. However, studies suggest that sea lamprey have no spawning site fidelity and do not home to natal streams (Applegate and Smith 1951; Bergstedt and Seelye 1995). Within Lake Champlain, dye marked sea lamprey transformers from the Pike River have been recovered as spawning-phase adults in Lewis Creek and the Great Chazy River, indicating that sea lamprey migrate and colonize beyond home spawning streams (John Gersmehl, USFWS-retired, personal communication). Therefore, sea lamprey are not sub-basin specific in Lake Champlain, and populations would redistribute from uncontrolled regions to controlled regions rendering this strategy ineffective.

E. Unacceptable Techniques

The following techniques represent methodologies suggested as possible sea lamprey control techniques, but which were found currently unacceptable as useful components of proposed long-term sea lamprey control for Lake Champlain. For more detailed discussions on these unacceptable techniques, see FEIS pages 58-67.

1. Fishing

Controlling sea lamprey by commercial, agency inspired or bounty fishing would require a very high degree of effectiveness in capturing upstream migrating adults, and is viewed as unattainable. Sea lamprey have very high fecundity (Vladykov 1951); therefore, just a few spawners escaping such an effort could repopulate the available larval habitat.

2. Parasites and Pathogens

There are no known sea lamprey specific parasites or pathogens that are effective in controlling the sea lamprey under natural conditions.

3. Stream Habitat Alteration

This measure would alter the stream bed by excavating gravel in spawning areas and/or fine materials in nursery areas. This represents an attempt to alter the character of the habitat and render it unsuitable for sea lamprey spawning or juvenile survival. Such actions are generally ecologically destructive and economically unsound. The only instance where such measures might be considered would be in conjunction with barrier dam construction, where small areas of spawning gravel might be removed immediately below a barrier.

4. Increase Stocking of Salmonids

The theory behind this approach is that salmonid mortality due to sea lamprey parasitism would be reduced if salmonid stocking, and therefore, abundance of salmonids (lamprey host) in Lake Champlain were substantially increased. A foraging hypothesis developed by Kitchell and Breck (1980) theorizes that when few hosts are available, the sea lamprey stays with one host until it dies. This hypothesis matches observations of Lawrie and MacCallum (1980), Christie and Kolenosky (1980), and Walters et al. (1980) that the rate of sea lamprey-induced mortality increased as relative lake trout density declined.

It is not possible to determine the level of salmonid stocking which might lead to maximum reduction in sea lamprey-induced mortality among salmonids in Lake Champlain. The question is extremely complex, involving not only host abundance relative to lamprey, but also host and lamprey sizes. Large fish are less susceptible to death from sea lamprey attacks than are smaller fish, while small lamprey are less likely to cause death than large lamprey.

This unproven control measure would require progressive increases in stockings beyond the 512,000 salmonid yearling/smolt equivalents currently stocked annually until levels of parasitism by sea lamprey were acceptable. Major increases in salmonid propagation, stocking and salmonid/sea lamprey assessments necessary to test this approach would not be expected to offer added benefits commensurate with increased costs. The approach would likely only provide more salmonid prey for: sea lamprey, older salmonids (cannibalism), and other predatory fish. Furthermore, greater numbers of salmonids would increase the risk for instability of the forage fish population (smelt), cause a decline in growth rates and condition (plumpness) of salmonids and lead to a generally unsatisfactory fishery. The potential for these consequences make this theoretical measure impractical at this time.

5. Reduce Salmonid Stocking

Sea lamprey control by this technique assumes that sea lamprey abundance is regulated by the abundance of preferred prey (salmonids), and if prey are reduced, an associated reduction in parasites would follow. However, reduced salmonid stocking in an effort to control sea lamprey numbers would likely result in increased predation on available salmonids remaining, the redirection of sea lamprey predatory pressures to secondary prey species, and loss of ecological and economic benefits of healthy salmonid populations.

The FEIS presents evidence that reduced stocking would not result in decreased sea lamprey abundance. Sea lamprey nest counts, which provide an index of abundance of sea lamprey adults, have been made annually at standard stations on nine index streams since 1983. Data prior to the experimental program (1983-1989) demonstrated that nest counts fluctuate widely, with no well-defined, strong trend toward more nests during this seven-year period (NYSDEC et al. 1990). During this period, prey availability (numbers of salmonids stocked) remained relatively constant. It is likely that the fluctuations observed were due to other environmental factors. This is similar to normal population fluctuations which characterize fish and wildlife populations in general; a reduction in stocking salmonids would not suppress these fluctuations.

The apparent lack of this type of a relationship also characterized the Cayuga Lake, New York sea lamprey and salmonid populations. Evidence from Cayuga Lake demonstrates that sea lamprey were two to three times more abundant in 1949 and 1950 than in the late 1970s and early 1980s. The elevated sea lamprey population of 1949 and 1950 occurred at time when the salmonid population consisted mainly of lake trout and was still building from very low levels in the early 1940s. In the late 1970s and early 1980s, when salmonids were more abundant, lamprey abundance was substantially less. We conclude from the results of the Lake Champlain and Cayuga Lake situation that sea lamprey abundance has not been linked to salmonid abundance in these two lakes (NYSDEC et al. 1990).

Further evidence from Seneca and Cayuga Lakes support this conclusion. Substantial reductions in lake trout stocking occurred in Cayuga Lake in 1965 and in Seneca Lake in 1972 when annual stocking levels were reduced from approximately 70,000 yearling equivalents to 28,000 yearling equivalents stocked (NYSDEC et al. 1990). The result was an increase in the incidence of lamprey attacks on salmonids, and probably in the lethality of the attacks, though this is not well documented. There was no decrease in lamprey populations (NYSDEC et al. 1990).

6. Electrofishing

Electrofishing is commonly used as a sea lamprey assessment technique, but use as a control method is not practical. Electrofishing might be effective as a control measure only if used repetitively over areas of larval sea lamprey habitat to deplete the larval sea lamprey population. Attempts using this technique on Trout Brook, Vermont to remove and protect state-threatened American brook lamprey prior to treatment, resulted in nontarget fish mortalities much greater than TFM-induced nontarget mortality, due to the repetitive exposures to electric current (VTDEC 1996a). Repetitive electrofishing as a sea lamprey control measure would require a large commitment of personnel and funds applied to very limited areas and would substantially increase the risk of mortality to nontarget organisms.

F. Comparison of Alternatives

This section compares sea lamprey population projections, fishing expectations, economic impacts, user conflicts, social impacts and costs of each alternative.

1. Parasitic Sea Lamprey Abundance Projections

Alternative 1. Initiate an Extensive, Integrated, Long-term Control Program for Sea Lamprey in Lake Champlain. (Proposed Action): Alternative 1 would cause greater reductions in parasitic sea lamprey abundance than were achieved during the eight-year sea lamprey control program. This alternative would expand control efforts to additional streams that were excluded during the experimental program. A variety of control methods would be examined for each stream to increase effectiveness of the control program and minimize, to the extent practical the use of lampricides. However, use of lampricides is currently the most effective method of controlling sea lamprey on most streams.

Alternative 2. Maintain Reduced Sea Lamprey Wounding Rates Attained During the Experimental Period by Applying Chemical Lampricides: Alternative 2 would reduce the abundance of sea lamprey to levels similar to those attained during the eight-year experimental period. During the eight-year control program, 16 of 24 stream treatments resulted in a reduction in larval sea lamprey abundance at index stations to 10 percent or less of pre-control levels (Fisheries Technical Committee 1999). Catches of spawning-phase sea lamprey in portable assessment traps on three index streams declined 80 to 90 percent during the period 1989-1997.

Alternative 3. Abandon Sea Lamprey Control as a Fisheries Management Tool for Lake Champlain. (No Action Alternative): Alternative 3 would abandon sea lamprey control as a fisheries management tool and result in an increase of sea lamprey abundance to pre-control or

1990 levels.

2. Fishing Expectations

Results from the eight-year experimental sea lamprey control program clearly demonstrated that fishery quality can be increased and maintained with a successful sea lamprey control program. The two alternatives that implement sea lamprey control would maintain or improve the quality of the salmonid fishery, as reflected in increased salmonid survival, increased numbers of salmonids caught by anglers and increased numbers of salmonid fishing trips. The walleye population would also receive relief from sea lamprey parasitism under Alternatives 1 and 2.

<u>Alternative 1. Initiate an Extensive, Integrated, Long-term Control Program for Sea Lamprey in Lake Champlain. (Proposed Action)</u>: Increased effort in sea lamprey control would result in lowering sea lamprey-induced mortality of salmonids, thus yielding a greater catch of larger fish. Under Alternative 1, lake trout catch rate and natural reproduction are expected to increase. The wounding rate objective for lake trout in the 533-633 mm (21.0-24.9 in.) length interval under Alternative 1 (25 wounds per 100 lake trout, ideally 10 wounds per 100 lake trout) represents a 55 to 82 percent improvement from the pre-control mean annual Main Lake wounding rate of 55 wounds per 100 lake trout and an improvement of 35 to 74 percent over the mean annual Main Lake post-experimental control wounding rate of 38 wounds per 100 lake trout. Commensurate increases in survival and catch are expected as fishery responses. The average size of lake trout harvested by anglers is expected to increase from 4.2 to 5.0 pounds as more fish live to older ages.

Under Alternative 1, the landlocked Atlantic salmon catch is expected to increase from levels experienced post-experimental control. The wounding rate objective for landlocked salmon in the 432-533 mm (17.0-21.0 in.) length interval under Alternative 1 (15 wounds per 100 salmon, ideally 5 wounds per 100 salmon) represents a 71 to 90 percent improvement from the pre-control mean annual Main Lake wounding rate of 51 wounds per 100 landlocked salmon and an improvement of 32 to 77 percent over the mean annual Main Lake post-experimental control wounding rate of 22 wounds per 100 landlocked salmon. Corresponding increases in survival and returns per fish stocked are expected as fishery responses. The average size of landlocked salmon caught is also expected to increase due to survival of fish to older ages. The estimated harvest of salmon that survived more than one year in the Main Lake increased 140 percent (VTDFW, Essex Junction, Vermont, unpublished data) during the experimental program and is expected to further increase as survival improves.

Steelhead and brown trout survival would also increase providing a more diversified fishery. It is expected that the catch of these two species should increase at rates similar to the salmon’s.

Walleye will also benefit from reduced sea lamprey predation under Alternative 1. The wounding rate objective for walleye of 534-634 mm (21.0-25.0 in.) in length under Alternative 1 (2 wounds per 100 walleye, ideally less than 1 wound per 100 walleye) represents an 85 to nearly 100 percent improvement from the pre-control mean annual Main Lake/South Lake wounding rate of 18.5 wounds per 100 walleye and an improvement of 52 to nearly 100 percent over the mean annual Main Lake post-experimental control wounding rate of 4.2 wounds per 100 walleye. Survival should improve but to a smaller degree than salmonid survival because walleye sea lamprey predation has been markedly lower with less resulting mortality due to sea lamprey predation (Nettles in review). Appearance of fish and average size should improve under Alternative 1.

Alternative 2. Maintain Reduced Sea Lamprey Wounding Rates Attained During the Experimental Period by Applying Chemical Lampricides: Alternative 2 would continue sea lamprey control with lampricides to achieve and maintain sea lamprey reductions similar to those resulting from the experimental sea lamprey control program. Implementation of this alternative would be expected to mimic the results of the experimental program.

The experimental program resulted in a 25 percent increase in annual survival rates of age 3-4 lake trout from pre-control levels, and a 50 percent increase in numbers of lake trout larger than 634 mm (25 inches) in the estimated angler harvest of lake trout in 1997 compared to 1990. An increase of 7 percent in average weight (3.9 to 4.2 pounds) of harvested lake trout also occurred between 1990 and 1997 (Fisheries Technical Committee 1999).

A response similar to that resulting from the experimental program is expected for landlocked salmon. Estimated Main Lake angler catches of salmon increased 2.2 times during the experimental program from 3,790 fish in 1990 to 8,496 in 1997; this was a 3.1 fold increase based on numbers of yearling salmon stocked (Fisheries Technical Committee 1999). The landlocked Atlantic salmon fishery also increased in quality (a greater number of larger/older salmon) in the Main Lake Basin as a result of the experimental sea lamprey control program.

Steelhead and brown trout catch and harvest rates would be expected to be similar to those achieved in the experimental program.

A similar walleye response to that realized from the experimental program is expected under Alternative 2. Sea lamprey wounding rates of 13 wounds per 100 Main Lake/South Lake fish in the 534-634 mm (21.0-25.0 in.) length interval can be expected. This level of sea lamprey predation probably does not markedly suppress walleye survival.

Alternative 3. Abandon Sea Lamprey Control as a Fisheries Management Tool for Lake Champlain. (No Action Alternative): Under Alternative 3, the overall salmonid fishery is expected to decline. Catch rate of Main Lake lake trout would be less than 0.05 fish per hour for fish greater than 634 mm (25 inches), based on a return to 1990 catch rates for fish in this size range, as estimated from angler diary cooperator data (Fisheries Technical Committee 1999). Managers may decide to increase stocking to offset the mortality of lake trout, but even if stocking were increased, the harvest would still not meet that achieved during the experimental program. Salmon stocking may continue, but numbers probably would be greatly reduced, and stocking may be restricted to areas of the lake that have shown the best returns in the past. The salmon fishery would probably revert back to one of similar or lower quality than was present in Lake Champlain in 1990. Brown trout and steelhead stocking may also be reduced or discontinued under Alternative 3 as survival of these two species is greatly reduced in the presence of sea lamprey.

Under Alternative 3, walleye wounding would return to approximately 13 wounds per 100 fish or higher for fish in the 534-634 mm length interval (21.0-25.0 in.). Survival rates of walleye populations experiencing this level of sea lamprey wounding were still considered good (Nettles in review), but increases in predation may occur if sea lamprey prey more heavily on walleye due to low abundance of more preferred salmonid prey.

3. Economic Impacts

<u>Alternative 1. Initiate an Extensive, Integrated, Long-term Control Program for Sea Lamprey in Lake Champlain. (Proposed Action)</u>: Rather than attempting a projection of estimated economic impacts associated with Alternative 1 in terms of dollar value, angler use, additional business opportunities or infrastructure capacity, the Cooperative notes that impacts are not precisely known, but would likely be greater than those of Alternative 2. The expectation of a higher quality fishery with Alternative 1 supports this view. For a relative comparison, the economic impacts anticipated under Alternative 2 are summarized below.

<u>Alternative 2. Maintain Reduced Sea Lamprey Wounding Rates Attained During the Experimental Period by Applying Chemical Lampricides</u>: The economic impacts of Alternative 2 would be similar to the impacts documented during the experimental sea lamprey control program. Estimated annual angler trips for anglers targeting salmonids during the experimental program increased by 47 percent, and 30 percent of the anglers plan to increase their fishing-related expenditures by 21 percent if the program is continued (Gilbert 1997, 1999b, 1999d). As described earlier in Section I.B., the eight-year experimental sea lamprey control program was characterized by a favorable benefit:cost ratio of 3.48:1. Continuation of sea lamprey control at this level would be expected to generate an additional $42.2 million in annual fishing-related expenditures and $59.3 million in annual water-based recreation expenditures (Gilbert 1999a).

Increased numbers of lake trout available as a result of sea lamprey control, larger average and maximum size and a more aesthetically acceptable appearance, stimulated expansion of the lake trout fishery. Despite a 16 percent reduction in fishing license sales in Vermont between 1991 and 1997, and a decline of 29 percent in the number of total annual fishing trips, the angler use of the lake trout fishery increased 26.5 percent from 1991 to 1997 (Gilbert 1999b). Angler use of the landlocked salmon fishery increased 40 percent from 1991, and the steelhead fishery increased 144 percent (Gilbert 1999b). Brown trout angler trips per year increased 106 percent over the same period.

The economic benefits of sea lamprey control also accrue to non-anglers. Gilbert (1989) estimated the annual economic value of sea lamprey control to heads of households within a 35-

mile radius of Lake Champlain to be nearly $5.3 million based on willingness to pay to continue the program. In comparison, Lake Champlain anglers were willing to pay about $3.3 million annually to continue sea lamprey control (Gilbert 1999b). The difference between these two values would approximate the annual economic value to non-anglers, amounting to $2.0 million.

Long-term sea lamprey control would continue to provide additional business opportunities for small business owners. Gross business income of 98 fishing and fishing-related businesses increased 32.9 percent from 1991 to 1997 (Gilbert 1999d). The largest increase among the businesses examined was within the fishing charter industry (69.6%), followed by bait/tackle dealers (41.1%), marinas (23.7%), taxidermy (18.0%) and boat/motor sales and repair (11.5%) in the eight-year experimental control period.

In addition to income growth, 48.5 percent of these businesses expanded during this same time. Success of the experimental sea lamprey control program was cited by the business owners as the specific reason for this expansion. If sea lamprey control was to continue, owners of 35.4 percent of the businesses had definite plans to expand their business (Gilbert 1999d).

Present infrastructure in the form of public and private boat launching sites, shore-based fishing sites, law enforcement and search and rescue units appears adequate to accommodate the expected increased angler use in Lake Champlain (Gilbert 1999c). There are 84 boat launching sites on the lake and its tributaries, with parking for an estimated 3,000 automobiles and trailers. Average unused, available capacity in the summer of 1997 was 2,521 vehicles on weekdays and 1,658 on weekends and holidays. There are ten specifically dedicated shore-based fishing sites with space for 405 anglers and 294 automobiles. These sites only approached capacity on a few weekends during the prime spring fishing periods in 1997.

Information obtained from representatives of regional and local chambers of commerce also indicate that private sector facilities and services can accommodate additional salmonid anglers since the bulk of the increase will occur when use rates of restaurants, motels, gas stations, etc. are low (spring/early summer and late summer/fall). Increase in salmonid sport fishing will offset the declining overall angler use, therefore impacts will be minimal. There is a lack of marina-based berthing, mooring and boat launching capacity but that primarily supports recreational boaters rather than anglers (Gilbert 1999c).

Law enforcement and search and rescue units have not experienced any measurable impact of the experimental sea lamprey control program on their activities and do not anticipate any significant changes in the immediate future (Gilbert 1999c).

<u>Alternative 3. Abandon Sea Lamprey Control as a Fisheries Management Tool for Lake Champlain. (No Action Alternative)</u>: Under Alternative 3, a reduction in the number of salmonid fishing trips as well as salmonid fishing expenditures would be expected as the salmonid fishery declines. Existing fishing and fishing-related businesses that sell fishing goods would likely decline, leading to an expected reduction in fishing related business employment.

4. Comparison of User Conflicts

The FEIS listed conflicts between the salmonid fishery and other lake/stream uses by the various alternatives (see FEIS Table III-6a, page 48). It was judged at that time that user conflicts would be minor under the eight-year experimental sea lamprey control program and the no control alternative, and more extensive under a long-term control program. User conflicts are discussed in Section VII.A.1.

5. Social Impacts

Alternative 1. Initiate an Extensive, Integrated, Long-term Control Program for Sea Lamprey in Lake Champlain. (Proposed Action): Recreational fisheries provide a host of benefits to society. The social impacts are elusive, however, and not readily identifiable because they are related to life and social well-being (Weithman 1993). Enjoyment derived from a fishing trip may not only come from catching fish but from the experience itself, including spending time with family or friends, enjoying the quiet setting, and finding a time and place to relax. Alternative 1 would enhance the value of the Lake Champlain fishing experience.

The projected increase in the number of salmonid angler and recreation days associated with continued or enhanced sea lamprey control would be the result of sea lamprey management providing greater numbers of salmonids, larger average and maximum size and a more aesthetically acceptable appearance of fish to the public (Gilbert 1999b). The increase in usage of the lake and its salmonid fishery will reflect this greater angler satisfaction.

Alternative 2. Maintain Reduced Sea Lamprey Wounding Rates Attained During the Experimental Period by Applying Chemical Lampricides: See Alternative 1.

Alternative 3. Abandon Sea Lamprey Control as a Fisheries Management Tool for Lake Champlain. (No Action Alternative): Without sea lamprey control, the salmonid fishery would be reduced and salmonid angler participation and satisfaction would decline.

6. Costs

Costs of long-term sea lamprey control vary depending on the control options employed for each stream and how a control option is implemented. The cost of lampricides represent the largest cost associated with most stream lampricide treatments and the quantity and type of lampricide formulation (TFM, TFM/niclosamide) applied is determined by varying water chemistry and stream flow. Treatment intervals may also vary due to sea lamprey population dynamics. Trapping operations, barrier and trap establishment, and life expectancy of structures proposed are also subject to variables that are difficult to predict with accuracy. All of these factors affect overall program costs. Thus, cost estimates are generated using estimates of projected high-end costs and assume four-year lampricide treatment cycles, annual trapping expenditures and a 50-year life expectancy of permanent structures.

Table V-2 compares the control strategy costs of Alternatives 1 and 2. The estimated high-end annual cost for sea lamprey control activities under Alternative 1 is $632,800. Estimates under Alternative 1 reflect the costs of the most applicable control strategies as determined by the Cooperative and as indicated in the summary strategies of each of the 20 screened streams in Section VIII . The estimated high-end annual cost for sea lamprey control activities under Alternative 2 is $488,425 and reflects the costs projected for the 13 streams treated during the experimental sea lamprey control program. Alternative 2 places reliance on lampricide treatments for sea lamprey control and ignores the integration of other techniques not established as part of the experimental program. Implementation of alternative 3 (no sea lamprey control) would incur no direct costs. In addition to the costs listed, the Service's monitoring and assessment activities would continue regardless of the Alternative, and that the direct cost is estimated at $142,195 annually. Additional costs associated with routine fisheries management activities unrelated to the sea lamprey control alternatives selected would be incurred. These include costs for fish production, stocking, environmental protection, boat launching site construction, rehabilitation and maintenance; a modest level of fish population and/or fishery monitoring or trouble shooting; enforcement of fishing-related regulations; etc. These are routine fisheries management activities which are carried out by both states on all waters accessible to the public for fishing purposes.

Table V-2. Comparison of maximum, estimated cost in year 2000 dollars of preferred control strategies under Alternative 1 and Alternative 2. Lampricide costs are those for one treatment (generally conducted every four years). Barrier costs, except for the Great Chazy River, are values for construction of new barriers with life expectancies of 50 years. Trapping costs are annual expenditures. The "Annual" subtotal heading is the sum of the annualized cost of lampricides, barriers and trapping. No control costs are associated with Alternative 3.

Stream	Alternative 1				Alternative 2			
	Lampricide	Barrier	Trapping	Annual	Lampricide	Barrier	Trapping	Annual
Great Chazy	75,700	1,900[a]	5,300	26,125	75,700	1,900	5,300	26,125
Saranac[b]	310,300		5,300	82,875	310,300		5,300	82,875
Salmon[b]	141,700	299,100	4,700	46,100	141,700		4,700	40,125
L. Ausable[b]	197,000			49,250	197,000			49,250
Ausable[b]	477,200			119,300	477,200			119,300
Boquet[b]	428,400			107,100	428,400			107,100
Beaver	18,600	75,000		6,150	18,600			4,650
Mullen		75,000	4,800	6,300				
Putnam	40,300			10,075	40,300			10,075
Mt. Hope[c]	20,800			5,200	20,800			5,200
Poultney[c]	70,700			17,675	70,700			17,675
Lewis	51,400			12,850	51,400			12,850
Winooski	132,900			33,225				
Sunderland			5,100	5,100				
Malletts		125,400	5,100	7,600				
Indian			5,100	5,100				
Trout			5,200	5,200	24,900			6,225
Stone Bridge			5,300	5,300	27,900			6,975
Missisquoi	120,700		5,500	35,675				
Youngman			5,500	5,500				
Pike[c]	106,200			26,600				
Morpion		195,000	10,600	14,500				
Total Annual Cost				**632,800**				**488,425**

[a] This cost represents barrier maintenance.

[b] Lampricide cost includes both stream and delta treatments.

[c] Mt. Hope Brook, Poultney and Pike River lampricide costs include those for Greenland Brook, the Hubbardton River and Morpion Stream, respectively.

VI. AFFECTED ENVIRONMENT

A. General Description

This section provides a description of Lake Champlain, its sea lamprey-producing tributaries and delta areas inhabited by sea lamprey larvae. Physical and biological characteristics and public uses of these water resources will be described in sufficient detail in Section VII to understand the effects of the Proposed Action and alternatives. Wetlands which would be exposed to lampricides will also be described in further detail in Section VII.

Lake Champlain occupies part of a large north-south valley between northeastern New York and western Vermont, and extends a short distance into the Province of Quebec, Canada. It is the sixth largest natural coldwater lake in the United States. The total lake water surface area is 435 square miles of which 62 percent is in Vermont, 34.5 percent in New York, and 3.5 percent in Quebec (see page 79 of the FEIS for more detail).

B. Lake Basins and Sea Lamprey-producing Tributaries

1. South Lake

The South Lake portion of Lake Champlain extends from Whitehall, New York, northward to the Crown Point Bridge. This area includes East Bay which is the lower portion of the Poultney River and South Bay. This section of Lake Champlain is characterized by relatively shallow waters and a more river-like environment than other sections of the lake. Extensive wetlands are associated with both shores of the lake in this region.

The shoreline of this basin is sparsely developed in terms of permanent residences. Seasonal homes and associated water oriented recreational activities, particularly boating, warmwater fishing, and waterfowl hunting are popular in this area. High turbidity and eutrophic conditions limit the suitability of water for household consumption and swimming. However, some water use for these purposes occurs.

Sea lamprey populations are known to exist in three stream systems tributary to the South Lake (Table V-1, Figure V-1). These are the Poultney River and its major tributary, the Hubbardton River, Mount Hope Brook and its tributary, Greenland Brook, and Putnam Creek. During the eight-year experimental sea lamprey control program these tributaries were treated for sea lamprey using the lampricide TFM (Fisheries Technical Committee 1999). There are ten additional South Lake streams that have suitable spawning and larval nursery habitat, but at present are not known to support sea lamprey larvae (see Table VIII-23).

2. Main Lake

The Main Lake Basin is the area extending from the Crown Point Bridge north to Rouses Point, New York, west of the Lake Champlain Islands of South and North Hero, and Alburg, Vermont. This area provides the majority of the deep, coldwater salmonid habitat in Lake Champlain.

Water usage in this basin includes public, industrial, commercial, agricultural, and private water supplies. Recreational use includes fishing, boating, waterfowl hunting, waterskiing, wind surfing, and swimming.

Land uses in the surrounding area includes many residential and seasonal homes, two major population centers in Burlington, Vermont and Plattsburgh, New York, and numerous public and private beaches. The Vermont shoreline has considerable agricultural use, while the New York shore is more forested.

There are eleven stream systems tributary to the Main Lake Basin where the presence of sea lamprey has been confirmed (Table V-1, Figure V-1). Nine of these streams were treated as part of the experimental program. An additional eighteen streams have suitable spawning and larval nursery habitat but at present are not known to support sea lamprey larvae (see Table VIII-23). Sea lamprey populations exist on five river deltas on the New York side of the Main Lake Basin. These deltas were treated with lampricide during the eight-year program (Fisheries Technical Committee 1999). The potential for populations on other deltas exists but none have been surveyed recently.

3. Malletts Bay

The Malletts Bay Basin is located north of Burlington on the east side of Lake Champlain. It is separated from the Main Lake Basin by a railroad causeway to the west and from the Inland Sea by a road causeway (Route 2) to the north. The basin consists of a moderately deep outer bay and a smaller and shallower inner bay.

Malletts Bay is used more for recreational boating than any other basin. Recreational use also includes fishing, waterfowl hunting, waterskiing, windsurfing, and swimming. The shoreline use includes forested land, commercial use and many seasonal and permanent homes, as well as a state wildlife refuge and park. Water is used for public, private and commercial water supplies.

Malletts Creek and its tributary Indian Brook, are the two sea lamprey-producing streams that flow into the basin (Table V-1, Figure V-1). Neither stream was treated during the eight-year program to protect the resident northern brook lamprey, listed as endangered in Vermont. There is an extensive wetland associated with the mouth of Malletts Creek. The Lamoille River is the largest tributary of Malletts Bay and flows into the outer bay, but it presently does not have a sea lamprey population. There are two additional streams that have suitable spawning and larval nursery habitat, but at present are not known to support sea lamprey larvae (see Table VIII-23).

4. Inland Sea

The Inland Sea is located to the east of the Lake Champlain Islands of North and South Hero, Vermont. There are no major tributaries that drain into the Inland Sea. The Inland Sea is generally mesotrophic in character.

Land uses along the shoreline of the Inland Sea includes permanent and seasonal homes, agriculture, and forested land. The high water quality facilitates its use for public and private water supplies, as well as fishing, boating, waterfowl hunting, waterskiing, windsurfing, and swimming. There are wetlands associated with some of the embayments, a state wildlife refuge, and several state parks in this sub-basin.

There are two tributaries where the presence of sea lamprey has been confirmed (Table V-1, Figure V-1). Both of these, Stone Bridge Brook and Trout Brook, were treated as part of the eight-year experimental program (Fisheries Technical Committee 1999). In addition, there are three streams that have suitable spawning and larval nursery habitat but at present are not known to support sea lamprey larvae (see Table VIII-23).

5. Missisquoi Bay

Missisquoi Bay is located to the north of the Inland Sea and drains south. The U.S./Canadian border divides the bay with the Province of Quebec located to the north. This shallow basin is eutrophic and supports primarily warmwater fish species.

There are many seasonal homes located on the shoreline, especially in Quebec. Water use includes both public, commercial, and private. Land use in the area is largely agricultural. Major wetlands are associated with the mouth of the Missisquoi River and are part of the Missisquoi National Wildlife Refuge, owned and operated by the Service. Fishing and waterfowl hunting are popular recreational uses of the bay.

There are four sea lamprey-producing streams that drain into the bay, none of which were included in the experimental program (Table V-1, Figure V-1). These are the Missisquoi River, Youngman Brook, Pike River, and Morpion Stream, a tributary to the Pike. There are three other streams that have suitable spawning and larval nursery habitat but at present are not known to support sea lamprey larvae (see Table VIII-23).

C. <u>Human Resources</u>

The total population of the three New York and five Vermont counties bordering Lake Champlain was 454,484 in 1990 and estimated at 471,265 in 1999 (Population Estimate Program, Population Division, U.S. Census Bureau, Washington, DC, http://www.census.gov/population/estimates). This represents a 3.7 percent increase in the total population over the course of the experimental sea lamprey control program. The changes in population by county ranged from a 7.3 percent decrease in Clinton County, New York to a 19.8 percent increase in Grand Isle County, Vermont. Franklin and Chittenden counties in Vermont had the second and third largest population increases at 11.1 percent and 9.2 percent, respectively. Year-round and seasonal home development along the lakeshore is concentrated near communities, particularly in the vicinity of Burlington, Chittenden County, Vermont and Plattsburgh, Clinton County, New York. Farmland more frequently borders streams than lakeshore.

D. <u>Water Resources</u>

1. Water Quality

Lake Champlain consists of five major water masses described above in Section VI.B. and by Potash et al. (1969). Starting from the southerly headwater of the lake at Whitehall, New York and moving northwards, these areas are: the South Lake (Whitehall to Crown Point, New York); the Main Lake (Crown Point to Rouses Point, New York); Malletts Bay (Colchester Point to Sandbar Bridge, Vermont); Inland Sea or Northeast Arm (Sandbar Bridge to Alburg, Vermont); and Missisquoi Bay (Highgate, Vermont to Quebec, Canada). Overall water quality in each of these areas largely governs the types of water usage. The least biologically productive waters (oligotrophic) are of the highest quality and provide the best potable water supplies, coldwater fisheries, swimming and boating. Moderately productive waters (mesotrophic) provide for both warmwater and coldwater fisheries, swimming and boating. Highly productive waters (eutrophic) are most suitable for wildlife habitat (wetlands), warmwater fishing and boating.

2. Uses of Water

Water from Lake Champlain is used for a variety of purposes. Table VII-1 presents an inventory of state-regulated water systems using Lake Champlain water. Numerous year-round and seasonal homes draw water from Lake Champlain. Tributaries proposed for lampricide treatments serve as water supplies for some riparian landowners including the Essex County Fish Hatchery, New York, while the lake serves several large industrial users and the Ed Weed Fish Culture Station in Grand Isle, Vermont. There are many agricultural users along the tributaries and the lake shoreline that also utilize stream and lake water in their operations. Recreational uses of Lake Champlain include swimming, fishing, boating, waterskiing, windsurfing, skin diving and waterfowl hunting (see FEIS, pages 80-81 for additional information).

E. <u>Biological Resources</u>

Biological resources described in this section are presented by phylogenetic category in a sequence that is followed throughout the remainder of this SEIS. Discussion of endangered and threatened species that are legally listed under the States of Vermont, New York, the federal government, and the Province of Quebec, will occur within each phylogenetic category. Endangered (equivalent to threatened in Quebec) species are those determined to be in danger of extinction in one or both states and/or its national range. Threatened (equivalent to vulnerable in Quebec) species are those species that are likely to become endangered within the foreseeable future. Quebec also lists species as susceptible which indicates this species may be designated as vulnerable or threatened in the future (see Section II for more detail). Canada has similar designations but they are advisory, and currently do not afford legal protection. Discussion of state and federal statutory authority regarding these protective categories is presented in Section II.

1. Wetlands

Two major wetland settings are present in the Lake Champlain system in the areas proposed for sea lamprey control: 1) wetlands lying below the 102 foot contour line (Lake Champlain wetlands) that are directly influenced by natural lake level fluctuations; and 2) wetlands at elevations greater than 102 feet (riparian wetlands) associated with the riparian zone of tributary stream systems that are influenced by changes in river stage rather than lake elevation (Gruendling and Bogucki 1986). For a more detailed description of Lake Champlain wetlands see the FEIS, pages 82-83.

2. Plants

Two plant species listed as threatened in New York have been found at survey sites near streams proposed for TFM treatments in New York. Spurred gentian, *Halenia deflexa*, has been observed in Ausable Chasm bordering the Ausable River and lance-leafed loosestrife, *Lysimachia hybrida*, has been observed near Mt. Hope Brook at a South Bay Creek-Cold Spring survey site. No federally-listed plant species are known to exist in the proposed treatment areas. None of these listed plant species is expected to be affected by sea lamprey control measures. For more detailed information on plants in or near Lake Champlain see the FEIS, page 83.

3. Invertebrates

Inventories of aquatic macroinvertebrates in wetland and deltaic areas of several Lake Champlain tributaries were conducted prior to and during the 1990-1997 experimental sea lamprey control program. Prior to control, Gruendling and Bogucki (1986) found the macroinvertebrate community dominated by the groups Diptera (midges), Amphipoda (scuds) and Isopoda (sowbugs). Subdominant groups in various wetlands were Gastropoda (snails) and Trichoptera (caddisflies).

Later surveys (1990-1992) to assess the impacts of TFM and niclosamide on the macroinvertebrate community on the Ausable and Little Ausable River Deltas determined the presence of "common species found throughout Lake Champlain and none...considered rare or endangered" (Gruendling and Bogucki 1993a, 1993b). Species found were similar to the 1986 study but with different orders dominating; Oligochaeta (worms), Amphipoda, Diptera, Hirudinea (leeches), Pelecypoda (fingernail clams), Ephemeroptera (mayflies) and Gastropoda were all found on these two deltas. Lyttle (1996) found 22 more species of gastropods in 1995 than did Gruendling and Bogucki (1993b) in 1992. None of the gastropods collected were state- (Vermont and New York) or federally-listed as unique or rare.

Two species of unionid mussels were found on the Ausable and Little Ausable River Deltas during the 1990-1992 lampricide impact surveys. These were eastern lampmussel and eastern elliptio, both of which are widely distributed in the Lake Champlain drainage (Tables VI-1 and VI-2) (Smith, D. G. 1985; Gruendling and Bogucki 1993b). Lyttle (1996) conducted a follow-up assessment of mussel populations on the Ausable and Little Ausable Deltas in 1995. The eastern floater and giant floater were found in addition to the eastern elliptio and eastern lampmussel. These four mussel species were also found at the majority of the other 51 sites sampled throughout Lake Champlain. The exotic zebra mussel was concurrently documented on these deltas.

An inventory of mussels found in the Lake Champlain tributaries and associated deltas currently under consideration for sea lamprey control is presented in Table VI-2. Eight of the 14 Lake Champlain Basin mussel species are listed in Vermont as endangered or threatened; none are federally-listed or listed in the State of New York (Table VI-1). The eastern pearlshell is the only Vermont-listed mussel that does not occur in lamprey-infested areas of Vermont tributaries, and thus will not be affected by lamprey control activities (Table VI-2).

4. Fish

General: At least 89 species of fish have been documented since 1970 either in Lake Champlain and/or in its tributaries (Table VI-3 and Table VI-4). The presence of a species in a stream is noted if that species is known to inhabit that particular stream during some period of the year or life history stage. For example, landlocked Atlantic salmon, steelhead trout and walleye may be present at various life stages due to migrations or current stocking programs. The lake has abundant and diverse warmwater and coldwater fisheries with at least 20 fish species actively sought by anglers.

Endangered and threatened fishes: No fish species in the Lake Champlain Basin are federally-listed or given similar protective status by Quebec. Seven fish species are classified as endangered or threatened in Vermont and/or New York (Table VI-3). Unless otherwise noted, all species descriptions and distributions are from C. L. Smith (1985).

Northern Brook Lamprey (endangered in Vermont) - This nonparasitic native lamprey is present only in the Malletts Creek/Indian Brook drainage in Vermont. In New York, it occurs in the Great Chazy River in the Lake Champlain Basin (Fisheries Technical Committee 1999) as well as Little Buffalo and Cayuga Creeks, tributaries to Lake Erie (Carlson 2001). Outside of New York and Vermont, the range of this lamprey is widely distributed throughout the upper Great Lakes. Scattered populations also exist in Missouri, Kentucky, Ohio, Pennsylvania, Manitoba, and Quebec.

American Brook Lamprey (threatened in Vermont) - In Vermont, this nonparasitic native lamprey is known to occur in Sunderland Brook (a tributary of the Winooski River), Trout Brook, Kelly Brook (a tributary of the Missisquoi River above the Swanton Dam), and Youngman Brook (NYSDEC et al. 1990; Fisheries Technical Committee 1999). In New York, American brook lamprey are found in the Ausable, Little Ausable and Salmon Rivers, and in Mullen Brook (NYSDEC et al. 1990; Fisheries Technical Committee 1999). Other New York populations are found in the Allegheny drainage, the Upper Genesee River system, Cattaraugus Creek, St. Lawrence River tributaries, the New York City area and on Long Island. It also occurs in the Pike River and Morpion Stream in Quebec (USFWS, Essex Junction, Vermont, unpublished data). The American brook lamprey also occupies a broad band across the northern part of the United States and southern Canada.

Lake Sturgeon (threatened in New York and endangered in Vermont) - Lake sturgeon are rare in Lake Champlain. Lake sturgeon occur in the Great Lakes Basin (including the St. Lawrence River and Lake Champlain) and the Mississippi River and Hudson Bay drainages. Habitat alteration and overfishing have led to their decline throughout most of their range.

The VTDFW in cooperation with the Service began an assessment program in 1998 by sampling for adult sturgeon during spring spawning migrations in the Winooski and Lamoille Rivers with gillnets. Three male sturgeon were captured in the Lamoille River in 1998. Four males were collected in the Lamoille (one recapture from 1998) and one in the Winooski in 1999. In 2000, three male sturgeon were collected in both the Lamoille and Winooski rivers. The three collected in the Lamoille were recaptures from previous years. No female lake sturgeon have been captured. Areas where sturgeon have been seen during sampling for other fish species or caught by anglers have included northern Lake Champlain, the Lamoille, Winooski and Missisquoi Rivers and Otter Creek. Efforts to assess lake sturgeon reproduction are currently underway. Lake sturgeon reproduction was documented in the Winooski River with the observation of a juvenile in summer 2001 (VTDFW, Essex Junction, Vermont, unpublished data).

Mooneye (threatened in New York) - The mooneye occurs in large rivers and lakes, ranging from the Mississippi River drainage through the Great Lakes/St. Lawrence, and James Bay drainages. In Lake Champlain, it is found in the more southerly areas and C.L. Smith (1985) characterizes the species as being "reasonably common" here, although local scientists are unsure of its status or believe mooneye are less abundant than suggested (C. MacKenzie, VTDFW, personal communication; D. Parish, USGS, personal communication).

Stonecat (endangered in Vermont) - In Vermont, the stonecat is present only in the LaPlatte River. In New York, it occurs in the Little Ausable, Salmon, Saranac and Great Chazy Rivers (Fisheries Technical Committee 1999). Stonecat also occur in the Great Lakes, St. Lawrence, upper Hudson, and Allegheny River systems and in Schoharie Creek. The Pike River, Quebec also contains stonecat (Gratton 1995). Elsewhere, the stonecat ranges from the St. Lawrence to the Upper Mississippi drainage and south on the western side of the Appalachians to Arkansas and the Tennessee River systems.

Eastern Sand Darter (threatened in New York and Vermont) - This small darter prefers moderate-sized streams with clean sandy bottoms and is found in the lower Winooski, Missisquoi and Lamoille Rivers in Vermont, and in the lower Poultney and Mettawee Rivers in both New York and Vermont. Outside of the Champlain Basin, the eastern sand darter occurs east of the Mississippi from southern Illinois and Kentucky through the Mississippi, Ohio, and Great Lakes drainages including Lake Erie and a few tributaries in New York, and in the Little Salmon River in the St. Lawrence drainage to southern Michigan and southern Ontario. Recently it has been found in the St. Regis, Deer, and Grasse Rivers in New York (Carlson 1998, 1999).

Channel Darter (endangered in Vermont) - The channel darter occurs in the lower Poultney River, the LaPlatte River and in the Winooski River. Carlson (1999) reported channel darters in the Grasse River and St. Regis River, New York. It also occurs in the Tennessee, the Ohio and St. Lawrence River systems, and Lakes Huron, Erie, and Ontario. A disjunct population occurs in the Red and Arkansas Rivers in Kansas, Oklahoma, Arkansas, and northern Louisiana.

5. Amphibians

Twenty amphibians are known to occur in the vicinity of Lake Champlain or its sea lamprey-producing tributaries (Table VI-5). The striped chorus frog is the only specially protected amphibian (endangered in Vermont, vulnerable in Quebec) in the vicinity of Lake Champlain, and a breeding site (cattail/sedge wetland) has been located near Alburg, Vermont. No lampricide treatments are proposed in the vicinity of the reported distribution of this frog. New York does not afford this tree frog special protection. It was collected in 1956 from a drainage slough elevated above the Saranac River flood plain at Plattsburgh, New York (Gibbs 1957). However, location of this habitat above the normal river level would isolate this population, if present, from exposure to river water containing lampricides.

6. Reptiles

Nineteen reptiles are known to occur in the vicinity of Lake Champlain or its sea lamprey-producing tributaries (Table VI-6). Four of the reptiles are given special status (endangered or threatened) by either New York, Vermont, or Quebec. New York classifies the Blanding's turtle and the timber rattlesnake as threatened. Vermont classifies the timber rattlesnake and five-lined skink as endangered, and the eastern spiny softshell turtle as threatened. Quebec classifies the eastern spiny softshell turtle as threatened.

7. Birds

A total of 318 species of birds are known to occur in the vicinity of Lake Champlain and tributary sections proposed for sea lamprey control (see the FEIS, pages 92-98). The exhaustive listing of birds in the FEIS Table V-3 includes known breeding, visitant, transient, casual, and accidental species to the area. Table VI-7 updates the changes in the status of the birds listed for protection.

8. Mammals

Fifty-six mammals are known to occur in the vicinity of Lake Champlain and tributary sections proposed for lamprey control (see FEIS page 99). The Indiana bat, *Myotis sodalis,* is Federally endangered; the small-footed myotis, *Myotis leibii*, is threatened (Vermont); and the marten, *Martes americana*, is classified as endangered (Vermont). These mammals are not likely to be adversely affected by the proposed sea lamprey control program.

9. Biological Resources Tables

Table VI-1. Lake Champlain Basin mussel species and legal protection status. E=endangered, T=threatened, VT=Vermont. (No federal or New York state-listed mussel species inhabit the Lake Champlain Basin.)

Common Name	Scientific Name	Status
Black sandshell	*Ligumia recta*	E - VT
Pocketbook	*Lampsilis ovata*	E - VT
Squawfoot	*Strophitus undulatus*	none
Fragile papershell	*Leptodea fragilis*	E - VT
Pink heelsplitter	*Potamilus alatus*	E - VT
Creek heelsplitter	*Lasmigona compressa*	none
Eastern floater	*Pyganodon cataracta*	none
Giant floater	*Pyganodon grandis*	T - VT
Fluted shell	*Lasmigona costata*	E - VT
Cylindrical papershell	*Anodontoides ferussacianus*	E - VT
Eastern pearlshell	*Margaritifera margaritifera*	T - VT
Eastern elliptio	*Elliptio complanata*	none
Eastern lampmussel	*Lampsilis radiata*	none
Triangle floater	*Alasmidonta undulata*	none
Elktoe	*Alasmidonta marginata*	none
Zebra mussel	*Dreissena polymorpha*	none

Table VI-2. Mussel species known to be present in Lake Champlain and reaches of selected tributaries and deltas accessible to sea lamprey. R=river, D=delta, X=river and delta, S=shell found only. Sources: Gruendling and Bogucki 1993a, 1993b; Lyttle 1996, 1999 (unpublished); Fisheries Technical Committee 1999.

Species	Great Chazy River	Bullis Brook [a,b]	Saranac River	Salmon River	Little Ausable River	Ausable River	Dry Mill Brook [c]	Boquet River	Beaver Brook	Mullen Brook
Black sandshell										
Pocketbook								X		
Squawfoot	X									
Fragile papershell										
Pink heelsplitter										
Creek heelsplitter										
Eastern floater				D	D	D				D
Giant floater						D			D	
Fluted shell										
Cylindrical papershell										
Eastern pearlshell				R			R			
Eastern elliptio	X		X	X	D	X		X	D	D
Eastern lampmussel	X		X	X	D	D		X	D	D
Triangle floater										
Zebra mussel	D		D	D	D	D		D	D	D

[a] Distribution unknown.
[b] Tributary to Great Chazy River.
[c] Tributary to Ausable River.

Table VI-2 (continued).

Species	Putnam Creek	Brevoort Brook [a,d]	Ranney Brook [a,d]	Mt. Hope Brook [a]	Greenland Brook [a,e]	Poultney River	Hubbardton River [f]	Lewis Creek	LaPlatte River[a]	Winooski River
Black sandshell						R				
Pocketbook						R		X	X	X
Squawfoot						R		X		R
Fragile papershell						R		X		R
Pink heelsplitter	D					R		X		R
Creek heelsplitter						R				
Eastern floater						R		R		
Giant floater						R		X		R
Fluted shell						R		X		R
Cylindrical papershell						R				
Eastern pearlshell										
Eastern elliptio	D					R		X		X
Eastern lampmussel	D					R		X		X
Triangle floater								X		
Zebra mussel	D			D	D	D		D	X	D

[a] Distribution unknown.
[d] Tributary to Putnam Creek
[e] Tributary to Mount Hope Brook
[f] Tributary to Poultney River

Table VI-2 (continued).

Species	Sunderland Brook [a,g]	Malletts Creek [a]	Indian Brook[a,h]	Trout Brook [a]	Stone Bridge Brook	Missisquoi River	Youngman Brook [a]	Pike River [a]	Morpion Stream [a,i]
Black sandshell						R			
Pocketbook						X			
Squawfoot					X	R			
Fragile papershell						X			
Pink heelsplitter					X	R			
Creek heelsplitter									
Eastern floater						R			
Giant floater						R			
Fluted shell						S			
Cylindrical papershell						R			
Eastern pearlshell									
Eastern elliptio					X	X			
Eastern lampmussel					X	X			
Triangle floater						R			
Zebra mussel				D	D				

[a] Distribution unknown.
[g] Tributary to Winooski River.
[h] Tributary to Malletts Creek.
[i] Tributary to Pike River.

Table VI-3. Fish species known to inhabit Lake Champlain and tributary reaches accessible to sea lamprey, and their legal protection status. E=endangered, T=threatened, S=susceptible, VT=Vermont, NY=New York, QC=Quebec.

Common Name	**Scientific Name**	**Status**
Northern brook lamprey	*Ichthyomyzon fossor*	E-VT
Silver lamprey	*Ichthyomyzon unicuspis*	none
American brook lamprey	*Lampetra appendix*	T-VT
Sea lamprey	*Petromyzon marinus*	none
Lake sturgeon	*Acipenser fulvescens*	E-VT, T-NY, S-QC
Longnose gar	*Lepisosteus osseus*	none
Bowfin	*Amia calva*	none
American eel	*Anguilla rostrata*	none
Blueback herring	*Alosa aestivalis*	none
Gizzard shad	*Dorosoma cepedianum*	none
Mooneye	*Hiodon tergisus*	T-NY
Cisco	*Coregonus artedii*	S-QC
Lake whitefish	*Coregonus clupeaformis*	none
Rainbow trout	*Oncorhynchus mykiss*	none
Landlocked Atlantic salmon	*Salmo salar*	none
Brown trout	*Salmo trutta*	none
Brook trout	*Salvelinus fontinalis*	none
Lake trout	*Salvelinus namaycush*	none
Rainbow smelt	*Osmerus mordax*	none
Central mudminnow	*Umbra limi*	none
Redfin pickerel	*Esox americanus americanus*	S-QC
Grass pickerel	*Esox americanus vermiculatus*	S-QC
Northern pike	*Esox lucius*	none
Muskellunge	*Esox masquinongy*	none
Chain pickerel	*Esox niger*	none

Table VI-3 (continued).

Common Name	Scientific Name	Status
Goldfish	*Carassius auratus*	none
Carp	*Cyprinus carpio*	none
Rudd	*Scardinius erythrophthalmus*	none
Cutlips minnow	*Exoglossum maxillingua*	none
Brassy minnow	*Hybognathus hankinsoni*	S-QC
Eastern silvery minnow	*Hybognathus regius*	none
Golden shiner	*Notemigonus crysoleucas*	none
Emerald shiner	*Notropis atherinoides*	none
Bridle shiner	*Notropis bifrenatus*	none
Common shiner	*Luxilus cornutus*	none
Blackchin shiner	*Notropis heterodon*	none
Blacknose shiner	*Notropis heterolepis*	none
Spottail shiner	*Notropis hudsonius*	none
Rosyface shiner	*Notropis rubellus*	none
Spotfin shiner	*Cyprinella spilopterus*	none
Sand shiner	*Notropis stramineus*	none
Mimic shiner	*Notropis volucellus*	none
Northern redbelly dace	*Phoxinus eos*	none
Redside dace	*Clinostomus elongatus*	none
Finescale dace	*Phoxinus neogaeus*	none
Bluntnose minnow	*Pimephales notatus*	none
Fathead minnow	*Pimephales promelas*	none
Blacknose dace	*Rhinicthys atratulus*	none
Longnose dace	*Rhinicthys cataractae*	none
Creek chub	*Semotilus atromaculatus*	none
Fallfish	*Semotilus corporalis*	none

Table VI-3 (continued).

Common Name	Scientific Name	Status
Pearl dace	*Margariscus margarita*	none
Quillback	*Carpiodes cyprinus*	none
Longnose sucker	*Catostomus catostomus*	none
White sucker	*Catostomus commersoni*	none
Silver redhorse	*Moxostoma anisurum*	none
Shorthead redhorse	*Moxostoma macrolepidotum*	none
Greater redhorse	*Moxostoma valenciennesi*	none
Black bullhead	*Ameiurus melas*	none
Yellow bullhead	*Ameiurus natalis*	none
Brown bullhead	*Ameiurus nebulosus*	none
Channel catfish	*Ictalurus punctatus*	none
Stonecat	*Noturus flavus*	E-VT
Tadpole madtom	*Noturus gyrinus*	none
Trout-perch	*Percopsis omiscomaycus*	none
Burbot	*Lota lota*	none
Banded killifish	*Fundulus diaphanus*	none
Brook stickleback	*Culaea inconstans*	none
Threespine stickleback	*Gasterosteus aculeatus*	none
White perch	*Morone americana*	none
Rock bass	*Ambloplites rupestris*	none
Pumpkinseed	*Lepomis gibbosus*	none
Bluegill	*Lepomis macrochirus*	none
Smallmouth bass	*Micropterus dolomieui*	none
Largemouth bass	*Micropterus salmoides*	none
Black crappie	*Pomoxis nigromaculatus*	none
White crappie	*Pomoxis annularis*	none

Table VI-3 (continued).

Common Name	Scientific Name	Status
Eastern sand darter	*Ammocrypta pellucida*	T-VT, T-NY
Fantail darter	*Etheostoma flabellare*	none
Johnny darter	*Etheostoma nigrum*	none
Tessellated darter	*Etheostoma olmstedi*	none
Yellow perch	*Perca flavescens*	none
Logperch	*Percina caprodes*	none
Channel darter	*Percina copelandi*	E-VT, S-QC
Sauger	*Stizostedion canadense*	none
Walleye	*Stizostedion vitreum vitreum*	none
Freshwater drum	*Aplodinotus grunniens*	none
Mottled sculpin	*Cottus bairdi*	none
Slimy sculpin	*Cottus cognatus*	none
Brook silverside	*Labidesthes sicculus*	none

Table VI-4. Fish species known to be present in Lake Champlain and reaches of selected tributaries accessible to sea lamprey.

Common Name	Lake Champlain	Great Chazy River	Bullis Brook	Saranac River	Salmon River	Little Ausable River	Ausable River	Boquet River	Beaver Brook	Mullen Brook	Putnam Creek	Ranney Brook	Brevoort Brook
Northern brook lamprey		X											
Silver lamprey	X	X			X	X	X	X	X		X		
American brook lamprey					X	X	X			X			
Sea lamprey	X	X	X	X	X	X	X	X	X	X	X		
Lake sturgeon	X												
Longnose gar	X	X											
Bowfin	X	X				X	X				X		
American eel	X												
Blueback herring	X												
Gizzard shad	X												
Mooneye	X												
Cisco	X												
Lake whitefish	X												
Rainbow trout	X			X	X		X	X			X	X	X
Landlocked Atlantic salmon	X			X	X	X	X	X					
Brown trout	X	X		X	X	X	X	X			X		
Brook trout	X			X			X	X	X		X	X	X
Lake trout	X			X		X	X	X					
Rainbow smelt	X												
Central mudminnow	X	X				X	X				X		
Redfin pickerel	X	X											
Grass pickerel	X												

Table VI-4 (continued).

Common Name	Lake Champlain	Great Chazy River	Bullis Brook	Saranac River	Salmon River	Little Ausable River	Ausable River	Boquet River	Beaver Brook	Mullen Brook	Putnam Creek	Ranney Brook	Brevoort Brook
Northern pike	X	X				X	X	X	X		X		
Muskellunge	X	X											
Chain pickerel	X										X		
Goldfish	X												
Carp	X												
Rudd	X												
Cutlips minnow		X			X	X	X	X					
Brassy minnow													
Eastern silvery minnow	X	X			X		X	X					
Golden shiner	X	X				X		X					
Emerald shiner	X			X	X	X	X	X					
Bridle shiner	X										X		
Common shiner	X	X		X	X	X	X	X	X		X		
Blackchin shiner													
Blacknose shiner											X		
Spottail shiner	X				X	X	X		X				
Rosyface shiner		X			X	X	X	X					
Spotfin shiner		X						X					
Sand shiner	X	X			X		X	X	X		X		
Mimic shiner	X	X		X	X		X	X			X		
Northern redbelly dace									X		X		
Redside dace [a]											X		
Finescale dace													

[a] Positive identification not achieved

Table VI-4 (continued).

Common Name	Lake Champlain	Great Chazy River	Bullis Brook	Saranac River	Salmon River	Little Ausable River	Ausable River	Boquet River	Beaver Brook	Mullen Brook	Putnam Creek	Ranney Brook	Brevoort Brook
Bluntnose minnow		X		X	X	X	X	X	X		X		
Fathead minnow	X								X				
Blacknose dace		X		X	X	X	X	X	X		X	X	X
Longnose dace		X		X	X	X	X	X			X		
Creek chub		X		X		X	X	X	X		X		X
Fallfish	X	X		X	X	X	X	X					
Pearl dace					X		X				X		
Quillback	X												
Longnose sucker		X				X	X						
White sucker	X	X		X	X	X	X	X	X		X		X
Silver redhorse	X	X											
Shorthead redhorse	X												
Greater redhorse	X												
Black bullhead	X												
Yellow bullhead	X										X		
Brown bullhead	X	X		X	X	X	X	X	X		X		
Channel catfish	X	X											
Stonecat		X		X	X	X							
Tadpole madtom						X							
Trout-perch	X												
Burbot	X	X											
Banded killifish	X	X		X	X		X	X					
Brook stickleback							X						
Threespine stickleback													

Table VI-4 (continued).

Common Name	Lake Champlain	Great Chazy River	Bullis Brook	Saranac River	Salmon River	Little Ausable River	Ausable River	Boquet River	Beaver Brook	Mullen Brook	Putnam Creek	Ranney Brook	Brevoort Brook
White perch	X												
Rock bass	X	X		X		X	X	X					
Pumpkinseed	X	X		X		X	X	X	X		X		
Bluegill	X					X			X				
Smallmouth bass	X	X		X	X	X	X	X					
Largemouth bass	X	X					X						
Black crappie	X	X											
White crappie	X												
Eastern sand darter													
Fantail darter		X					X						
Johnny darter	X												
Tessellated darter	X	X		X	X	X	X	X	X		X		
Yellow perch	X	X		X	X	X	X	X	X				
Logperch	X	X		X	X	X	X	X	X		X		
Channel darter	X												
Sauger	X												
Walleye	X	X		X			X	X					
Freshwater drum	X												
Slimy sculpin	X			X		X		X			X		X
Brook silverside	X												

Table VI-4 (continued).

Common Name	Mt. Hope Brook	Greenland Brook	Poultney River	Hubbardton River	Lewis Creek	LaPlatte River	Winooski River	Sunderland Brook	Indian Brook	Mallets Creek	Trout Brook	Stone Bridge Brook	Missisquoi River	Youngman Brook	Pike River	Morpion Stream
Northern brook lamprey									X	X						
Silver lamprey	X		X	X	X	X	X		X	X		X	X		X	X
American brook lamprey								X			X			X	X	X
Sea lamprey	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lake sturgeon							X						X			
Longnose gar		X	X										X			
Bowfin	X	X			X	X	X			X			X			
American eel					X	X	X			X			X		X	
Blueback herring			X													
Gizzard shad		X	X				X									
Mooneye																
Cisco															X [b]	
Lake whitefish																
Rainbow trout					X	X	X								X	
Landlocked Atlantic salmon					X		X						X			
Brown trout		X	X		X		X						X		X	
Brook trout	X													X		
Lake trout			X				X									
Rainbow smelt		X	X				X					X	X			
Central mudminnow	X							X			X			X	X	X
Redfin pickerel	X				X										X	
Grass pickerel	X															

[b] From Gratton (1995), however it is unlikely that cisco are present for any extended period of time.

Table VI-4 (continued).

Common Name	Mt. Hope Brook	Greenland Brook	Poultney River	Hubbardton River	Lewis Creek	LaPlatte River	Winooski River	Sunderland Brook	Indian Brook	Mallets Creek	Trout Brook	Stone Bridge Brook	Missisquoi River	Youngman Brook	Pike River	Morpion Stream
Northern pike			X		X	X	X			X		X	X		X	
Muskellunge							X						X		X	
Chain pickerel	X				X	X	X			X			X			
Goldfish																
Carp		X	X		X	X	X			X			X		X	
Rudd																
Cutlips minnow																
Brassy minnow			X													
Eastern silvery minnow			X	X	X	X	X	X		X	X	X	X		X	
Golden shiner	X	X			X	X	X		X	X	X	X	X	X	X	
Emerald shiner			X		X	X	X			X	X	X	X	X	X	
Bridle shiner	X															
Common shiner			X		X	X	X	X	X	X	X	X	X		X	
Blackchin shiner			X						X							
Blacknose shiner	X						X		X	X			X		X	
Spottail shiner					X	X	X				X	X	X		X	
Rosyface shiner			X		X	X	X	X	X				X			
Spotfin shiner			X		X	X	X		X				X		X	
Sand shiner			X		X		X								X	
Mimic shiner			X		X	X	X	X					X		X	
Northern redbelly dace					X	X		X		X	X	X		X		
Redside dace																
Finescale dace											X					
Bluntnose minnow			X	X	X	X	X	X	X	X	X	X	X		X	X

Table VI-4 (continued).

Common Name	Mt. Hope Brook	Greenland Brook	Poultney River	Hubbardton River	Lewis Creek	LaPlatte River	Winooski River	Sunderland Brook	Indian Brook	Mallets Creek	Trout Brook	Stone Bridge Brook	Missisquoi River	Youngman Brook	Pike River	Morpion Stream
Fathead minnow			X		X	X	X	X				X		X		
Blacknose dace	X		X	X	X	X		X	X	X	X	X	X	X	X	X
Longnose dace			X	X	X	X	X		X	X	X	X			X	X
Creek chub	X		X		X	X	X	X	X	X	X	X	X	X	X	X
Fallfish	X		X	X	X		X		X	X			X		X	
Pearl dace	X															
Quillback							X								X	
Longnose sucker							X									
White sucker	X		X		X	X	X	X	X	X	X	X	X		X	X
Silver redhorse			X										X		X	
Shorthead redhorse			X				X						X		X	
Greater redhorse													X		X	
Black bullhead																
Yellow bullhead	X		X	X	X	X									X	X
Brown bullhead	X		X		X	X	X			X	X	X	X			
Channel catfish			X				X			X			X			
Stonecat						X									X	
Tadpole madtom																
Trout-perch			X		X		X									
Burbot					X						X				X	
Banded killifish					X	X	X	X		X	X				X	
Brook stickleback											X	X	X	X	X	
Threespine stickleback															X	
White perch			X				X						X		X	

Table VI-4 (continued).

Common Name	Mt. Hope Brook	Greenland Brook	Poultney River	Hubbardton River	Lewis Creek	LaPlatte River	Winooski River	Sunderland Brook	Indian Brook	Mallets Creek	Trout Brook	Stone Bridge Brook	Missisquoi River	Youngman Brook	Pike River	Morpion Stream
Rock bass			X		X	X	X		X	X		X	X	X	X	X
Pumpkinseed	X		X	X	X	X	X		X	X	X	X	X	X	X	
Bluegill	X		X	X												X
Smallmouth bass			X		X	X	X	X		X		X	X		X	X
Largemouth bass	X		X		X	X	X			X			X		X	X
Black crappie			X		X	X	X			X			X		X	X
White crappie																
Eastern sand darter			X				X						X			
Fantail darter															X	X
Johnny darter															X	
Tessellated darter	X		X	X	X	X	X	X	X	X	X	X	X		X	X
Yellow perch	X		X		X	X	X		X	X		X	X		X	X
Logperch	X		X		X	X	X				X	X	X		X	X
Channel darter			X			X	X									
Sauger			X													
Walleye	X		X		X	X	X						X		X	
Freshwater drum			X				X						X		X	
Slimy sculpin	X											X				
Brook silverside			X													

Table VI-5. Amphibian species known to be present in the vicinity of Lake Champlain or its tributaries. Sources: NYSDEC et al. 1990; Shank 1999.

Common Name	Scientific Name	Status
American toad	*Bufo americanus americanus*	none
Spring peeper	*Hyla crucifer crucifer*	none
Gray tree frog	*Hyla versicolor*	none
Striped chorus frog	*Pseudacris triseriata*	Endangered - Vermont Vulnerable - Quebec
Northern leopard frog	*Rana pipiens*	none
Pickerel frog	*Rana palustris*	Susceptible - Quebec
Green frog	*Rana clamitans melanota*	none
Bull frog	*Rana catesbeiana*	none
Mink frog	*Rana septentrionalis*	none
Wood frog	*Rana sylvatica*	none
Mudpuppy	*Necturus maculosus maculosus*	none
Eastern newt [a]	*Notophthalmus viridescens viridescens*	none
Jefferson salamander	*Ambystoma jeffersonia*	none
Blue-spotted salamander	*Ambystoma laterale*	none
Spotted salamander	*Ambystoma maculatum*	none
Northern dusky salamander	*Desmognathus fuscus fuscus*	Susceptible - Quebec
Redback salamander	*Plethodon cinereus*	none
Four-toed salamander	*Hemidactylium scutatum*	Susceptible - Quebec
Northern spring salamander	*Gyrinophilus porphyriticus porphyriticus*	Susceptible - Quebec
Northern two-lined salamander	*Eurycea bislineata bislineata*	none

[a] Also known as Red spotted newt

Table VI-6. Reptile species known to be present in the vicinity of Lake Champlain or its tributaries. Sources: NYSDEC et al. 1990; Shank 1999.

Common Name	Scientific Name	Status
Common snapping turtle	*Chelydra serpentina serpentina*	none
Stinkpot	*Sternotherus odoratus*	none
Wood turtle	*Clemmys insculpta*	Susceptible - Quebec
Map turtle	*Graptemys geographica*	Susceptible - Quebec
Eastern painted turtle	*Chrysemys picta picta*	none
Blanding's turtle	*Emydoidea blandingii*	Threatened - New York Susceptible - Quebec
Eastern spiny softshell turtle	*Apalone spinifera*	Threatened - Vermont Threatened - Quebec
Five-lined skink	*Eumeces fasciatus*	Endangered - Vermont
Northern redbelly snake	*Storeria occipitomaculata occipitomaculata*	none
Northern brown snake	*Storeria dekayi dekayi*	Susceptible - Quebec
Common garter snake	*Thamnophis sirtalis sirtalis*	none
Eastern ribbon snake	*Thamnophis sauritus sauritus*	none
Northern ringneck snake	*Diadophis punctatus edwardsi*	none
Northern water snake	*Nerodia sipedon sipedon*	Susceptible - Quebec
Northern black racer	*Coluber constrictor constrictor*	none
Eastern smooth green snake	*Opheodrys vernalis vernalis*	none
Black rat snake	*Elaphe obsoleta obsoleta*	none
Eastern milk snake	*Lampropeltis triangulum triangulum*	none
Timber rattlesnake	*Crotalus horridus*	Endangered - Vermont Threatened - New York

Table VI-7. List of birds that are provided protection and are known to occur in the vicinity of Lake Champlain or its tributaries. Special concern species are only indicated if they are threatened or endangered in other states. (p) = Bird is a piscivorous species. Sources: NYSDEC; VTDFW; Shank 1999.

Common Name	Scientific Name	Status
Common loon (p)	*Gavia immer*	Endangered - Vermont Special concern - New York
Pied-billed grebe (p)	*Podilymbus podiceps*	Threatened - New York Susceptible - Quebec
Least bittern (p)	*Ixobrychus exilis*	Threatened - New York
Osprey (p)	*Pandion haliatus*	Endangered - Vermont Special concern - New York
Bald eagle (p)	*Haliaeetus leucocephalus*	Endangered - Vermont Threatened - New York Threatened - Federal Susceptible - Quebec
Northern harrier	*Circus cyaneus*	Threatened - New York
Golden eagle (p)	*Aquila chrysaetos*	Endangered - New York Susceptible - Quebec
Cooper's hawk	*Accipiter cooperii*	Susceptible - Quebec
Peregrine falcon	*Falco peregrinus*	Endangered - New York Endangered - Vermont Susceptible - Quebec
King rail	*Rallus elegans*	Threatened - New York
Piping plover	*Charadrius melodus*	Endangered - New York Endangered - Federal Threatened - Quebec
Upland sandpiper	*Bartramia longicauda*	Threatened - New York Threatened - Vermont
Common tern (p)	*Sterna hirundo*	Endangered - Vermont Threatened - New York
Least tern (p)	*Sterna antillarum*	Threatened - New York
Black tern (p)	*Chlidonias niger*	Threatened - Vermont Endangered - New York
Short-eared owl	*Asio flammeus*	Endangered - New York

Table VI-7 (continued).

Common Name	Scientific Name	Status
Sedge wren	*Cistothorus platensis*	Threatened - New York Threatened - Vermont Susceptible - Quebec
Loggerhead shrike	*Lanius ludovicianus*	Endangered - New York Endangered - Vermont Threatened - Quebec
Grasshopper sparrow	*Ammodramus savannarum*	Threatened - Vermont Susceptible - Quebec
Henslow's sparrow	*Ammodramus henslowii*	Endangered - Vermont Threatened - New York

VII. ENVIRONMENTAL CONSEQUENCES

A. Alternative 1. Initiate an Extensive, Integrated, Long-term Control Program for Sea Lamprey in Lake Champlain. (Proposed Action)

1. Adverse Impacts

a. Water

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

Several potential temporary water impacts associated with tributary lampricide treatments under the Proposed Action can be expected. These include the potential for temporary exposure to public and private water supply systems, domestic wells, public beaches, livestock watering and irrigation systems.

Rhodamine WT dye studies were conducted on the 13 tributaries proposed for treatment during the experimental program to predict the potential for exposure of TFM to water supplies (Laible and Walker 1987; Myers 1987a, 1987b; Neuderfer 1989). The dye studies by Myers (1987a, 1987b) and transport modeling by Laible and Walker (1987) provided a basis for predicting the potential for contamination of municipal and private water intakes and bathing beaches in the event of TFM treatments. These studies concluded that water supply intakes located downstream of the TFM application points in the streams will be exposed to treatment or diluted levels of TFM and components of the TFM formulation for periods generally less than 24 hours (see Appendix F for discussion of components of the formulation). It was also found that similar intakes in Lake Champlain within a radius ranging from 0.5 to 4.0 miles from the mouths of treated streams except for the Poultney River, could be exposed to very dilute concentrations of TFM (20 ppb [0.02 ppm] or greater) and other components of the TFM formulation. TFM concentrations of 20 ppb or greater were estimated to extend 20 miles north of the outlet of South Bay (see FEIS page 28).

Water supply impacts were minor, temporary and successfully mitigated, and no municipal water supply was exposed to lampricides during the experimental program. An inventory of public water systems with intakes in Lake Champlain and expected impacts from lampricide treatments under the Proposed Action is presented in Table VII-1. There is potential for low-level exposure to the Philipsburg, Quebec water system if lampricides are applied in the Pike River system (Gary Neuderfer, NYSDEC, Avon, New York, unpublished data). Household and agricultural water supply intakes located downstream of TFM application points as well as those intakes in Lake Champlain near the mouths of the treated tributaries were exposed to treatment or diluted levels of TFM and components of the TFM formulation. See Section VII.A.2. for mitigating measures.

There is some potential for a few domestic wells or infiltration galleries to be exposed to TFM or

TFM/niclosamide treated water although this risk is small. A pre-experimental program analysis by James Garry, Senior Engineering Geologist, NYSDEC concludes that "few, if any, domestic wells will be affected by the lampricide treatment program. Only those shallow wells located within approximately 30 feet of the areas treated or exposed to lampricide face any risk of contamination given worst case variables." This was supported by results of a Rhodamine WT dye study done on Cayuga Inlet, New York (Jolliff et al. 1983). No traces of lampricides were detected in the Ausable Point State Campground well system during TFM treatments of the Ausable River and Little Ausable River in 1990 and 1994 (Robert Bauer, NYSDEC, Avon, New York, personal communication). No domestic wells were exposed during the Lake Champlain experimental program.

Public and private bathing beaches located downstream of the lampricide application points and within the plume area in the lake will be briefly exposed to treatment or diluted levels of TFM or TFM/niclosamide and other components of their formulations. An inventory of public beaches on Lake Champlain and expected impacts from lampricide treatments under the Proposed Action is presented in Table VII-2. During the experimental program, use of seven public beaches associated with treatments of six streams was restricted until water-use advisories were lifted (Table VII-2).

Livestock with access to treated streams will be briefly exposed to treatment or diluted levels of TFM or TFM/niclosamide and other components of their formulations. Treated stream water used for irrigation can damage some agricultural or garden crops (Gilderhus 1990)

The application of TFM or the TFM/niclosamide mixture produces a temporary visual impact, imparting a pale yellow color to the water that disappears as the treated block of water passes down each point along the stream. Riparian water users are advised not to use lampricide-treated water sources until notified that TFM concentrations dissipate below advisory threshold levels (20ppb).

The Georgia-Pacific Company paper mill in Plattsburgh, New York, uses a water supply intake near the mouth of the Saranac River for its paper product manufacturing process. This intake was expected to be exposed to TFM during a treatment of the river and a Bayluscide treatment of the delta. Prior to the 1991 Saranac River Delta Bayluscide treatment, NYSDEC arranged to connect the Georgia-Pacific plant to the City of Plattsburgh municipal water supply system. This connection successfully mitigated the situation, allowing Georgia-Pacific to temporarily switch to Plattsburgh city water through the course of the 1991 and 1995 delta Bayluscide treatments and 1992 stream TFM treatment, and related water-use advisory periods, thus avoiding use of lake water until TFM levels dissipated. The infrastructure is still in place to temporarily change the plant’s water source during future Saranac River and Delta lampricide applications.

In New York, the Putnam Creek water supply for the Essex County Fish Hatchery was exposed to treatment levels of TFM in 1994. TFM was applied downstream of the hatchery intake during a 1998 treatment of Putnam Creek, eliminating the impact.

Some wetlands may be exposed to lampricides during treatments. Gruendling and Bogucki (1986) used the dye study data from Myers (1987a) to predict area and duration of exposure of wetlands to TFM. Streams were selected for the wetland exposure study on the basis of their size and proximity to wetlands and included the Great Chazy, Saranac, Boquet, Little Ausable and Ausable Rivers, Lewis and Putnam Creeks and Beaver Brook. Late spring or midsummer plumes were traced with both being done on the Saranac River to confirm the effect of differential stream/lake temperatures on plume behavior. An exception was Beaver Brook, which was conducted in October. See additional discussion under Mitigating Measures (Section VII.A.2.).

The potential use of the TFM/niclosamide combination to treat larger tributaries is expected to cause water impacts similar to those of TFM alone. Since treatments using the combination can reduce the total amount of lampricide required for effective sea lamprey control by up to 50 percent (see Section IV.A.), the lower TFM concentration may dissipate to below threshold levels more rapidly, thus potentially shortening the time period that water-use advisories are imposed. The niclosamide portion should not significantly affect water impacts since it comprises only 0.5 percent to 2.0 percent of the combination and readily binds to sediments before degrading (EPA 1999).

Under the Proposed Action, tributaries not included in the experimental program which may be proposed for lampricide treatment in the future may impact additional water users; however, unique or problematic water impact situations are not anticipated. Rhodamine WT dye studies similar to those described above will be conducted on these streams to determine the extent of potential water-use impacts prior to obtaining permits to implement treatments.

Table VII-1. Inventory of public water supply systems with intakes in Lake Champlain or its tributaries, impacts and mitigation during lampricide treatment.[a]

State/ Province	Lake Basin	Name of System	Town	Impact	Treatment Stream	Mitigation
New York	Main Lake	Rouses Point Village	Champlain	No		
		B. Porter Reed	Beekmantown	No		
		Ausable Point State Campsite[b]	Ausable	No		
		Corlear Bay Club Water Supply[b]	Chesterfield	No		
		Willsboro Bay Water Supply	Willsboro	No		
		Willsboro Water District #2	Willsboro	No		
		Essex Water Supply	Essex	No		
		Crater Club Water Supply[b]	Essex	No		
	South Lake	Essex County Fish Hatchery	Crown Point	Yes	Putnam Creek	Apply lampricides downstream of Hatchery
Vermont	Main Lake	Alburg Village Water System	Alburg	No		
		Alburg Spring Water	Alburg	No		
		Terry Lodge[b]	Isle La Motte	No		
		Ruth Cliffe Lodge and Resort[b]	Isle La Motte	No		
		St. Annes Snack Bar[b]	Isle La Motte	No		
		Lakehurst Campground[b]	Isle La Motte	No		
		Bow & Arrow Mobile Home Pk.	North Hero	No		
		Grand Isle Fire District #4	Grand Isle	No		

[a] Based upon Laible and Walker 1987; Myers 1987a,1987b; Neuderfer 1989.

[b] Non-municipal and/or seasonal systems.

Table VII-1 (continued).

State/ Province	Lake Basin	Name of System	Town	Impact	Treatment Stream	Mitigation
Vermont	Main Lake	Grand Isle Consolidated	Grand Isle	No		
		Ed Weed Fish Culture Station[b]	Grand Isle	No		
		South Hero Fire District #4	South Hero	No		
		Burlington Water Res.	Burlington	No		
		Champlain Water District	Shelburne	No		
		Thompson Point Association	Charlotte	No		
		Point Bay Marina	Charlotte	No		
		Vergennes Panton Water District	Panton	No		
		Tri-Town Water District	Addison	No		
	Malletts Bay	Marble Island Resort[b]	Colchester	No		
		Brown Ledge Camp[b]	South Hero	No		
		Allen Point Water System	South Hero	No		
		Camp Skyland[b]	South Hero	No		
	Inland Sea	Appletree Bay Resort[b]	South Hero	No		
		Sandbar State Park[b]	Milton	No		
		Kill Kare State Park[b]	St. Albans	No		
		Burton Island State Park[b]	Milton	No		
		St. Albans Water Department	St. Albans	No		

[a] Based upon Laible and Walker 1987; Myers 1987a,1987b; Neuderfer 1989.

[b] Non-municipal and/or seasonal systems.

Table VII-1 (continued).

State/ Province	Lake Basin	Name of System	Town	Impact	Treatment Stream	Mitigation
Vermont		Swanton Village Water	Swanton	No		
		Alburg Springs Water Company	Alburg	No		
		North Hero Water System	North Hero	No		
		Coopers Mobile Home Park[b]	Grand Isle	No		
	Missisquoi Bay	Campbell's Bay Campground[b]	Swanton	Possible[c]	Missisquoi River	Provide alternative water, if necessary
		Highgate Fire District No. 1				
Quebec	Missisquoi Bay	Philipsburg Water System	Phillipsburg	Possible[c]	Pike River/Morpion Stream Missisquoi River	Provide activated carbon filtration

[a] Based upon Laible and Walker 1987; Myers 1987a,1987b; Neuderfer 1989.
[b] Non-municipal and/or seasonal systems.
[c] Impacts to be determined prior to implementation of lampricide treatments.

Table VII-2. Inventory of public beaches and anticipated impacts during lampricide treatment.[a]

Name of Beach	Town, State/Province	Beach Type	Impact	Treatment Stream
		Main Lake		
Rouses Point Beach	Champlain, NY	Community	No	
Point AuRoche State Park	Beekmantown, NY	State	No	
Cumberland Bay State Park	Plattsburgh, NY	State	Yes	Saranac R.
Plattsburgh Municipal Beach	Plattsburgh, NY	Community	Yes	Saranac R.
Ausable Point State Campsite	Ausable, NY	State	Yes	Ausable/L. Ausable R.
Port Douglas Beach	Chesterfield, NY	Community	No	
Willsboro Bay Beach	Willsboro, NY	Community	No	
Noblewood Park	Willsboro, NY	Community	Yes	Boquet R.
Essex Town Beach	Essex, NY	Community	No	
Westport Beach	Westport, NY	Community	No	
Port Henry Beach	Moriah, NY	Community	No	
Bulwagga Bay Beach	Moriah, NY	Community	No	
Crown Point Reservation	Crown Point, NY	State	No	
Crown Point Village	Crown Point, NY	Community	Yes	Putnam Ck.
South Hero Town Beach	South Hero, VT	Community	No	
North Beach	Burlington, VT	Community	Possible[b]	Winooski R.
Wapanaki	Burlington, VT	Community	No	
Red Rocks Park	Burlington, VT	Community	No	
South Burlington Town Beach	South Burlington, VT	Community	No	
Shelburne Town Beach	Shelburne, VT	Community	No	
Charlotte Town Beach	Charlotte, VT	Community	No	
Ferrisburg Town Beach	Ferrisburg, VT	Community	Yes	Lewis Creek
Kingsland Bay State Park	Ferrisburg, VT	State	Yes	Lewis Creek
Button Bay State Park	Ferrisburg, VT	State	No	
D.A.R. State Park	Addison, VT	State	No	
Alburg Dunes State Park	Alburg, VT	State	No	

[a] Based upon Laible and Walker 1987; Myers 1987a,1987b; Neuderfer 1989.

[b] Impacts to be determined prior to implementation of lampricide treatments.

Table VII-2 (continued).

Name of Beach	Town, State/Province	Beach Type	Impact	Treatment Stream
Malletts Bay				
Malletts Bay Beach	Colchester, VT	Community	No	
Niquette Bay State Park	Colchester, VT	State	No	
Inland Sea Basin				
Grand Isle Town Beach	Grand Isle, VT	Community	No	
Grand Isle State Park	Grand Isle, VT	State	No	
Swanton Town Beach	Swanton, VT	Community	No	
St. Albans Town Beach	St. Albans, VT	Community	No	
Burton Island State Park	St. Albans, VT	State	No	
Kill Kare State Park	St. Albans, VT	State	No	
Woods Island State Park	St. Albans, VT	State	No	
Isle LaMotte Beach	Isle LaMotte, VT	Community	No	
Knight Point State Park	North Hero, VT	State	No	
Georgia Town Beach	Georgia, VT	Community	No	
Sandbar State Park	South Hero, VT	State	No	
Missisquoi Bay				
Plage Phillipsburg	Phillipsburg, Quebec	Community	Possible[b]	Pike River
Plage Missisquoi	Phillipsburg, Quebec	Community	Possible[b]	Pike River
Plage Champlain	Venise-en-Quebec, Quebec	Community	Possible[b]	Pike River
Plage Venise	Venise-en-Quebec, Quebec	Community	Possible[b]	Pike River
Plage Miller	Clarenceville, Quebec	Community	Possible[b]	Missisquoi River

[a] Based upon (Myers 1987a and 1987b, Laible and Walker 1987, Neuderfer 1989).

[b] Impacts to be determined prior to implementation of lampricide treatments.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

Potential water-related impacts from applications of Bayluscide granules on deltas and estuarine portions of certain tributaries are limited to low level exposure to water supply intakes and public beaches. Private water intakes in the general vicinity of proposed treatment areas will be exposed to low concentrations of niclosamide (active ingredient) and other components of the Bayluscide formulation. Laible and Walker (1987) found no potential for contamination of municipal water supply intakes from treatments of the five New York deltas treated during the experimental program. There was also no potential for exposure of treated water to livestock (Sausville et al. 1988).

After Bayluscide application, the sand grains on which the active ingredient is carried will be left along the bottom of the treated area. This will amount to approximately 110 pounds per acre of bottom treated at the required application rate for the 3.2% Granular Sea Lamprey Larvicide formulation.

In the 1982 treatment of a 101 acre plot in Seneca Lake, New York, the highest niclosamide concentration measured was 573 ppb and attenuation to the limit of detection, 10 ppb, occurred within 96 hours of application (Ho and Gloss 1987). Gruendling and Bogucki (1993a) measured Bayluscide concentrations near the lake bottom from the 1991 treatments of the Little Ausable River Delta (75 acres) and the Ausable River Delta (250 acres). Median concentrations from 10 sampling stations in the Little Ausable treatment area (Figure VII-1) reached 246 ppb three hours after application and persisted at 25 ppb 98 hours after application (Table VII-3). Median concentrations from 11 sampling stations in the Ausable treatment area (Figure VII-2) reached 146 ppb six hours after application and dropped to mainly undetectable levels 70 hours after application (Table VII-4).

Bayluscide applications in the five New York delta areas treated during the experimental program resulted in impacts to a maximum of 129 households using water from treated areas, and to public beaches at the Ausable Point State Campsite, Plattsburgh Municipal Beach, and Cumberland Bay State Park as well as some private beaches in the general vicinity of treated areas. These impacts were temporary and successfully mitigated. See Section VII.A.2. for mitigating measures. No municipal water intakes, domestic wells or water used for livestock or irrigation were exposed during the experimental program.

Under the Proposed Action, Bayluscide may be applied to other deep water larval habitat areas, including estuarine areas of some tributaries, in addition to the five deltas treated during the experimental program. If conducted, these treatments may impact additional water users; however, unique or problematic water impact situations are not anticipated.

<u>Trapping</u>

Negligible water impacts are expected to result from spawning phase sea lamprey trapping activities.

Figure VII-1. Little Ausable River Delta sampling sites following the 1991 Bayluscide application (From Gruendling and Bogucki 1993a).

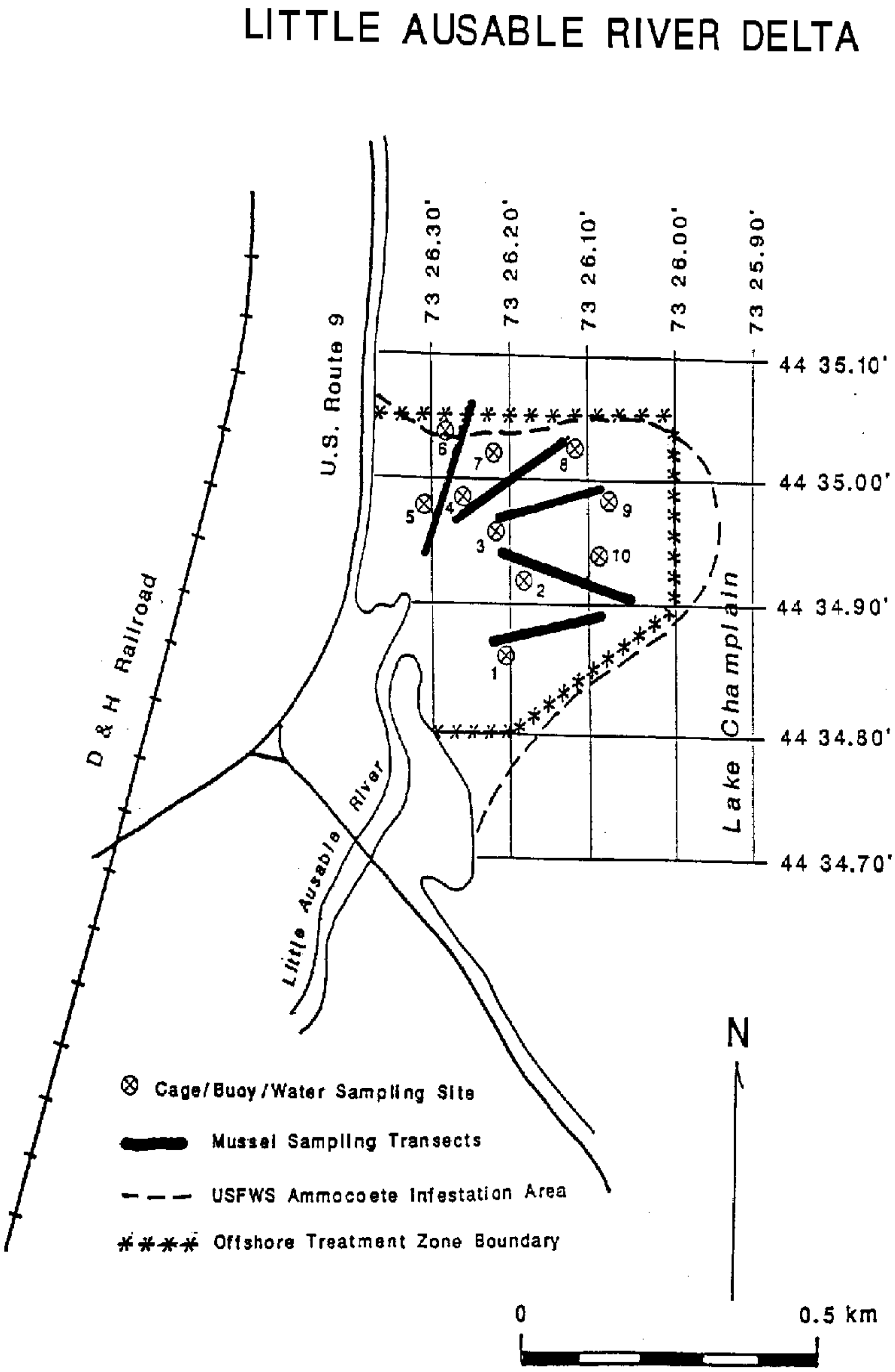


Figure VII-2. Ausable River Delta sampling sites following the 1991 Bayluscide application (From Gruendling and Bogucki 1993a).

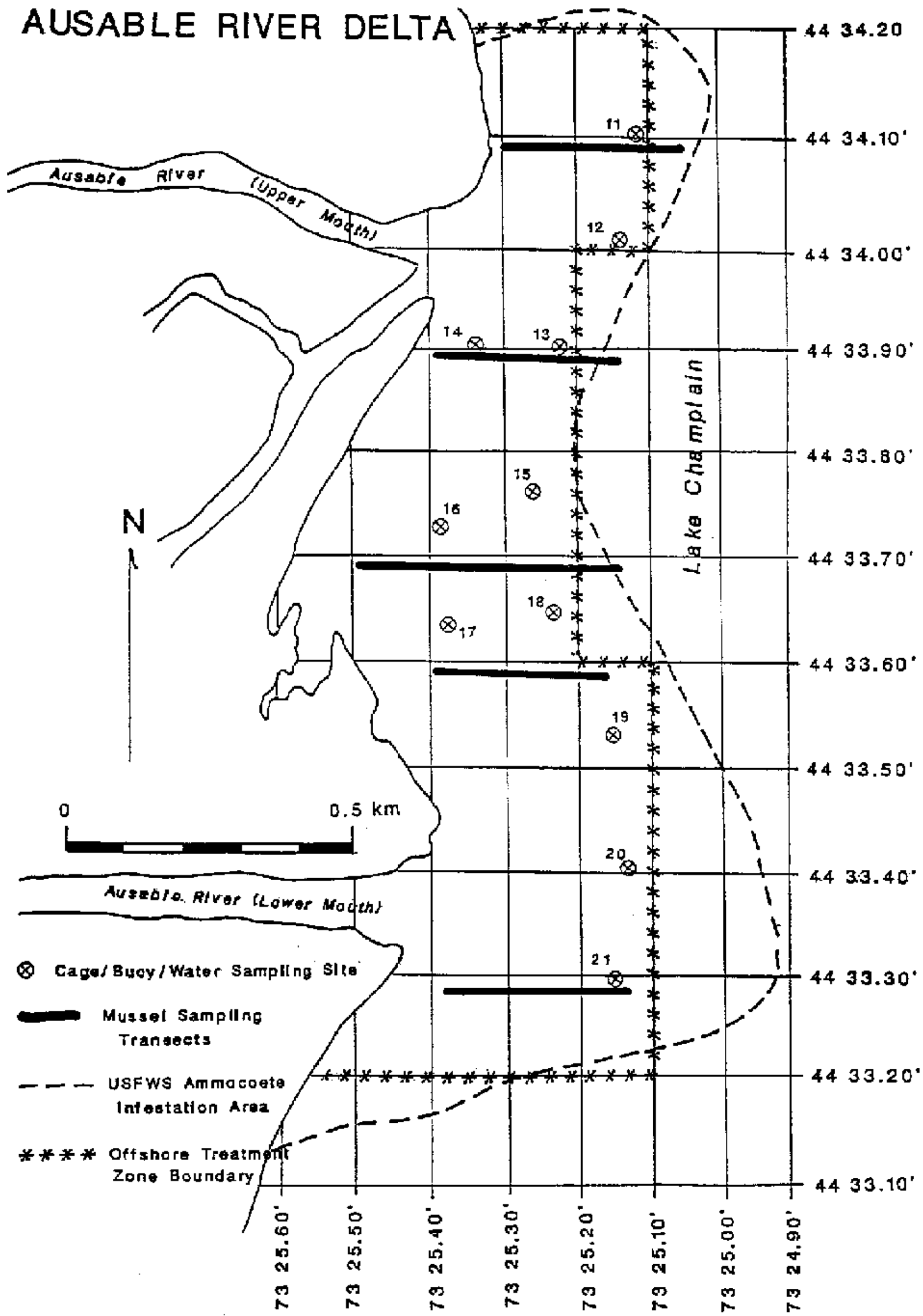


Table VII-3. Concentrations (ppb) of niclosamide from Little Ausable River Delta beginning three hours after the 1991 Bayluscide application. Water samples taken 0.1m above sediment. ND = non-detectable (<10 ppb). Adapted from Gruendling and Bogucki (1993a).

Site No.	3 hr	6 hr	12 hr	24 hr	48 hr	72 hr	98 hr
1	120.4	122.5	189.6	423.7	145.9	61.4	26.4
2	19.6	31.9	56.4	219.3	46.0	42.7	26.0
3	627.0	304.4	256.9	229.9	120.6	38.5	21.2
4	470.1	645.4	976.2	374.4	118.6	56.8	32.9
5	242.2	504.2	557.5	272.3	93.2	32.2	21.4
6	427.9	475.4	446.4	170.1	119.9	60.3	30.9
7	249.5	248.6	262.8	43.2	ND	26.4	23.1
8	251.4	165.6	176.8	49.9	ND	15.5	15.9
9	61.5	66.8	21.0	27.9	ND	ND	17.9
10	117.9	65.7	37.9	70.7	10.4	22.7	27.4
Mean	258.8	263.0	298.2	188.1	65.5	35.6	24.3
Median	246.2	207.1	223.2	194.7	118.6	38.5	24.5

Table VII-4. Concentrations (ppb) of niclosamide from Ausable River Delta beginning three hours after the 1991 Bayluscide application. Water samples taken 0.1m above sediment. ND = non-detectable (<10 ppb). Adapted from Gruendling and Bogucki (1993a).

Site No.	3.0 hr	6.0 hr	12.5 hr	25.0 hr	46.5 hr	95 hr
11	109.6	19.5	ND	ND	ND	ND
12	316.4	98.3	20.8	ND	ND	12.9
13	88.0	146.8	290.7	12.9	ND	ND
14	118.8	211.1	133.0	17.9	ND	ND
15	71.7	79.0	ND	ND	ND	ND
16	202.3	87.5	26.7	ND	15.6	10.6
17	424.9	383.7	85.9	120.2	59.8	ND
18	124.9	21.8	20.5	ND	ND	ND
19	100.3	183.2	291.9	15.5	77.9	ND
20	77.3	282.8	ND	38.8	26.4	ND
21	210.2	295.6	21.7	ND	ND	ND
Mean	167.7	164.5	81.0	18.7	16.3	2.1
Median	118.8	146.8	56.3	17.9	43.1	11.8

Barriers

Sea lamprey barrier dams may restrict water flow and/or impound water creating a pooling effect above the dam. Depending upon the design and placement of the barrier, the decrease in water velocity behind a barrier may trap some amounts of sediment, and in some cases, impounded water may increase in temperature above that characteristic of an unrestricted stream channel. Also, the increase of water velocity over the barrier may cause stream bed scouring directly below the dam. Where adjustable-crest barriers are used, these effects are largely limited to the period they are in operation during the sea lamprey spawning period.

Following an extensive analysis of low-head barrier dams in the Great Lakes drainage, Noakes et al. (2000) found that these dams are not large enough to significantly change the substrate composition of the stream, and do not retain water long enough to greatly affect stream water temperatures. The authors concluded that overall, barrier dams do not have substantial impacts on the physical habitat in streams beyond the small impoundment above the dam and the plunge pool below.

Electrical barriers will have no impacts to water, except for the generation of an electrical field in the immediate vicinity of the barrier.

Temporary and manageable water impacts, including possible temporary increases in turbidity, may occur as a result of barrier construction activities. Installation of access roads and power transmission lines may cause minor impacts to riparian habitat.

b. Human Exposure

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

The risk of human exposure to water containing lampricides is generally limited to exposure by drinking, skin contact, and consuming fish from treated water. These risks are temporary, being limited to the time of treatment and shortly thereafter.

There is a risk for human exposure to water containing up to a maximum of 15 ppm of TFM, and up to 5.1 ppm of isopropanol through drinking and skin contact[2]. Fish in treated water will absorb muscle tissue levels of TFM approaching water concentrations (Table VII-5). Via this route, TFM could be ingested by persons who eat the fish. However, the availability of TFM in fish muscle tissue will decline rapidly once the TFM levels in the water have dissipated (Table VII-5). The isopropanol component of the TFM formulation, if found in fish exposed to this formulation, is expected to be rapidly excreted (NYSDOH 1989). Isopropanol is volatile and typically is released into the atmosphere (Engstrom-Heg 1989; NYSDOH 1989).

[2] Based on a current TFM formulation containing about 38% TFM and 13% isopropanol and on the maximum allowable concentration for Putnam Creek the stream potentially requiring the highest treatment concentration due to its higher pH and alkalinity combination.

The amount of niclosamide in a TFM/niclosamide combination is extremely small (0.5-2.0% of combined active ingredient). Therefore, the risk for human exposure to significant levels of niclosamide in treated stream water is extremely low.

Treatment personnel handling concentrated lampricide formulations (TFM or a TFM/niclosamide mixture) have the greatest risk of exposure, with potential exposure routes through the skin, eyes, and inhalation; however, this risk is minimized by use of required personal protective equipment. See Section VII.A.1.k. for discussion of adverse effects on mammals.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

There is the potential for human exposure to niclosamide and minor or trace quantities of the inert components of the Bayluscide formulation in the areas proposed for treatment through drinking, bathing and eating fish from treated water for a short time following treatment. These risks are temporary, lasting less than 14 days following treatment. Muscle residues in rainbow trout and largemouth bass held in cages at the Dresden treatment plot in Seneca Lake in 1982 reached a maximum of 858 ppb which roughly reflected water concentrations where the cages were deployed (Table VII-6; Ho and Gloss 1987). Those were worst-case exposures, however, since the fish were caged near the lake bottom, they were subjected to heavier exposure than fish which were free to swim up or out of the area.

Because of the high mammalian tolerance to niclosamide (see VII.A.1.k.), the greatest potential human health threat posed by this formulation may be from the sand grains or dust being inhaled or getting in the eyes. Certain persons may suffer reactions to the active ingredient in the dust from granular formulations. Dust was not noticeable during the 1982 Seneca Lake Bayluscide treatments. The Bayluscide 5% granule formulation applied to the Lake Champlain deltas in 1991 and 1995 did produce noticeable dust, but the new 3.2% granule formulation is made up of micro-encapsulated grains and is dust-free. Personnel handling and applying the chemical wear required personal protective equipment, preventing exposure (see Section VII.A.2.a.).

Trapping

Spawning-phase sea lamprey trapping activities will have negligible human impacts.

Barriers

Human interactions with stream barriers are possible. Streams navigable by watercraft will be affected, requiring vessels to be portaged around a barrier. The risk of human injury is possible from contact with any barrier design, by collisions from watercraft, or by walking or climbing or swimming on or near barriers.

Table VII-5. TFM residue levels in the muscle tissue of seven species of fish after exposure to 1mg/L TFM for 12 hours and during a 24-hour period in "clean" water (from Sills and Allen 1975). (ND indicates TFM was not detected).

Species	**Temp. (◦C)**	**Water Hardness (mg. L $CaCO_3$)**	**pH**	**Withdrawal Interval (h)**	**Muscle Tissue Concentration (µg/g wet weight)**
Rainbow trout (*Oncohynchus mykiss*)	12	40-48	7.2-7.6	0 12 24	0.30 0.01
Brown trout (*Salmo trutta*)	12	40-48	7.2-7.6	0 12 24	0.77 0.13 0.10
Lake trout (*Salvelinus namaycush*)	12	40-48	7.2-7.6	0 12 24	0.11 0.02 <0.01
White bass (*Morone chrysops*)	12	40-48	7.2-7.6	0 12 24	0.20 <0.01 <0.01
Largemouth bass [a] (*Micropterus salmoides*)	18.5	20-22	6.5-6.9	0 12 24	0.32 <0.01 <0.01
	14	–	6.8	0 12 24	0.86 ND ND
Bluegill (*Lepomis macrochirus*)	18.5	20-22	6.5-6.9	0 12 24	0.21 0.04 0.01
Channel catfish (*Ictalurus punctatus*)	18.5	40-48	7.2-7.6	0 12 24	0.77 0.01 <0.01

[a] From Schultz et al. 1979.

Table VII-6. Concentrations of niclosamide (ppb wet wt) in standard fillet samples from caged fish after Bayluscide application in Seneca Lake (- indicates no sample taken; <45 indicates trace amount below quantifiable limit). The control station was located slightly north of the treatment area (from Ho and Gloss 1987).

Station	Depth (meters from bottom)	Largemouth bass Time post treatment (h)						Rainbow trout Time post treatment (h)					
		8	14	24	48	96	168	8	14	24	48	96	168
Control	0	<45	0	0	<45	0	0	<45	<45	<45	0	0	75
	1	<45	<45	<45	<45	-	55	0	0	0	0	0	<45
	2	0	<45	61	0	-	0	<45	<45	<45	<45	0	0
C	0	52	-	83	0	0	70	46	0	<45	0	<45	0
	1	0	75	62	0	0	0	0	0	0	0	<45	<45
	2	<45	94	51	0	0	0	0	0	0	0	0	0
D	0	288	151	470	363	106	142	208	217	379	128	<45	0
	1	0	356	124	155	162	0	-	268	81	0	0	-
	2	109	238	264	181	0	-	116	513	144	89	63	0
G	0	-	367	858	391	780	-	-	338	-	-	-	-
	1	0	-	322	325	-	118	0	266	301	72	80	-
	2	264	<45	71	73	0	0	0	0	85	0	0	-

c. Wetlands

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

Prior to implementation of the experimental program, Gruendling and Bogucki (1986) conducted a comprehensive investigation of Lake Champlain wetlands associated with 18 tributaries under preliminary consideration for TFM treatment. They used literature dealing with TFM and information from the dye plume studies (Myers 1987a) to assess the potential of TFM exposure to the wetlands, and drew the following basic conclusions:

> First, most wetlands along tributaries above the influence of Lake Champlain water levels (above 102 feet or 31.1 meters) are situated high on the river bank or are located behind natural levees and have no open water connection with the river except at high flow. Second, for those river-level wetlands along tributaries above the influence of Lake Champlain the net flow of water is from the wetland to the river. These two general conclusions lead to the statement that no wetlands

> above the influence of Lake Champlain water levels will be significantly impacted by lampricide . . . as long as that lampricide will be applied when lake and river levels are at or below the elevation recorded on the day(s) of field investigation.
>
> The third general conclusion is that only wetlands associated with Lake Champlain water levels will be exposed to lampricide and the amount of potential exposure is related to covertype.

Forested wetland and scrub shrub would be little or not exposed; emergent wetlands would be subject to more than marginal exposure only at high lake levels, but not at low lake levels when flowing river water does not effectively penetrate them. Aquatic beds would be subject to exposure at any lake level (Gruendling and Bogucki 1986).

Of the wetlands identified as being subject to exposure, Gruendling and Bogucki (1986) stated that only a small portion of wetland habitat is inundated at late summer/early fall water levels, when most treatments are conducted. Only aquatic beds would be at serious risk of exposure to treatment level concentrations of TFM. They identified the Saranac River, Beaver Brook, Sunderland Brook, Trout Brook and Stone Bridge Brook as having no wetlands that would be at significant risk of exposure to lampricides.

The streams studied by Gruendling and Bogucki (1986) are summarized with major survey findings in Tables VII-7, VII-8 and VII-9. The wetlands listed in Table VII-7 are under NYSDEC jurisdiction, and were recently reclassified pursuant to New York State's wetland regulations (6NYCRR Part 664); therefore, this table reflects the reclassified wetland designations. Wetlands in Tables VII-8 and VII-9 are consistent with the Gruendling and Bogucki (1986) classifications.

Gruendling and Bogucki (1986) reported that in those instances where dye penetrated emergent and aquatic bed habitats, treatment levels were seldom reached and in most cases concentrations had dropped significantly within 24 hours. In general, they indicated minimal impacts to wetland organisms could be expected from TFM treatments done under the conditions they recommended, namely moderate lake levels and normal stream flows. Those impacts will be addressed below under each of the biota divisions.

Gruendling and Bogucki (1993b) measured TFM concentrations in the Ausable and Little Ausable River Deltas following treatments of these rivers in 1990. They found little exposure to emergent wetlands near the mouth of the Ausable River and found low concentrations of TFM in the emergent wetland fringe area along the Little Ausable Delta. Concentrations diminished to trace levels within three days.

Impacts of TFM/niclosamide combinations in wetlands are expected to be similar to those of TFM. The relative toxicity to most nontarget organisms (compared to sea lamprey) of TFM/niclosamide is somewhat similar to or less than that of TFM but overall amounts of chemical used and concentrations of active ingredients will be substantially lower; thus, the potential for infiltration into wetlands would be somewhat lower than for TFM. Potential impacts of stream lampricide treatments on wetland biota are discussed in the following pages, by taxonomic group (Sections VII.A.1.e. - VII.A.1.k.).

Tributaries with potential to be proposed for lampricide treatment under the Proposed Action, and which were not included in the Gruendling and Bogucki (1986) analysis will be assessed for potential impacts to wetlands following their methodology, prior to obtaining permits for treatment. These include the Winooski River, LaPlatte River, and possibly Bullis Brook and Mullen Brook. Wetland impacts are expected to be consistent with those predicted prior to, and observed during the experimental program.

Table VII-7. Summary of wetlands under NYSDEC jurisdiction, associated with selected Lake Champlain tributaries which were determined to be at risk of lampricide exposure in the event of treatments. NYSDEC wetlands are those in the State of New York outside of the Adirondack Park boundary and regulated by NYSDEC. Wetland designation, classification and characteristics are consistent with those recorded in NYSDEC files.

Tributary	Wetland Designation	Wetlands Classification	NYSDEC Classification Characteristics [a]	Comments	Total Potential Exposure Area (acres) [c]
Great Chazy River	CH-9	II	9, 11, 12	High and low level exposure depending on lake level	$\leq$ 178.5
Saranac River	-	-	-	No wetland exposure	none
Little Ausable River	KV-9	II	9, 11, 26	Potential treatment level exposure	$\leq$ 26.9
Ausable River	KV-10	II	11, 12, 26, 27	Potential treatment and low level exposure depending on lake level	$\leq$ 0.3
Poultney River (New York side)	WH-1	I	[b]	Limited low level exposure	unknown [d]
	WH-2	I	[b]	Limited low level exposure	$\leq$0.2

[a] NYSDEC classification characteristics numbered above (from 6NYCRR Part 664) are as follows: 9 - Contains two or more wetland structural groups. 11 - Associated with permanent open water outside of wetland. 12 - Adjacent or contiguous to streams classified $C_{(t)}$ or higher under Article 15 ECL. 26 - Deciduous swamp. 27 - Shrub swamp.

[b] Poultney River classification characteristics were unavailable in database accessible to author.

[c] Potential exposure area was determined by Gruendling and Bogucki (1986). Most Poultney River wetlands would have no area exposed under low lake and river levels according to Gruendling and Bogucki (1986). Exposure areas at higher levels are unknown, but expected to be minimal or non-existent under conditions favorable for treatment.

[d] Not included by Gruendling and Bogucki (1986). The characteristics of this wetland are similar to WH-2, thus the exposure area is expected to be very small.

Table VII-8. Summary of wetlands under APA jurisdiction, associated with selected Lake Champlain tributaries which were determined to be at risk of lampricide exposure in the event of treatments[a]. APA wetlands are those in New York within the Adirondack Park boundary and regulated by the Adirondack Park Agency. APA wetland designation, classification and characteristics are consistent with those listed in Gruendling and Bogucki (1986).

Tributary	**Wetland Designation**	**Wetlands Classification**	**Covertype**	**Comments**	**Total Potential Exposure Area (acres)** [b]
Salmon River	1	III	Aquatic bed	Potential treatment level exposure	6.0
Little Ausable River	1	I	Forest Scrub-shrub Emergent Aquatic Bed	Potential treatment level exposure	109.1
Ausable River	2	I	Forest Scrub-shrub Emergent Aquatic Bed	Potential treatment and low level exposure depending on lake level	≤ 26.2
Boquet River	5	I	Forest Scrub-shrub Emergent	Most area no impact; potential low level exposure along river	1.1
Beaver Brook	3	II	Forest Emergent	Potential low level exposure in small emergent zone adjacent to tributary	0.25
Putnam Creek	1	III	Aquatic Bed	Potential treatment and low level exposure	(included in 3 below)
	2	III	Aquatic Bed	Potential treatment and low level exposure	(included in 3 below)
	3	I	Forest Scrub-shrub Emergent Aquatic Bed	Potential treatment and low level exposure	≤ 30.5 (wetlands 1 - 3 combined)

[a] Tributaries that may be proposed for future lampricide treatment under the Proposed Action, and were not included in the Gruendling and Bogucki (1986) analysis will be assessed for potential impacts to wetlands following their methodology, prior to obtaining permits for treatment.
[b] Potential exposure area was determined by Gruendling and Bogucki (1986).

Table VII-8 (continued).

Tributary	Wetland Designation	Wetlands Classification	Covertype	Comments	Total Potential Exposure Area (acres) [b]
Mount Hope Brook	2	I	Scrub-shrub Emergent Aquatic Bed	Potential treatment and low level exposure	(included below)
	3	I	Forest Scrub-shrub Emergent Aquatic Bed	Potential low level exposure in isolated spots	≤ 81.0 (wetlands 2 and 3 combined)

[a] Tributaries that may be proposed for future lampricide treatment under the Proposed Action, and were not included in the Gruendling and Bogucki (1986) analysis will be assessed for potential impacts to wetlands following their methodology, prior to obtaining permits for treatment.
[b] Potential exposure area was determined by Gruendling and Bogucki (1986).

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

Some lakeshore wetlands which are associated with deltas proposed for treatment with Bayluscide granules would be exposed directly or marginally to this lampricide. Therefore, the kinds of adverse effects to biota from niclosamide exposure on the deltas are also essentially the same as those that would occur in the wetlands.

Of the five river deltas proposed for Bayluscide treatment in the experimental program, Gruendling and Bogucki (1986) determined that no wetlands would be exposed to niclosamide on the Saranac and Ausable River Deltas, while most of the aquatic bed portions of wetlands on the Salmon, Little Ausable and Boquet River Deltas would be exposed to treatment level concentrations.

Niclosamide concentrations documented during the 1982 treatment of a delta infestation in Seneca Lake, New York, are summarized in Table VII-10. The maximum concentration observed in that treatment was 573 ppb of niclosamide in a sample collected 0.1m (about 4 inches) above the lake bottom. Other concentrations were lower but varied widely depending on location and place in the water column. The data in Table VII-10 were presented as a basis for predicting the concentrations of niclosamide that could be expected in the five deltas proposed for treatment in the FEIS.

Exposure of niclosamide in wetlands was minimal during the experimental program. Gruendling and Bogucki (1993a) measured niclosamide concentrations in the Ausable and Little Ausable River Deltas following treatments of these deltas in 1991 and found wetland exposure limited to the aquatic bed category within the targeted delta areas. The range of niclosamide concentrations observed during these treatments (Tables VII-3 and VII-4) varied widely, similar to that of Seneca Lake (Table VII-10).

Deltas or estuarine lower tributary areas that may be proposed for future Bayluscide treatment, where Bayluscide was not applied during the experimental program, will be assessed for potential impacts to wetlands prior to implementation of treatment. Wetland impacts are expected to be consistent with those predicted prior to and observed during the experimental program.

Table VII-9. Summary of wetlands under Vermont Agency of Natural Resources jurisdiction, associated with selected Lake Champlain tributaries which were determined to be at risk of lampricide exposure in the event of treatments[a] (Adapted from Gruendling and Bogucki 1986).

Tributary	Wetland Designation	Wetlands Classification [b]	Covertype	Comments	Total Potential Exposure Area (acres) [c]
Poultney River (Vermont side)	-	-	-	No wetland exposure	none
Lewis Creek	1	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level exposure	(included in 5 below)
	2	Class Two	Emergent	Potential treatment and low level exposure	(included in 3 below)
	3	Class Two	Forest Scrub-Shrub Emergent	Potential treatment and low level exposure	(included in 3 below)
	4	Class Two	Forest Scrub-Shrub Emergent	Potential treatment and low level exposure along tributary entrance sites	(included in 3 below)
	5	Class Two	Emergent	Potential treatment and low level exposure along margins only	$\leq$ 81.0 (wetlands 1 - 5 combined)

[a] Tributaries that may be proposed for future lampricide treatment under the Proposed Action, and were not included in the Gruendling and Bogucki (1986) analysis will be assessed for potential impacts to wetlands following their methodology, prior to obtaining permits for treatment.

[b] Wetlands classifications are consistent with the Vermont Wetland Rules.

[c] Potential exposure area was determined by Gruendling and Bogucki (1986). Poultney River wetlands would have no area exposed under low lake and river levels according to Gruendling and Bogucki (1986). Exposure areas at higher levels are unknown, but expected to be minimal or non-existent under conditions favorable for treatment.

Table VII-9 (continued).

Tributary	Wetland Designation	Wetlands Classification [b]	Covertype	Comments	Total Potential Exposure Area (acres) [c]
Malletts Creek/ Indian Brook	1	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level in lower reaches of tributary	(included in 5 below)
	4	Class Two	Forest Emergent Aquatic Bed	Potential treatment and low level exposure depending on lake level	(included in 5 below)
	5	Class Two	Emergent Aquatic Bed	Potential treatment and low level exposure depending on lake level	$\leq$ 69.1 (wetlands 1, 4 and 5 combined)
Trout Brook	-	-	-	No wetland exposure	none
Stone Bridge Brook	-	-	-	No wetland exposure	none
Youngman Brook	1	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level exposure	34.4
Missisquoi River	1	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level exposure near mouth and along shoreline	(included in 9 below)

[a] Tributaries that may be proposed for future lampricide treatment under the Proposed Action, and were not included in the Gruendling and Bogucki (1986) analysis will be assessed for potential impacts to wetlands following their methodology, prior to obtaining permits for treatment.

[b] Wetlands classifications are consistent with the Vermont Wetland Rules.

[c] Potential exposure area was determined by Gruendling and Bogucki (1986). Poultney River wetlands would have no area exposed under low lake and river levels according to Gruendling and Bogucki (1986). Exposure areas at higher levels are unknown, but expected to be minimal or non-existent under conditions favorable for treatment.

Table VII-9 (continued).

Tributary	Wetland Designation	Wetlands Classification [b]	Covertype	Comments	Total Potential Exposure Area (acres) [c]
Missisquoi River	2	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level exposure along river in lower reaches, and along shoreline	(included in 9 below)
	3	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level exposure along river in lower reaches, and along shoreline	(included in 9 below)
	4	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level exposure along river in lower reaches, and along shoreline	(included in 9 below)
	5	Class Two	Scrub-Shrub Emergent	Limited potential low level exposure	(included in 9 below)
	8	Class Two	Forest Scrub-Shrub Emergent Aquatic Bed	Potential treatment and low level exposure in lower reaches only	(included in 9 below)
	9	Class Two	Forest Emergent Aquatic Bed	Potential treatment and low level exposure in lower reaches only	337.4 (wetlands 1 - 5, 8 and 9 combined)

[a] Tributaries that may be proposed for future lampricide treatment under the Proposed Action, and were not included in the Gruendling and Bogucki (1986) analysis will be assessed for potential impacts to wetlands following their methodology, prior to obtaining permits for treatment.

[b] Wetlands classifications are consistent with the Vermont Wetland Rules.

[c] Potential exposure area was determined by Gruendling and Bogucki (1986). Poultney River wetlands would have no area exposed under low lake and river levels according to Gruendling and Bogucki (1986). Exposure areas at higher levels are unknown, but expected to be minimal or non-existent under conditions favorable for treatment.

Trapping

Spawning-phase sea lamprey trapping activities will have no impact in wetlands.

Barriers

Fixed-crest barriers impounding water may inundate portions of wetlands and may create new wetlands. Impacts from adjustable-crest barriers will be seasonal and temporary, occurring during times the barrier is operational (actively preventing lamprey from upstream movement) and during times of high flows. Most configurations of electrical barriers would have no impact on wetlands unless installed in conjunction with fixed or adjustable-crest barriers or other channel-constricting structures.

If unacceptable flooding effects are predicted to occur upstream of an adjustable crest barrier at a particular water elevation, the barrier controls can be programmed to drop the crest to an acceptable level, then relying on the high water velocity to block spawning-phase sea lamprey passage. This tradeoff may increase the risk of sea lamprey passing over the barrier, however. At very high flows, the downstream tailwater will approach the barrier's headwater elevation, causing the influence of the barrier on restricting stream flow to diminish (Ellie Koon, USFWS, Ludington, Michigan, personal communication).

Table VII-10. Concentrations (ppb) of niclosamide in lake water samples collected from treatment areas in Seneca Lake following a control application (numerical values are distances above substrate in m, S = water surface, M = mid-depth). Area treated = 101 acres (roughly 1000 m on N-S Axis, 400 m on W-E Axis). Detection limit in water is $\geq$10 ppb. Adapted from Ho and Gloss 1987.

		Time Post Treatment (h)														
Station	**Depth**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**4.0**	**5.0**	**6.0**	**12.0**	**18.0**	**24.0**	**48.0**	**72.0**	**96.0**
A	S	63	17	22	43	29	53	51	123	46	46	18	18	0	0	0
N. Boundary	M	0	0	19	16	18	19	11	30	31	0	18	10	0	0	0
Depth 4.5 m	1.00	0	0	14	17	26	31	30	49	51	10	0	9	0	0	0
	0.50	0	0	13	29	21	31	38	51	103	10	0	13	0	0	0
	0.25	0	0	13	30	23	47	33	283	108	10	0	15	0	0	0
	0.10	0	0	13	23	33	60	52	321	144	0	0	15	0	0	0
B	S	44	31	26	39	27	56	113	123	93	59	26	24	0	0	0
100 m S. of	M	28	31	20	37	22	30	31	35	32	10	26	39	0	0	0
Station A	1.00	40	34	39	50	38	44	26	27	96	10	0	38	0	0	0
Depth 3.2 m	0.50	23	36	62	80	106	61	47	75	152	0	0	38	0	0	0
	0.25	-	35	40	114	193	72	64	132	133	13	13	40	0	0	0
	0.10	23	48	107	175	131	117	115	141	148	16	13	45	0	0	0
C	S	16	26	27	11	19	40	22	102	132	36	24	13	11	0	0
N.E. Corner	M	16	14	27	0	0	0	0	17	0	0	0	0	0	0	0
Depth 4.5 m	1.00	22	16	13	7	12	7	0	0	0	0	0	0	0	0	0
	0.50	27	23	27	11	13	8	8	0	0	0	0	0	0	0	0
	0.25	42	41	28	10	18	10	16	9	14	0	0	0	0	0	0
	0.10	46	46	50	-	23	18	20	11	14	0	0	0	0	0	0

Table VII-10 (continued).

		Time Post Treatment (h)														
Station	**Depth**	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**4.0**	**5.0**	**6.0**	**12.0**	**18.0**	**24.0**	**48.0**	**72.0**	**96.0**
D	S	28	20	18	13	22	19	39	26	30	49	32	57	14	0	0
Center	M	17	13	17	11	18	13	27	15	70	108	0	0	-	-	0
Depth 2.5 m	1.00	28	30	16	9	18	11	79	152	78	65	0	0	11	0	0
	0.50	33	137	16	65	112	58	62	148	137	60	0	0	11	0	10
	0.25	52	139	135	97	130	50	92	147	131	60	14	0	16	0	10
	0.10	118	168	176	92	138	-	109	147	127	54	14	0	16	10	10
E	S	0	-	25	11	0	0	0	0	0	30	24	87	12	0	0
Center	M	0	28	34	13	0	0	0	0	0	0	0	0	0	0	0
Boundary	1.00	18	19	18	0	11	0	0	0	0	0	0	0	0	0	0
Depth 3.0 m	0.50	16	16	15	0	0	0	0	0	0	0	0	0	0	0	0
	0.25	17	0	13	0	0	0	0	0	0	0	0	0	0	0	0
	0.10	16	0	15	0	0	0	0	0	0	0	0	0	0	0	0
F	1.00	32	107	303	256	341	334	416	420	345	309	103	74	26	9	0
Near West-Center	0.50	23	59	146	206	276	320	266	279	204	131	112	66	26	9	0
Shoreline	0.25	32	131	235	207	279	256	269	265	200	150	130	108	0	9	0
Depth 1.0 m	0.10	72	248	267	228	293	262	244	275	219	149	133	112	24	9	0

Table VII-10 (continued).

Station	Depth	Time Post Treatment (h) 0.5	1.0	1.5	2.0	2.5	3.0	4.0	5.0	6.0	12.0	18.0	24.0	48.0	72.0	96.0
G	S	0	0	0	0	0	0	0	0	0	109	31	25	13	0	0
200 m South	1.00	0	0	12	14	36	10	12	0	0	70	83	32	12	0	0
of Center	0.50	20	38	39	60	131	164	11	0	24	207	72	52	15	8	0
2.6 m	0.25	30	52	89	69	460	182	14	0	99	250	82	49	18	0	0
	0.10	39	35	461	556	573	228	23	0	21	252	81	47	20	14	0
H	S	0	0	0	0	0	0	0	0	0	155		25	12	0	-
South	1.00	0	0	0	0	0	0	0	0	0	157	202	44	15	0	0
Boundary	0.50	0	0	0	0	0	0	0	0	0	359	155	124	13	8	0
Depth 2.5 m	0.25	21	13	0	0	0	0	0	0	0	363		98	18	8	0
	0.10	55	97	0	42	0	10	0	0	0	386	115	99	20	14	0
I	0.00	0	0	0	0	0	0	0	0	0		22	15	0	0	0
250 m South	1.00	0	0	0	0	0	0	0	0	0	0		33	16	0	0
of South Boundary	0.50	0	0	25	0	0	0	0	0	0	0	116	80	19	0	0
Depth 2.5 m	0.25	0	0	0	0	0	0	0	0	0	13	93	99	20	0	0
	0.10	0	0	0	0	0	0	0	0	0	13	102	107	18	0	0

d. Endangered and Threatened Species

1. Plants

No threatened or endangered plant species are expected to be adversely impacted by lampricide treatments or spawning-phase trapping. There is some potential for construction of certain barriers to impact some plants (see Section VII.A.1.c.) but no threatened or endangered plant species are known to be present near potential barrier sites.

2. Invertebrates

<u>Stream Lampricide (TFM or TFM/Niclosamide) Treatments</u>

Mussels are the only listed threatened or endangered invertebrates found in potential sea lamprey control areas. Seven of the eight Vermont-listed mussel species (Table VI-2) inhabit certain Vermont tributaries or delta areas which may be subject to sea lamprey control under the Proposed Action (Table VI-3). The other species, eastern pearlshell, exists only upstream of sea lamprey barriers in the Winooski River and Lewis Creek drainages in Vermont's portion of the Lake Champlain Basin, and thus will not be affected by sea lamprey control in Vermont. The relative toxicity of TFM and/or TFM/1% niclosamide to mussels including three Vermont-listed species is discussed in Section VII.A.1.f. These toxicity data indicate that stream treatment concentrations up to at least 1.3 times MLC will have negligible impacts on each of these species.

<u>Bayluscide Treatments on Lake Deltas and Selected Stream Sections</u>

Bayluscide applications may cause mussel mortality. A full discussion of lampricide impacts on mussels is included in Section VII.A.1.f..

<u>Trapping</u>

Spawning-phase sea lamprey trapping activities will have negligible impact on endangered and threatened mussels.

<u>Barriers</u>

Barriers are not expected to have significant adverse impacts on threatened and endangered mussels; however, their reproduction and recruitment above barriers could potentially be affected if they depend upon fish hosts which are only seasonally available upstream of barrier sites, and barriers prevent fish passage. Permanent low-head barrier dams may potentially lead to loss of riverine mussel habitat immediately behind the dam. Noakes et al. (2000) found that low-head barriers do not have substantial impacts on the physical habitat in streams beyond the small impoundment above the dam and the plunge pool just below.

3. Fish

Stream Lampricide (TFM or TFM/niclosamide) Treatments

Of nontarget fish species that could be exposed to lampricide treatment, northern brook lamprey (E-VT) and American brook lamprey (T-VT) are most vulnerable to mortality (Schuldt and Goold 1980). The stonecat (E-VT) is also sensitive to TFM, and some mortality occurs at most concentrations necessary for effective sea lamprey control. Substantial numbers of stonecat mortalities were recorded in four treated tributaries in New York (where they are not protected), particularly in the Great Chazy River (Fisheries Technical Committee 1999). It is likely that adverse impacts to the stonecat will occur if lampricides are applied to the LaPlatte River, which contains Vermont's only known stonecat population. The effects of lampricides on these species are discussed in detail in Section VII.A.1.g.

Certain stages of juvenile lake sturgeon (T-NY, E-VT) are known to be very sensitive to lampricides (Johnson et al. 1999). This is discussed in detail in SectionVII.A.1.g. The presence of juvenile lake sturgeon was documented in the Winooski River in summer 2001 (VTDFW, Essex Junction Vermont, unpublished data). Juvenile sturgeon have not been found in any other proposed treatment areas, however (Anderson 1986; Bouton 1986). The potential for lake sturgeon reproduction also exists in the Missisquoi River, based on presence of adults in the river during the spring spawning period. Consequently, impacts of lampricide on sturgeon need to be considered and mitigated on both the Winooski and Missisquoi rivers.

The eastern sand darter (T-NY, T-VT) is moderately tolerant of TFM at treatment concentrations based on a series of TFM toxicity studies (Neuderfer 1987, 2000a; MacKenzie 1991, 1995). The channel darter (E-VT) is more sensitive to TFM than the eastern sand darter, but also appears to be tolerant of concentrations at or slightly above the sea lamprey MLC (Neuderfer 2000, 2001). Impacts of lampricides on these and other darter species are discussed in detail in SectionVII.A.1.g.

Mooneye (T-NY) is not known to inhabit areas which may be treated under the Proposed Action, but does inhabit areas within water-use advisory zones in the South Lake Basin. Exposure of lampricides in these areas would be limited to greatly reduced concentrations, and no impacts are expected. No impact on mooneye was documented during the experimental program.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

Northern brook lamprey are susceptible to niclosamide, but are not found in the areas proposed for Bayluscide treatments, and thus will not be affected. American brook lamprey mortalities were noted following Bayluscide applications on New York's Ausable River and Salmon River Deltas (where they are afforded no statutory protection) during the experimental program. American brook lamprey were not known to inhabit river delta areas prior to these treatments (Fisheries Technical Committee 1999). Granular Bayluscide application is not a proposed sea lamprey control method in Vermont waters containing endangered or threatened lamprey species.

In the unlikely event that lake sturgeon or mooneyes were present on a delta during a treatment, they would likely escape the effects of the chemical by swimming away from the chemical. These species were not observed in delta surveys conducted by Bouton (1986).

Trapping

Northern and American brook lamprey are present in small streams proposed for spawning-phase sea lamprey trapping as a supplemental means of control. Instream movements of brook lamprey and other fish may be affected by trapping equipment, but most brook lamprey are small enough to swim through the mesh of these traps and will not be captured. Those brook lamprey that may be captured in traps are usually alive and can be released unharmed.

Barriers

Impacts to fish by barriers primarily include the blocking of fish migrations (Noakes et al. 2000). Several streams in Vermont deemed potentially suitable for barriers as a means of sea lamprey control contain Vermont-listed fish species. These include Indian Brook and Malletts Creek (northern brook lamprey), and Sunderland, Trout and Youngman Brooks (American brook lamprey). Impacts of barriers on fish are discussed in more detail in Section VII.A.1.g.

4. Amphibians

No threatened or endangered amphibian species are known to exist in proposed treatment areas.

5. Reptiles

Species under special protection include the Blanding's turtle (T-NY), timber rattlesnake (T-NY, E-VT), five-lined skink (E-VT), spiny softshell turtle (T-QC, T-VT) and map turtle (S-QC). None of these species are expected to be affected by use of lampricides either because they are tolerant (see Section VII.A.1.i.) and/or they will not be subject to exposure because they are not likely to be present in the treatment areas. These species also are not found in or near streams proposed for potential trapping activities or control with barriers.

6. Birds

None of the birds listed as threatened or endangered will be directly affected by use of lampricides, trapping or barriers. Birds are tolerant of lampricides, and treatments could cause minor and temporary reductions in fish and invertebrates which serve as food for birds such as the common loon, osprey, bald eagle, common tern and least tern. However, the mobility of these birds would tend to render such effects of little consequence. See additional discussion in VII.A.1.j.

7. Mammals

None of the special status mammals are expected to be affected by exposure to lampricides because of the high tolerance of mammals to TFM and niclosamide. Potential for exposure to the lampricides is very small for some (e.g., marten) because of their distribution or habits. These species also will not be affected by other control methods under the Proposed Action. See VII.A.1.k. for further discussion.

e. Plants

Stream Lampricide (TFM or TFM/niclosamide) Treatments

Analyses of adverse effects on plants from TFM treatments show a 50 percent reduction in growth of algae and a 5-10 percent reduction in growth of some submerged macrophytes (NRCC 1985). These effects are not significant since they will cease as the lampricide block passes.

TFM was once patented as an herbicide but required 15-25 ppm in standing water and 100 ppm in flowing water to control common aquatic plants such as *Anacharis* or *Ceratophyllum* (Gilderhus and Johnson 1980). Effects at lower concentrations used for sea lamprey control are minor and temporary. Maki (1975), did 96-hour LC_{50} tests (concentration in which 50% of test organisms died after 96 hours of continuing exposure) with 10 species of algae. This resulted in no mortality at up to 30 mg/L (roughly equivalent to ppm). However, inhibition of growth up to 50 percent occurred at normal sea lamprey treatment levels of TFM with diatoms being most sensitive and blue-green algae most tolerant. Normal growth resumed once TFM disappeared. Maki and Johnson (1976) found a 5 to 10 percent reduction in growth in *Elodea* and *Myriophyllum* during a treatment-level exposure to TFM.

Recent studies (Scholefield et al. 1999) found that algae cultures exposed to TFM concentrations typical of those levels used to control sea lamprey in streams showed minor changes in pH (<0.1) and small reductions in dissolved oxygen (about 8% in lighted conditions and 11% in dark conditions). There are probably less effects on higher plants because of their increased resistance to material uptake through water contact. Gruendling and Bogucki (1986) inferred the same basic impacts to wetland flora based on the dye plume studies. These were also the conclusions from the DEC Adjudicatory Hearing on sea lamprey control in Cayuga Lake (Marsh and O'Connor 1986).

The effects in wetlands are expected to be less than noted above because the exposure levels indicated by the plume studies seldom reached treatment concentrations, and those had dropped significantly within 24 hours (Gruendling and Bogucki 1986). Gruendling and Bogucki (1993b) found little TFM exposure in emergent wetlands near the mouth of the Ausable River and found low concentrations of TFM in the emergent wetland fringe area along the Little Ausable Delta after treatments of these tributaries in 1990 (see also Section VII.A.1.c.). Furthermore, the impact on plant production will be minimal in the case of fall treatments when activity by most plants is naturally in decline, or in the spring before significant growth occurs.

Irrigating agricultural fields or spraying gardens with TFM-treated water may result in damage to certain cultivated crops. Gilderhus (1990) noted severe damage to young cucumber and cantaloupe plants, and minor leaf spotting on young green bean and tomato plants following irrigation for 12 hours with water containing 10 mg/l of TFM; no effects on lettuce, radish, sweet corn and potato were evident in this test.

The adverse effects on plants that can be expected from proposed TFM/niclosamide treatments will be similar to or less than the TFM impacts described above since lower concentrations of the combination are applied.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

Based on the available evidence, there will be no significant effect on plants from the proposed Bayluscide treatments, including those in the wetlands that are likely to be exposed. Schiff and Garnett (1961) reported a severe setback of *Chara* exposed to 1,000 ppb of niclosamide. However, Abdalla and Nasr (1961) found that up to 5,000 ppb did not harm aquatic vegetation. Farringer (1972) found a 50 percent suppression of algal (*Chlamydomonas* and *Chlorella*) growth as the only effect of 50,000 ppb. Gilderhus and Johnson (1980), concluded that aquatic vegetation would not be substantially affected by treatment-level concentrations of niclosamide. Gruendling and Bogucki (1986) reached the same general conclusion. Assuming a maximum measured concentration of 976 ppb and treatment area median concentrations of less than 250 ppb from experimental program treatments of the Ausable and Little Ausable Rivers (Tables VII-3 and VII-4, respectively), further Bayluscide treatments should be relatively benign to plants.

Trapping

No adverse effects on plants are anticipated from trapping.

Barriers

No adverse effects on plants are anticipated from use of barriers, other than minor site disturbance during construction. Small impoundments created above permanent low-head barriers may favor increased growth of aquatic and wetland vegetation and some loss of riparian vegetation.

f. Invertebrates

Stream Lampricide (TFM or TFM/niclosamide) Treatments

The following adverse impacts of stream lampricide treatments on aquatic invertebrates were noted in the FEIS: (1) Substantial losses of aquatic worms and erpobdellid leeches will occur;

(2) The blackfly family Simuliidae is sensitive and significant losses would occur in many streams, while most other Diptera are resistant; (3) The mayflies *Hexagenia* and *Litobrancha* could suffer substantial losses while *Cloeon*, *Pseudocloeon*, *Baetis* and *Isonychia* could suffer lesser losses and most other mayflies would not be significantly affected; (4) The caddisflies *Chimarra*, *Dolophilodes* and *Glossosoma* are likely to suffer heavy losses while most other caddisflies will not be significantly affected; (5) Snails and mussels are generally intermediate in sensitivity but minor losses have been reported in some Great Lakes treatment summaries. The magnitudes and durations of these potential impacts are further discussed below.

Static TFM toxicity tests on a wide range of aquatic invertebrates were performed by Smith (1967), who concluded that hydras (Coelenterata), turbellarian worms, erpobdellid leeches, blackfly larvae (Simuliidae) and nymphs of burrowing mayflies *Hexagenia* would suffer significant mortality at concentrations required to kill 100 percent of sea lamprey. Organisms unaffected or not significantly affected included glossiphoniid leeches; isopods *Asellus*, scuds *Gammarus*, and crayfish *Cambarus*; stoneflies *Paragnetina*, *Chloroperla*, and *Isoperla*; dragonflies *Ophiogomphus* and *Gomphus*; giant waterbugs *Lethocerus* and waterboatmen (Corixidae); non-burrowing mayflies *Ephemerella*, *Stenonema*, and *Isonychia*; caddisflies *Triaenodes*, *Chematopsyche* and *Hydropsyche*; bloodworms (Tendipedidae), snipe flies *Atherix*; snails *Physa* and clams (Unionidae). Maki et al. (1975) performed continuous flow toxicity tests to determine the effects of TFM on 35 benthic macroinvertebrate taxa (See Table F-3 in Appendix F). In addition to the organisms tested by Smith (1967), they found that TFM could cause significant mortality to annelid worms, caddisflies *Chimarra* and mayflies *Baetis* and *Cloeon*. Moderately to highly resistant taxa tested by Maki et al. (1975), in addition to those in Smith (1967) included mayflies *Baetisca*, *Paraleptophlebia* and *Tricorythodes*; stoneflies *Acroneurla* and *Pteronarcys*; caddisflies *Brachycentrus*, *Lepidostoma*, *Limnephilus*, and *Macronemum*; dobsonflies *Chauliodes*; and dipterans *Pecidia* and *Chrysops.*

The effects of lampricides on the burrowing mayfly *Hexagenia limbata* has been of particular interest in both the Great Lakes and Lake Champlain Basins due to apparent declines in abundance of this species observed in these and other waters in the 1970s and 1980s. Bills et al. (1985) performed a series of 24-hour static laboratory toxicity tests using soft water on eggs, newly hatched nymphs and larger size classes of nymphs of this species. The egg stage was most resistant to TFM, and sensitivity increased with time after hatching; nymphs from 16 to 27 mm long were two to three times more sensitive than nymphs 7 mm long. Tests with a TFM/2% niclosamide mixture yielded similar size-selective results. Niclosamide alone had little effect on any of the life stages at concentrations of up to 0.4 mg/L for 24 hours. In this same study, groups of the largest (most sensitive) nymphs (averaging 25 mm long) were exposed to four concentrations each of TFM, TFM/2% niclosamide, and niclosamide alone for periods of 6, 9, 12, or 24 hours. All of the nymphs were killed at TFM concentrations of 5 mg/L at 9 hours, and 60 percent mortality was found at 2.5 mg/L for 12 hours; mortality was similar for the same concentrations of the TFM/niclosamide combination (Table VII-11). For comparison, the predicted sea lamprey MLC for the test water chemistry parameters (total alkalinity=30-35 mg/L $CaCO_3$ and pH=7.2-7.6) would range from 0.4 to 0.6 mg/L of TFM, or 0.2 to 0.3 mg/L of

TFM/niclosamide (Appendix D). The authors also found that burrowed nymphs were twice as resistant to TFM than free-swimming nymphs, and most burrowed nymphs remained burrowed, except at higher concentrations.

Table VII-11. Percent mortality of large (25 mm long) burrowing mayfly *Hexagenia limbata* nymphs exposed to TFM, TFM/2% niclosamide, and niclosamide in soft water after various periods of exposure. From Bills et al. 1985.

Chemical	Concentration mg/L	Exposure Period (h)			
		6	9	12	24
TFM	0	0	0	0	0
	2.5	10	20	60	100
	5.0	30	100	100	100
	10.0	100	100	100	100
TFM/2% Niclosamide	0	0	0	0	0
	2.5	0	0	60	100
	5.0	60	100	100	100
	10.0	100	100	100	100
Niclosamide	0	0	0	0	0
	2.5	0	10	0	10
	5.0	20	0	0	10
	10.0	10	0	10	0

A series of field studies were conducted to assess the impacts of Great Lakes stream treatments on burrowing mayflies (Ephemeridae). Toxicity tests conducted during the 1982 TFM treatment of the Sturgeon River, Michigan, revealed that *Ephemera simulans* was much more resistant to TFM than *Hexagenia limbata*; 16-hour LC_{50}'s were 5.7 mg/l for *E. simulans* and 3.2 mg/l for *H. limbata* (Daugherty et al. 1984). Similar results were obtained for these two species in a static toxicity test conducted in 1985. An additional burrowing mayfly genus, *Litobrancha,* was included in the 1985 test and found to be similar in tolerance to TFM as was *Hexagenia* (USFWS, Marquette, Michigan, unpublished data). A test during the 1986 TFM treatment of the Whitefish River, Michigan, found age 1 *Hexagenia* nymphs to be more than twice as resistant to TFM than age 2 nymphs (USFWS, Marquette, Michigan, unpublished data). The age classes probably correspond to the large and small length classes of this genus tested in the laboratory by Bills et al. (1985).

A long-term study to assess the impacts of lampricide treatments on the *Hexagenia* population in the East Branch of the Whitefish River was conducted from 1984 through 1993. This stream received three lampricide treatments during the course of the study (June 1986, July 1990 and September 1992). A significant population decline was noted after the 1986 treatment, but not after the 1990 or 1992 treatments. *Hexagenia* populations were also monitored in untreated control streams during this study. Population fluctuations in the control streams were similar to those observed in the treated streams, showing that natural environmental factors were largely responsible for the population variability, and that lampricide treatments were a minor factor (USFWS, Marquette, Michigan, unpublished data).

Burrowing mayflies were among nontarget organisms evaluated by on-site flow-through toxicity tests (pre-treatment simulation and during actual treatment), and pre-treatment and post-treatment benthic sampling associated with a TFM application to a side channel of the St. Marys River, Michigan in September 1988 (Weisser et al. 1996). In the 12-hour pre-treatment toxicity test, groups of sea lamprey larvae and nontarget organisms were exposed to 5 TFM concentrations (0.8, 1.1, 1.5, 2.0 and 2.8 mg/L) and a control (0.0 mg/L); 100 percent of tested *Hexagenia* survived at 2.0 mg/L (the lowest concentration that killed 100% of sea lamprey larvae) and 80 percent survived at 2.8 mg/L. The second toxicity test was performed during the treatment, with TFM-treated water pumped directly from the river for 18 hours after the TFM block reached the test site; the block ranged at or above the predetermined MLC (1.8 mg/L) to a maximum of 2.1 mg/L for 7 hours, and all the tested *Hexagenia* nymphs survived, while all the tested sea lamprey died. Finally, no significant changes in abundance of two burrowing mayfly genera (*Hexagenia* and *Ephemera*) were detected from pre-treatment and post-treatment benthic sampling in the channel (Table VII-12).

Table VII-12. Average number/m^2 and 95% confidence intervals of burrowing mayflies *Ephemera* and *Hexagenia* collected by benthic sampling (Ekman dredge) before and after a TFM treatment of a side channel of the St. Marys River, Michigan, on September 21, 1988. A total of 60 Ekman dredge samples were collected, 30 each on September 16 and 22. From Weisser et al. (1996).

Genus	**Sampling Period**	**Number/m^2**	**95% Confidence Interval**
Ephemera	Before Treatment	207	74 - 340
	After Treatment	198	91 -306
Hexagenia	Before Treatment	280	155 - 405
	After Treatment	279	192 - 365

Wiant (1986) concluded that the overall density of benthic invertebrates was relatively unaffected by TFM treatment of Cayuga Inlet, New York in the fall of 1986. Mean density of organisms per sample was 117 at four hours before and 114.5 at four days after treatment. Major decreases were detected in abundance of certain Diptera (mainly Simuliidae and especially *Prosimulium* and *Simulium*) and certain Trichoptera (mainly Philopotamidae and especially *Chimarra* and

Dolophilodes), however. Species richness showed a slight decline averaging 17.9 and 15.3 before and after treatment, respectively. Net pre- to post-treatment changes in the mean number of organisms per sample in each of four important orders were as follows: Ephemeroptera (mayflies) - 21% decrease; Plecoptera (stoneflies): 7% increase; Trichoptera (caddisflies): 18% increase; Diptera (flies): 22% decrease.

Schuldt et al. (1996) found that only 6 of 65 macroinvertebrate taxa held in treated and control cages during 21 Great Lakes stream TFM treatments were sensitive (survival less than 90%); these included three caddisflies (*Chimarra, Dolophilodes* and *Glossosoma* at 2%, 14% and 31% survival, respectively), the mayflies *Litobrancha* (36% survival) and *Hexagenia* (43% survival for older nymphs and 96% survival for younger nymphs), and the blackfly *Simulium* (63% survival). The mayflies *Isonychia* and Baetidae were more susceptible to mortality in six treatments with higher than normal treatment concentrations (exceeding 1.5 times the stream MLC for more than 10 hours).

The long-term effects of such invertebrate losses appear to be minimal (Gilderhus and Johnson 1980). Maki and Johnson (1976) found that community metabolism returned to normal within 24-36 hours after the treated water passed while Torblaa (1968) found that numbers or organisms in most study streams had recovered within six weeks after treatment. In another study, the adversely affected organisms were found to have recovered seven months after TFM treatment (Kolton et al. 1986). Maki (1980) investigated effects of TFM on species diversity indices and found no significant differences before and after treatment in natural and model stream systems. Dubois (1993) found no evidence that repeated TFM treatments conducted since 1959 in the Brule River drainage, Wisconsin, caused persistent damage to the aquatic insect community.

Lieffers (1990) studied the effects of a TFM treatment on the macroinvertebrate community in a previously untreated small stream in a Lake Michigan tributary system. Bi-weekly benthic macroinvertebrate samples were collected from April through September for two years prior to the treatment and from April through October on the year of the treatment, which occurred in April. It is notable that much of this stream was exposed to levels of TFM that were substantially higher than typical stream treatment levels in current practice. The pre-treatment toxicity test determined the sea lamprey MLC to be 4.0 mg/L, but the chemical was applied at a concentration of 14.0 mg/L (3.5 times MLC) to accommodate increasing downstream flow inputs which would dilute it to 4.0 mg/L at the stream's mouth. Immediately following this treatment, numbers of organisms decreased in 88% of the taxa, but populations of all affected taxa recovered to pre-treatment levels within five months and species richness and composition were not notably changed by the treatment.

A ten-year study was conducted in treated and untreated reaches of three Great Lakes tributary systems (Brule River, Lake Superior; Whitefish River, Lake Michigan; Sturgeon/Boardman River, Lake Huron). This analysis found no significant long-term adverse effect from repeated TFM treatment on macroinvertebrate communities; they remained stable or quickly returned to pre-treatment abundance between treatments (Weisser et al. in review). It was concluded that most aquatic macroinvertebrates survive TFM treatments, a few taxa are sensitive and die, but these taxa recover within one year following treatment.

Effects other than direct lethality to macroinvertebrates may occur during lampricide applications. Maki (1980) observed a dramatic increase in drift rates, and suggested that this was responsible for a large part of macroinvertebrate declines following a TFM treatment. Among the taxa found to be susceptible to increased drift by Maki (1980), Dermott and Spence (1984), Jeffrey et al. (1986) and Kolton et al. (1986), were the mayfly *Baetis*, and caddisflies *Chimarra* and *Dolophilodes*, various oligochaete worms, leeches and scuds *Gammarus*. In earlier field reports from Great Lakes TFM treatments, *Gammarus* was reported as killed, but based upon this newer evidence, it is now believed that they were drifting and not killed, although they would be more vulnerable to predation in this state. *Chironomus* has been found in laboratory studies to become immobilized at one-sixth of the TFM concentration required to produce 50% mortality which likewise may increase susceptibility to predation (NRCC 1985). Dubois and Plaster (1993) found results similar to the above authors, and also documented an immediate significant increase in drift rates of blackflies *Simulium* during the first day of a TFM treatment in a small softwater stream. They also noted that this response closely resembled responses of these insects to commonly used blackfly larvicides.

It has been widely suggested that burrowing into the substrate may afford appreciable protection of sensitive invertebrates from TFM. Jeffrey et al. (1986) demonstrated that low levels of TFM penetrated up to 55 cm into a stream substrate's hyporheic region as a result of convective forces caused by declining water temperatures during a late fall treatment. Despite this penetration, Tubificid worms were the only benthic invertebrates within the substrate to be significantly impacted. The authors concluded that the relatively high convective forces observed were not typical of what would happen during seasons when lampricides are most often applied (late spring through early fall). When convective forces are low, as they would be over most of the treatment season, TFM would not penetrate as far into the substrate, and the hyporheic region would serve as a more effective refuge from treatments, than observed in their study. They produced evidence to indicate that vertical migration into this area of substrate was an important mechanism of rapid population recovery for burrowing forms of invertebrates.

Documented impacts of Lake Champlain TFM stream treatments on invertebrates during the experimental program were minor and temporary, and were consistent with those found in other studies:

Langdon and Fiske (1991) found significant decreases of caddisflies of the *Chimarra* genus and the burrowing mayfly *Hexagenia limbata* immediately following the 1990 Lewis Creek TFM treatment, while overall the macroinvertebrate community indices showed no significant differences from pre- to post-treatment. They also noted an apparent differential in mortality levels of *H. limbata* nymphs, with the larger nymphs (probably age 2) being affected more greatly than smaller, younger nymphs; this observation was consistent with the Great Lakes *Hexagenia* findings discussed earlier. Results of continued monitoring of Lewis Creek demonstrated that the two taxa which exhibited post-treatment population declines increased in density to levels at or above pre-treatment levels within one year following treatment (VTDEC 1994). The authors also found that TFM treatment of Lewis Creek had no undue adverse effect on the biotic integrity of its macroinvertebrate communities.

Similar studies (VTDEC 1996a) found no short term impacts to the Trout Brook macroinvertebrate community following the 1995 TFM treatment. Major groups of macroinvertebrates showed no shifts in percent composition before and after treatment and several measures of community metrics remained virtually unchanged.

Gruendling and Bogucki (1993b) found that the TFM plumes from treatment of the Little Ausable and Ausable Rivers caused no significant impacts to associated delta macroinvertebrate communities. The community was measured by sampling with a Ponar Grab Dredge. Mussel densities were estimated in 0.25 m^2 and 10 m^2 quadrats on the Little Ausable and Ausable Deltas respectively. Caged mussels were also placed on the deltas. No significant differences occurred in pre- and post-treatment densities in the macroinvertebrate community sampled by dredge. The caged mussel experiment also revealed no significant TFM-induced mortality at either delta. No conclusions could be drawn from the mussel sampling; however, it can be inferred from the caged mussel studies that negligible mussel impacts occurred.

Acute lampricide toxicity tests have been conducted to predict treatment impacts on five mussel species found in the Lake Champlain Basin. The pink heelsplitter was tested in the laboratory, with a static 12-hour TFM exposure (Bills et al. 1992). The pocketbook and black sandshell were tested on-site at the Poultney River in 12-hour continuous flow-through TFM exposures designed to simulate a stream treatment (Neuderfer 2001). Similar on-site flow-through TFM toxicity tests were performed on the eastern floater and eastern elliptio, as well as additional testing of the effects of a TFM/1% niclosamide combination on eastern elliptio, at the White River/Bad River system, Ashland County, Wisconsin (Waller et al. in review). These tests exposed groups of mussels and sea lamprey to selected lampricide concentrations and also included unexposed control groups handled similarly to exposed groups to separate the effects of handling on mussel survival. Acute toxicity was determined at 36 hours and 14 days post exposure and chronic toxicity was determined approximately one year post exposure. Sea lamprey larvae were tested simultaneously with the mussels in each case, except for the pink heelsplitter study, in order to directly compare the effects of TFM on mussels relative to the sea lamprey MLC.

The no-observed-effect concentrations (NOEC) and lowest-observed-effect concentrations (LOEC) empirically determined from the above mussel toxicity tests are summarized relative to sea lamprey MLC's in Table VII-13. Standard operating procedures for acute toxicity testing (ASTM 1996; EPA 1975) allow 10% mortality in control exposures because such low mortality may be due to random effects and not to treatment effects. Mortality exceeding 10% in treatment exposures is assumed to be significant. The highest lampricide concentration that exhibited $\leq$10% mortality is the NOEC. The next higher concentration that exhibited >10% mortality is the LOEC. All NOEC's presented in Table VII-13 were at concentrations where no actual mortality occurred, except for the pink heelsplitter, where 10% mortality was observed.

Bills et al. (1992) concluded that the pink heelsplitter is sensitive to TFM, finding 10% mortality (NOEC) at 3.5 mg/L and 60% mortality at 5.25 mg/L, the next higher concentration tested (LOEC). The authors determined these two concentrations to be equal to 1.0 times MLC and 1.5 times MLC, respectively. However, in light of more recent research, there are some shortcomings of this study that lead us to a different conclusion. Unlike the other toxicity tests discussed, a direct relationship between the concentrations causing mussel mortality and sea lamprey MLC could not be established since sea lamprey larvae were not simultaneously exposed in this test; therefore, the MLC of 3.5 mg/L was estimated from a regression chart based on the test water alkalinity level (Seelye et al. 1988). More recent research has led to development of a predictive regression model incorporating the effect of both pH and alkalinity on the toxicity of TFM, which showed that the model based on alkalinity alone overestimated MLC's (Bills et al. in review). Applying the test water pH and alkalinity data from the Bills et al. (1992) study to the newer pH/alkalinity chart (Appendix D) predicts an MLC of 2.1 mg/L rather than 3.5mg/L estimated by the older alkalinity chart. Therefore, the pink heelsplitter NOEC and LOEC become 1.6 and 2.5 times the estimated MLC, respectively (Table VII-13).

The acute toxicity data shown in Table VII-13 suggest that none of the five mussel species tested are expected to suffer mortality from exposure to lampricides at stream treatment concentrations of 1.3 times MLC or less. Treatment concentrations up to 1.5 times MLC should not adversely impact mussels in streams not inhabited by the black sandshell.

The eastern elliptio appears to be more tolerant to TFM than the other four species. This agrees with the findings of Waller et al. (1998) that toxicity of TFM to unionid mussels appears to vary by subfamily due to morphological differences. The eastern elliptio is a member of the subfamily Ambleminae, characterized by a thick shell, small valve gape and tightly clamped valves. This is relative to the species in subfamilies Lampsilinae (pink heelsplitter, black sandshell and pocketbook) and Anodontinae (eastern floater), which have thinner shells and valves that do no close as tightly. There does not appear to be an appreciable difference between acute toxicity between subfamily Lampsilinae and Anodontinae, with the possible exception of the black sandshell (Table VII-13).

The black sandshell data in Table VII-13 should be viewed as worst case. Black sandshell specimens were collected by a commercial mussel harvester using a braille in the Kentucky River, Kentucky, and transported to the test site at the Poultney River. Prior to the toxicity test, several of these specimens exhibited physical damage to their shells attributable to the collection method (Neuderfer 2001). This handling stress is likely to be responsible for the observed mortality at a lower relative TFM concentration than the other mussels tested.

Waller et al. (in review) also evaluated latent effects of the lampricides on eastern elliptio and eastern floater. The mussels used in the acute toxicity tests were held in cages in the Bad River for a period of approximately one year post-exposure. Two additional sets of caged, unexposed control specimens were also held through this period, one collected and held at the toxicity test site and then returned to the river simultaneously with the treated animals, and the other collected and immediately caged and returned to the river. Both survival and growth rates after approximately one year were not significantly different between the treated and control groups, showing that TFM and the TFM/1% niclosamide combination did not affect long-term mussel survival or growth. Survival was higher for the eastern elliptio than for the eastern floater, and for adults relative to juveniles. These differences were determined to be a function of handling stress stemming from morphological differences. The authors concluded that the more short-lived and thin-shelled eastern floater is apparently more sensitive to handling than is the eastern elliptio.

TFM produces a narcotizing or anesthetizing effect on freshwater mussels giving the appearance of mortality at sub-lethal concentrations (Bills et al. 1992; Waller et al. 1998). Behavioral responses associated with this effect include emergence from sediment if burrowed, extension of the foot and gaping valves, along with failure to respond to external stimuli in the more advanced stages of narcosis. Bills et al. (1992) reported that 60% of the pink heelsplitters exposed to 3.5 mg/L TFM concentration for 12 hours in a static bioassay exhibited these characteristics. After 12 hours in fresh water, 50% were unresponsive, and at 14 days post-exposure, all but 10% fully recovered. The authors concluded that the correct assessment of the effects of TFM on mussels requires post-exposure observation over several days. They concluded that incidence of mussel mortality recorded from Great Lakes post-treatment surveys conducted shortly after stream treatments may be significantly overestimated, and many non-responsive mussels that were considered dead might have later recovered. Subsequent research has found that narcotized mussels that survive TFM exposure recover within 24 to 48 hours (Waller et al. 1998; Waller et al. in review). Narcotized mussels may also be more vulnerable to predation, physical displacement or pathogens during the recovery period (Waller et al. 1998).

Post-treatment mortality surveys were usually conducted within 24 hours after a stream reach was treated during the Lake Champlain experimental program. No mussel mortalities were reported from 19 of 24 stream TFM treatments, and minimal numbers of mussels (species not identified) were observed and considered dead after treatments of Lewis Creek and the Great Chazy, Little Ausable and Saranac Rivers (Fisheries Technical Committee 1999; Appendix E). These observations were noted largely in areas immediately downstream of TFM application points where the chemical may not have been thoroughly mixed in the water column. Surveys by VTDEC of sections of Lewis Creek one day following treatment documented apparent mortality of one pink heelsplitter specimen out of nine individuals of this species observed after the 1990 TFM treatment. Several individuals of three mussel species including pink heelsplitter were observed following the 1994 Lewis Creek treatment and no mortality was detected for any species (Steve Fiske, VTDEC memorandum, October 18, 1994). It is possible that these reported mussel mortalities included individuals that were temporarily narcotized, but later may have recovered. Therefore, mussel mortality may actually have been lower than the minimal levels observed.

Table VII-13. Acute TFM and TFM/1% niclosamide toxicity to five Lake Champlain Basin mussel species determined from mortality observations 14 days after 12-hr exposures. Toxicity is expressed as a relative factor of the sea lamprey minimum lethal concentration (MLC=9-hr $LC_{99.9}$). Sea lamprey MLC was determined by exposing sea lamprey larvae simultaneously in each mussel trial, except for the pink heelsplitter test.

Species	Test Trial	NOEC Factor[a]	LOEC Factor[b]	Reference
TFM				
Pink Heelsplitter[c,d]	1	1.6	2.5	Bills et al. (1992)
Black sandshell[c]	1	1.3	1.7	Neuderfer (2001)
Pocketbook[c] - adult	1	1.5	1.9	Neuderfer (2001)
Pocketbook[c] - juvenile	1	1.5	2.3	Neuderfer (2001)
Eastern floater adult	1 2 3	1.6 1.6 1.9	1.9 2.0 2.4	Waller et al. (In review)
Eastern floater juvenile	1 2	1.6 1.6	1.9 2.0	Waller et al. (In review)
Eastern elliptio adult	1 2 3	1.9 2.5 2.4	>1.9 >2.5 >2.4	Waller et al. (In review)
Eastern elliptio juvenile	1 2 3	1.6 2.5 2.4	1.9 >2.5 >2.4	Waller et al. (In review)
TFM/1% Niclosamide				
Eastern elliptio adult	1 2 3	2.4 1.9 2.4	>2.4 2.4 >2.4	Waller et al. (In review)
Eastern elliptio juvenile	1 2	2.4 2.4	>2.4 >2.4	Waller et al. (In review)

[a] NOEC Factor = no observed effect concentration divided by sea lamprey MLC.
[b] LOEC Factor = lowest observed effect concentration divided by sea lamprey MLC.
[c] Vermont endangered species.
[d] Factors for the pink heelspliter are based on MLC estimated from USFWS pH/alkalinity regression model (Klar and Schleen 1999; Bills et al. in review). See discussion in text.

Fichtel (1992) monitored mussel beds in the Poultney River before, during and after the 1992 TFM treatment. No signs of stress were observed and all appeared to maintain proper orientation and normal filtration.

During the 1996 Poultney River TFM treatment, gravid pocketbook and eastern lampmussels were observed to assess whether glochidia were prematurely released in response to TFM exposure (Lyttle and Pitts 1997). No prematurely-released glochidia were observed in any of the treatment or post-treatment drift samples collected immediately below trays holding gravid mussels. Several gravid eastern lampmussels were observed in the river eight months later in June 1997.

Comparison of TFM and TFM/Niclosamide Toxicity in Invertebrates

As shown in the prior discussion of burrowing mayfly toxicity test results (Bills et al. 1985), stream treatments with the TFM/niclosamide mixture appears to elicit similar effects on aquatic biota as did TFM alone. The addition of small amounts of niclosamide to TFM results in higher toxicity to aquatic invertebrates, but it also results in greater increases in toxicity to sea lamprey than to most invertebrates (Gilderhus and Johnson 1980). This differential enables lower treatment concentrations of the mixture to effectively control sea lamprey while reducing effects on most invertebrates (NRCC 1985; EPA 1999). The snail *Physa* was the only taxon tested (freshwater mussels included) that had exhibited lower differential toxicity to the mixture than to TFM alone (Gilderhus and Johnson 1980), but it was still 2.5 times more tolerant to the mixture than sea lamprey (Rye and King 1976). It is also notable that niclosamide levels alone in such combination treatments rarely, if ever, reach lethal concentrations (Bills et al. 1985; NRCC 1985).

Eastern elliptio were slightly more resistant to the TFM/1% niclosamide mixture, relative to sea lamprey, than to TFM alone (Table VII-13), but the difference was not statistically significant (Waller et al. in review). This finding, in conjunction with results discussed above for other invertebrate taxa exposed to the mixture, suggests that risk of adverse impacts to other mussel species from TFM/1% niclosamide treatments, as prescribed in Great Lakes standard operating procedures (Klar and Schleen 1999), are no greater than the risk from treatments using TFM alone.

Adverse impacts on invertebrates, if any, from other ingredients in the TFM formulation or the TFM/niclosamide combination are included as a component of the overall adverse impact of these products. There apparently have been no studies on the toxicity of isopropanol to aquatic invertebrates (Gary Neuderfer, NYSDEC, Avon, New York, personal communication). However, due to its high volatility, rapid biodegradation or oxidation, and the high tolerance and lack of effects on other animals, isopropanol itself is not likely to have serious effects on invertebrates at the concentrations used (EPA 1986; Engstrom-Heg 1989; NYSDOH 1989).

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

Niclosamide itself is much more toxic to most invertebrates than TFM or the TFM/niclosamide mixture. Turbellarians, oligochaetes and leeches are among the most sensitive organisms. Mussels and snails are also known to be sensitive to niclosamide since its original and more widespread use was as a molluscicide to control snails, that are vectors of schistosomiasis ("swimmers itch") (Gilderhus and Johnson 1980). The relative toxicity of niclosamide to aquatic insects varies greatly; while most insect taxa are more sensitive, including dipterans (midges and blackflies), stoneflies and caddisflies, some like the mayfly *Hexagenia* were found to be more resistant to niclosamide than to TFM (Bills et al. 1985; NRCC 1985).

The FEIS predicted the following adverse effects to macroinvertebrates on the five Lake Champlain deltas proposed for treatments with Bayluscide based on expected niclosamide concentrations (Table VII-10), available information on invertebrate toxicity (Rye and King 1976; Gilderhus and Johnson 1980; NRCC 1985) and invertebrate inventories by Gruendling and Bogucki (1986): (1) Substantial mortalities to the snails *Physa*, *Bithynia*, *Stagnicola* and *Valvata* could occur (Snails collectively are a significant component of invertebrates found on the Ausable, Little Ausable and Salmon River Deltas, but less so on the Saranac and Boquet River Deltas.); (2) Substantial mortalities to the unionid mussels *Elliptio* and *Lampsilis*, and fingernail clams *Sphaerium* and *Pisidium*, could occur (These forms also comprise a significant component of the invertebrate populations found on all the deltas.); (3) Oligochaeta, which comprise a major numerical component of delta invertebrates could suffer heavy losses; (4) Dipterans of the family Chironomidae, of varying abundance on those deltas, could suffer significant losses; and, (5) Leeches (Hirudinea), of lesser importance on those deltas, could suffer heavy losses.

Most of the effects projected above were observed in a Bayluscide 5% Granular treatment at Boardman Lake, Michigan (Gilderhus 1979). An exception was that snails were essentially unaffected at the same treatment rate (100 lb/acre) as was proposed for the Lake Champlain deltas. Similarly, post-treatment SCUBA diving transects after the 1982 Bayluscide 5% Granular treatment at Seneca Lake observed live mussels but none that were dead (Engstrom-Heg 1983).

Gruendling and Bogucki (1986) stated that the composition of invertebrate fauna among the Lake Champlain deltas was fairly similar, so they evaluated the effects of the 1991 Bayluscide treatments in the Ausable and Little Ausable River Deltas on macroinvertebrates, which were expected to be representative of all of the treated delta areas (Gruendling and Bogucki 1993a). The authors employed pre- and post-treatment benthic community sampling, unionid mussel sampling, *in-situ* caged macroinvertebrate experiments on the deltas with unionid mussels and representative species of six taxa (amphipods, isopods, crayfish, snails, dragonfly larvae and fingernail clams), as well as laboratory acute toxicity tests on two common unionid species.

This benthic community sampling revealed significant, immediate, post-treatment declines in densities of snails, fingernail clams, chironomids and leeches on both deltas, and also oligochaetes on the Ausable Delta. Isopods, mayflies and caddisflies were not affected. One year later, chironomids rebounded to 1991 pre-treatment levels on the Little Ausable Delta, and leeches and oligochaetes recovered to 1990 pre-treatment levels on the Ausable Delta; the other taxa remained at depressed levels. Mortality among caged groups was similar to that observed from community sampling. Field mortality rates tended to be lower, probably due to the ability of some invertebrate groups to minimize exposure to niclosamide in field conditions. Stress among caged organisms may also have been a factor.

Both unionid mussel species sampled on each delta significantly declined in density three days after treatment. The eastern lampmussel declined 77% and the eastern elliptio declined 42% on the Little Ausable Delta. Declines of these species on the Ausable Delta were 43% and 49%, respectively. Additional mortality may have occurred as the population density estimates conducted one year post-treatment suggest overall mortality for the eastern lampmussel was 86% and that for the eastern elliptio was 69% on the Little Ausable Delta. Overall mortality estimates for these species on the Ausable Delta were 71% and 77%, respectively.

The eastern lampmussel was consistently more sensitive to niclosamide than the eastern elliptio in the *in-situ* cage study. Mean mortalities of caged eastern elliptio and eastern lampmussel specimens were 70% and 94% on the Little Ausable Delta respectively. These species exhibited mean mortality rates of 32.7% and 73.6%, respectively, on the Ausable Delta. *In situ* field sampling plots adjacent to caged unionid mussels stations yielded relatively similar data.

The laboratory-estimated 24-hour LC_{50} value for the eastern elliptio was 998 ppb, which was higher than the maximum concentrations recorded on either delta (Tables VII-3 and VII-4). The LC_{50} values calculated for this species from the *in-situ* cage study fell within the range of niclosamide concentrations on both deltas. The eastern lampmussel laboratory-estimated LC_{50} value was 178 ppb; the lab LC_{50} value and the *in situ* LC_{50} values for this species were within the range of concentrations monitored on the two deltas (Tables VII-3 and VII-4).

The differences in tolerance of niclosamide between the two species of unionid mussels studied by Gruendling and Bogucki (1993a) are likely due to different physiological tolerances, and the greater ability of the eastern elliptio to avoid the lampricide by burrowing and tightly closing valves when exposed. LC_{50} values calculated in the laboratory, among caged specimens and in field plots were more variable for the eastern elliptio than for the eastern lampmussel. Exposure to higher laboratory niclosamide concentrations or the fact that the eastern elliptio could not burrow in the test cages on the deltas may account for this. In the lab the mussels quickly burrowed under the sand upon exposure to niclosamide.

Gruendling and Bogucki (1993a) determined that mollusc population densities (mussels and snails) had not recovered to pre-treatment levels one year after Bayluscide treatments of the Little Ausable and Ausable River Deltas. Lyttle (1996) conducted a follow-up assessment in 1995, four years following treatment, and found no long-term depression of mussel or snail populations on either delta. The overall density of mussels in 1995 was somewhat higher on the Ausable

Delta and slightly lower on the Little Ausable Delta than recorded during pre-treatment surveys; however, neither difference was significant. Age-frequency distributions of mussels from both deltas showed recruitment to be fairly stable and consistent rather than sporadic. Age frequencies also included mussels younger than four years, demonstrating that recruitment has occurred since the 1991 Bayluscide treatments. Besides the eastern elliptio and eastern lampmussel, Lyttle's study documented presence of the eastern floater and giant floater (two additional native mussels), as well as the exotic zebra mussel, on both deltas. Snail densities had increased and exceeded pre-treatment levels in both deltas in 1995. A greater diversity of snail species was also noted in this survey

Trapping

Spawning-phase sea lamprey trapping activities will have negligible impact on invertebrates. Insignificant numbers of stream invertebrates may be physically killed or dislodged as a result of deploying and tending portable lamprey traps.

Barriers

Activities associated with construction of barriers could lead to mortalities of some macroinvertebrates at the construction site, and potentially downstream if siltation is excessive. This would be a temporary condition and populations should return to normal soon after such activities cease. Mussel reproduction and recruitment above barriers could potentially be affected if they depend upon fish hosts which are only seasonally available upstream of barrier sites, and the barriers prevent fish passage. Permanent low-head barrier dams may potentially lead to loss of riverine mussel habitat immediately behind the dam. Noakes et al. (2000) found that low-head barriers do not have substantial impacts on the physical habitat in streams beyond the small impoundment above the dam and the plunge pool just below.

g. Fish

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

The FEIS projected that resident nontarget fish species of notable risk of suffering mortality during Lake Champlain Basin TFM stream treatments included native lamprey, logperch, eastern sand darter, other darters, catfishes, pike, pickerel, muskellunge, and suckers. Treatment-related mortalities of these species or groups, with the exception of the eastern sand darter were documented during the experimental program. Comprehensive mortality surveys following each of the 24 stream TFM treatments during the experimental program documented mortalities of 50 identifiable nontarget fish species. Only 13 of these species were found to have greater than a total of 50 dead individuals in approximately 141 stream miles treated over the eight years of the program, while 34 species had less than 25 mortalities and 22 species had less than 10 mortalities (Fisheries Technical Committee 1999; Appendix E). Table VII-14 summarizes the nontarget fish mortalities recorded during these post-treatment surveys. As expected, American brook lamprey, silver lamprey, stonecat and logperch experienced the heaviest mortalities.

The effects of TFM treatments on nontarget fish in Lewis Creek, Vermont and Trout Brook, Vermont were studied in 1990 (Langdon and Fiske 1991) and 1995 (VTDEC 1996a), respectively. Both studies concluded there were no measurable impacts from TFM treatments on the resident fish communities of these two streams. The long-term effects of the TFM treatment on the nontarget fish populations of Lewis Creek were also investigated (VTDEC 1994). No undue adverse effects were noted at the study site, with the fish community being consistently good to excellent in quality with good production and relatively high structural stability.

Table VII-14. Mortality counts for nontarget fish species associated with 24 TFM treatments of Lake Champlain tributaries during the 1990-1997 experimental sea lamprey control program. Numbers of native lamprey are estimates derived from identification of larval lamprey samples.

Species	Observed or Estimated Mortalities	Number Streams with Observed Mortality	Number Treatments with Observed Mortality	Number Treatments with >50 Dead Individuals	Average Number Dead per Stream Mile Treated[a]
American brook lamprey	40,851	4	7	5	1,215.8
Silver lamprey	8,619	7	12	9	151.5
Stonecat	6,730	4	7	6	104.0
Logperch	1,057	10	14	3	8.7
Bluntnose minnow	755	7	9	1	7.3
Blacknose dace	517	7	9	2	10.1
White sucker	340	11	15	2	2.9
Tessellated darter	318	13	21	2	2.4
Northern brook lamprey	209	1	2	1	4.5
Brown bullhead	162	8	12	0	1.8
Chain pickerel	130	2	4	1	7.6
Fantail darter	68	2	3	0	1.3
Longnose dace	66	6	7	1	0.7
37 other species combined [b]	452	14	23	0	3.3

[a] Based on mileage of treated streams where mortality was noted for the species.

[b] Includes seven unidentified specimens.

A third round of TFM treatments was conducted on the eight tributaries (approximately 35 stream miles) wholly within New York State from 1998 through 2000. Post-treatment nontarget mortality counts were conducted following the same procedures used during the experimental program. Observed levels of fish mortality (Table VII-15) were similar to that observed earlier during the experimental program period. Nontarget fish mortality counts from individual Lake Champlain stream treatments are detailed in Appendix E.

The Service employed *in-situ* cage toxicity studies on a wide variety of fish species in the Great Lakes from 1983 to 1989 (Schuldt et al. 1996). Small fishes were confined to cages in control and treated stream sections during 26 TFM applications on 23 streams throughout the Great Lakes.

Table VII-15. Mortality counts for nontarget fish species associated with eight TFM treatments of Lake Champlain tributaries during the 1998-2000 period. Numbers of native lamprey are estimates derived from identification of larval lamprey samples.

Species	Observed or Estimated Mortalities	Number Streams with Observed Mortality	Number Treatments with Observed Mortality	Number Treatments with >50 Dead Individuals	Average Number Dead per Stream Mile Treated[a]
American brook lamprey	21,328	2	2	1	1,568.2
Logperch	1,622	7	7	3	47.6
Stonecat	1,602	3	3	2	91.0
Silver lamprey	915	4	4	3	55.5
Brown bullhead	365	8	8	3	10.0
Blacknose dace	274	6	6	2	10.3
Tessellated darter	202	6	6	1	8.0
Creek chub	165	3	3	1	18.5
White sucker	115	8	8	0	3.1
Bluntnose minnow	64	2	2	0	5.3
Unidentified Cyprinid	130	2	2	1	15.1
Unidentified fish	194	1	1	1	25.9
27 other species combined	202	8	8	0	5.5

[a] Based on mileage of treated streams where mortality was noted for the species.

Most treatments were maintained at or above the pre-determined stream MLC for at least 9 hours, and up to 18.6 hours. Concentrations exceeded 1.5 times the stream MLC for 10 to 13.5 hours on four tributary cage sites. Most fishes survived in control cages and 38 of 50 nontarget fish species survived treatments at overall rates of greater than 90 percent. No caged black bullhead, yellow bullhead, tadpole madtom or grass pickerel survived treatments, although they were tested in only one treatment each in very low numbers. Overall *in-situ* cage survival results for the fish species tested which also inhabit Lake Champlain and lower tributaries are summarized in Table VII-16. More detailed discussion of results for certain species will be included in following text, and also in Appendix F.

Boogaard et al. (in review) performed a series of 12-hour flow-through laboratory bioassays designed to simulate stream treatments, to determine the toxicity of TFM and a TFM/1% niclosamide (Bayluscide) mixture to 16 common Great Lakes nontarget fish species (15 of which inhabit Lake Champlain) representing seven families. They calculated toxicity ratios for each species to determine its relative sensitivity to the lampricides; the toxicity ratio is defined as the nontarget 12-hour LC_{50} divided by the sea lamprey MLC predicted from the pH/alkalinity chart (Klar and Schleen 1999; Appendix D). The calculated toxicity ratios are shown in Table VII-17. The authors considered nontarget species with toxicity ratios of 1.5 or less to be sensitive, and to be potentially significantly impacted by routine treatment concentrations of up to 1.5 times MLC Centrarchids (smallmouth bass, bluegill and green sunfish *Lepomis cyanellus*) and yellow perch were the least sensitive to the lampricides while ictalurids (black bullhead, channel catfish and tadpole madtom) were the most sensitive. Lake sturgeon and lake whitefish were also quite sensitive, while salmonids (Atlantic salmon, brown trout, lake trout and rainbow trout), walleye, white sucker and carp were found to be intermediate in sensitivity. Specific results from this study are presented in the appropriate discussion of each species or group below.

______Native Lamprey

In comparative toxicity tests, King and Gabel (1985) found the toxicity of TFM to be highest in larval sea lamprey, intermediate in the northern brook lamprey, and lowest in the American brook lamprey; MLC values determined for the northern brook lamprey and American brook lamprey averaged 25% and 44% greater than for sea lamprey, respectively. Despite these differences in toxicity, substantial losses of brook lamprey have been unavoidable under normal treatment concentrations (up to 1.5 times MLC). Significantly greater proportions of brook lamprey populations than sea lamprey should also survive treatments closer to 1.0 times MLC and persist, especially the American brook lamprey.

Schuldt and Goold (1980) found that TFM treatments of Lake Superior tributaries from 1958 to 1977 were more harmful to genus *Icthyomyzon* species (northern brook lamprey and/or silver lamprey) than to American brook lamprey. American brook lamprey were eliminated from treated sections in 6 of 42 tributaries compared with the elimination of *Ichthyomyzon* spp. from treated sections in 41 of 81 tributaries (There is not a reliable method to differentiate the larval phase of silver lamprey from northern brook lamprey using external characteristics, thus they are usually identified only to genus when the spawning phase is not present). The authors also pointed out that American brook lamprey commonly exist further upstream than do sea lamprey, providing refuge from treatment. The principal reason American brook lamprey have been impacted less is that they are more tolerant of colder water temperatures and often inhabit stream headwaters above the areas in which sea lamprey are found.

The impacts on native lamprey noted by Schuldt and Goold (1980) occurred over the first two decades of the Great Lakes sea lamprey control program, without any special effort at mitigation. TFM treatment concentrations at the time often exceeded those concentrations typically employed now. There is evidence from more recent Great Lakes lamprey assessments(1980 to 1999) that these losses have stabilized, and that some reestablishment of native lamprey populations, particularly by American brook lamprey, have occurred (Department of Fisheries and Oceans Canada, Sault Ste. Marie, Ontario, unpublished data). It has also been suggested that reductions in larval sea lamprey abundance may benefit native lamprey, since invading sea lamprey are highly adaptable and have a competitive advantage (Schuldt and Goold 1980).

American brook lamprey (T-VT) mortalities were observed in four streams during the Lake Champlain experimental program (Table VII-14), but 98.9% of mortality for this species was recorded from two treatments over a large population in the Ausable River. In a 1990 TFM treatment of the Ausable River, an estimate of 12,193 American brook lamprey were killed based on identification of larval samples collected during mortality counts. The second Ausable River treatment in 1994 resulted in an estimated 28,467 killed (Fisheries Technical Committee 1999). NYSDEC conducted a third Ausable treatment in 1999 and estimated a mortality of 21,303 American brook lamprey (Neuderfer 1999). These results suggest that American brook lamprey populations persisted through the three TFM treatments, and tend to support the findings of Schuldt and Goold (1980) and King and Gabel (1985).

Table VII-16. Combined number of selected fish species, caged in control and treatment sites, and number live after treatment, from 26 TFM treatments in 23 Great Lakes streams,1983-1989. Adapted from Schuldt et al. (1996).

Species	Number of Treatments	Number of Treatments With Mortality	Treatment Cages		Control Cages	
			Caged	Live	Caged	Live
Lake sturgeon	2	2	40	9	40	40
Brook trout	2	0	6	6	6	6
Brown trout	2	0	25	25	9	9
Rainbow trout	9	3	85	78	60	59
Central mudminnow	7	0	33	33	18	17
Grass pickerel	1	1	7	0	0	-
Carp	1	0	10	10	10	10
Creek chub	9	2	49	44	46	36
Blacknose dace	13	5	118	104	126	124
Longnose dace	11	3	82	79	58	58
Northern redbelly dace	3	1	19	18	11	11
Pearl dace	2	0	10	10	9	9
Common shiner	9	5	74	68	70	58
Rosyface shiner	2	0	4	4	5	5
Spotfin shiner	1	0	16	16	17	17
Bluntnose minnow	5	0	8	8	5	5
Fathead minnow	1	0	12	12	14	14
White sucker	8	0	38	38	33	33
Redhorse spp.	1	0	5	5	4	4
Black bullhead	1	1	1	0	0	-
Yellow bullhead	1	1	2	0	0	-

Table VII-16 (continued).

Species	Number of Treatments	Number of Treatments With Mortality	Treatment Cages		Control Cages	
			Caged	Live	Caged	Live
Tadpole madtom	1	1	1	0	0	-
Brook stickleback	3	0	15	15	7	6
Burbot	3	0	12	12	3	3
Banded killifish	1	0	1	1	1	1
Smallmouth bass	7	0	44	44	43	42
Largemouth bass	2	0	20	20	10	10
Bluegill	2	0	2	2	1	1
Pumpkinseed	2	0	45	45	40	39
Rock bass	8	2	41	38	36	36
Black crappie	1	0	2	2	2	2
Fantail darter	6	4	68	44	54	53
Johnny darter	11	3	77	72	72	63
Logperch	7	2	44	38	37	36
Mottled sculpin	12	1	99	98	139	139
Slimy sculpin	4	1	20	19	17	17
Sculpin spp.	3	0	73	73	10	10

The 1995 TFM treatment of Trout Brook, Vermont, exhibited the only case of a threatened or endangered species suffering mortality, and this loss was partially mitigated. The treatment impact on this population of American brook lamprey was minimized due to pre-treatment removal and post-treatment restocking of individuals in the 0.4 mile treated section. Prior to treatment, 280 American brook lamprey were collected, held in untreated water during the treatment, and subsequently released back into the stream after the post treatment mortality survey. The post-treatment survey revealed an estimated mortality of 92 American brook lamprey (Anderson and Staats 1996), which represents an approximately 25% population loss in the treated section. Considering that the American brook lamprey population in Trout Brook ranges more than one mile upstream of the application point, the overall population loss was likely to be substantially lower.

Silver lamprey also experienced substantial mortality from TFM treatments (Table VII-14). Among native lamprey in the Lake Champlain Basin, only the silver lamprey is parasitic. This native species is considered relatively harmless to other fish due to its much smaller size at maturity relative to sea lamprey, and appears to be no impediment in reaching salmonid management objectives for Lake Champlain. Toxicity of TFM to silver lamprey is slightly less than for sea lamprey, but the difference may not be enough to avoid heavy silver lamprey losses (King and Gabel 1985) under routine treatment concentrations.

Schuldt and Goold (1980) reported losses of silver lamprey populations in a substantial portion of treated Lake Superior tributaries between 1958 and 1977, when little attention was given to control of lampricide applications to protect nontarget species. Surveys through the 1980s and 1990s show that the silver lamprey population distribution has stabilized, and adult silver lamprey have recently been captured in sea lamprey assessment traps in streams where they have not been observed for many years; *Ichthyomyzon* larvae have also become reestablished in several treated streams, but the difficulty in identifying larvae of this genus to species limits interpretation of these findings (Doug Cuddy, Department of Fisheries and Oceans Canada, Sault Ste. Marie, Ontario, personal communication).

Preliminary results of larval lamprey population assessments conducted in 2000 on Lewis Creek and the Poultney River suggest that greater proportions of silver lamprey survived experimental program treatments than did sea lamprey. The Poultney River silver lamprey population, in particular, has grown much more rapidly than sea lamprey population there since sea lamprey numbers were dramatically reduced during the 1996 TFM treatment (USFWS, Essex Junction, Vermont, unpublished data).

Table VII-17. Relative toxicity of TFM and TFM/1% niclosamide mixture to selected nontarget fishes in 12-hour flow-through laboratory toxicity tests. Toxicity ratio is the nontarget LC_{50} divided by the predicted sea lamprey MLC; sea lamprey MLC's were derived from pH/alkalinity prediction tables (Appendix D) based on average pH and alkalinity of the test water. (From Boogaard et al. in review)

Species	**Test Trial**	**TFM Toxicity Ratio**	**TFM/1% niclosamide Toxicity Ratio**
Lake sturgeon[a]	1	1.95	1.68
	2	1.77	1.78
Atlantic salmon	1	3.47	2.68
	2	3.11	2.71
Brown trout	1	3.18	3.55
	2	3.71	3.34
Lake trout	1	3.98	3.00
	2	4.56	3.08
Rainbow trout	1	3.65	2.80
	2	4.42	3.57
	3	4.25	-
Lake whitefish	1	1.66	2.03
White sucker	1	2.13	2.75
	2	2.57	2.94
Black bullhead	1	1.66	1.58
	2	1.70	1.51
Channel catfish	1	1.68	1.25
	2	1.27	1.30
Tadpole madtom	1	1.48	1.26
	2	2.01	1.17
Carp	1	2.26	2.33
	2	2.58	2.36
Bluegill	1	7.97	6.44
	2	8.78	5.67
Green sunfish	1	8.43	6.50
	2	7.88	6.56
Smallmouth bass	1	6.85	3.47
	2	6.29	3.50
Walleye	1	2.17	2.36
Yellow perch	1	8.11	4.79
	2	>7.33	4.81

[a] Average size of lake sturgeon tested was 127 mm total length.

The relative difference in TFM toxicity to northern brook lamprey (E-VT) in relation to sea lamprey is not great enough to avoid a serious loss to a population (King and Gabel 1985). No lampricide applications were conducted to control sea lamprey during the experimental program in the Malletts Creek/Indian Brook system to protect Vermont's only known northern brook lamprey population, and none are planned under the Proposed Action. In New York, where northern brook lamprey is not protected, this species occurs in the Great Chazy River. Mortality of 197 individuals was estimated in one area of the Great Chazy following the 1992 TFM treatment, and an estimated 12 were killed there during the 1996 treatment (Fisheries Technical Committee 1999).

Lake Sturgeon

Lake sturgeon (T-NY, E-VT) are known to be sensitive to lampricides. Field and laboratory toxicity tests found no mortality of juvenile lake sturgeon (100 to 218 mm total length) at concentrations of TFM up to approximately 1.3 times the MLC of sea lamprey larvae (Johnson et al. 1999). Results from additional toxicity tests conducted in the laboratory with TFM and a TFM/1% niclosamide combination have found lake sturgeon sac fry to be significantly more tolerant to both formulations than sea lamprey (NOEC=1.5 times sea lamprey MLC). Swim-up fry and young-of-year up to approximately 80 mm total length were found to have similar sensitivity as sea lamprey, however, with NOEC's significantly less than sea lamprey MLC's. Larger sturgeon young-of-year ($\geq$100 mm) and age 1+ (219 to 301 mm) were significantly more tolerant to both formulations than sea lamprey, with NOEC's at or greater than sea lamprey MLC's (Table VII-18; Boogaard et al. in review).

Salmonids

Salmonids are known to be moderately resistant to TFM. Toxicity ratios determined in laboratory bioassays for landlocked Atlantic salmon, brown trout, lake trout and rainbow trout ranged from 3.51 to 4.56 for TFM and from 2.68 to 3.57 for TFM/1% niclosamide (Table VII-17; Boogaard et al. in review). Trout are routinely used in pre-treatment bioassays to set maximum allowable concentrations (MAC's). MAC's are often set from brown trout LC_{25}'s as referenced on the pH/alkalinity prediction chart (Klar and Schleen 1999; Appendix D). Trout and salmon were rarely impacted in the experimental program; no Atlantic salmon were killed by TFM treatments, and only 14 rainbow trout, 9 brook trout and 2 brown trout mortalities were recorded, limited to treatments of Putnam Creek and the Saranac River (Fisheries Technical Committee 1999).

Dubois and Blust (1994) examined salmonid population data from a small stream over a 10-year period that received three TFM treatments. Reduced biomass and growth rate of brook trout were noted in the year with an early-season (June) treatment, but no discernable salmonid population effects were noted one year after late-season (September) treatments. The authors recommended that it would be preferable to delay lampricide treatments in small trout streams until late in the growing season, but the long-term risk of not delaying treatment appears minimal, since environmental variables potentially have more of an effect on trout populations than do periodic treatments.

Table VII-18. Comparison of TFM and TFM/1% niclosamide (Bayluscide) mixture No Observed Effect Concentration (NOEC) factors for eight stages/size ranges (mm total length) of young-of-year lake sturgeon. The NOEC factor is the lake sturgeon NOEC divided by the observed sea lamprey minimum lethal concentration (MLC=9-hr $LC_{99.9}$). Sea lamprey MLC was determined by exposing sea lamprey larvae simultaneously in each test trial. (From Boogaard et al. in review)

Stage/average length (range)	Test Trial	TFM NOEC factor	TFM/1% niclosamide NOEC Factor
Sac fry	1	1.50	1.18
	2	1.54	1.53
	3	1.52	1.50
Swim-up fry	1	0.52	0.53
	2	0.52	0.47
	3	0.43	0.64
26 (22 - 30)	1	0.52	0.53
	2	0.41	0.47
	3	0.42	0.65
41 (32 - 48)	1	0.65	0.79
	2	0.50	0.65
	3	0.63	0.79
65 (52 - 82)	1	0.65	0.67
	2	0.65	0.64
	3	0.81	0.81
107 (85 - 125)	1	1.00	1.21
	2	1.00	1.23
	3	1.00	1.23
157 (131 - 181)	1	1.00	1.00
	2	1.00	1.00
	3	1.00	1.00
217 (183 - 255)	1	1.25	1.24
	2	1.23	1.21
	3	1.00	1.31
261 (219 - 301)	1	1.52	1.17
	2	1.60	1.21
	3	1.27	1.29

Esocids

Members of the pike family are relatively sensitive to TFM and treatment-related mortalities are frequently noted during Great Lakes TFM treatments, in both adult and juvenile stages and any season of the year. Some mortality was noted from experimental program treatments for all five esocid species found in Lake Champlain, mainly in the lower reaches of treated streams, including the Great Chazy, Little Ausable and Ausable Rivers, Lewis Creek, and Stone Bridge and Mount Hope Brooks. Most mortalities were chain pickerel (Table VII-14), followed by northern pike; juvenile muskellunge (probably hatchery fish recently stocked in the Great Chazy River), and redfin and grass pickerel were noted in very low numbers (Fisheries Technical Committee 1999). With the exception of muskellunge, these species are abundant throughout Lake Champlain and the documented losses will have no effect on their populations. Muskellunge are common in the Great Chazy River, and few post-treatment mortalities of this species were noted there (Fisheries Technical Committee 1999). Muskellunge were tested in pre-treatment TFM toxicity tests in 1992 and 1996 using hatchery-reared juveniles. In both tests, muskellunge were not affected by TFM concentrations as high as 1.6 times the sea lamprey MLC (Steinbach 1992a; Neuderfer 1997a). Great Lakes treatment-related mortalities are not known to have resulted in overall population declines of any esocid species.

Ictalurids

Bullheads and catfishes are among the nontarget fishes that are most susceptible to mortality from lampricide applications. Channel catfish and tadpole madtom were the only species tested by Boogaard et al. (in review) with TFM and TFM/1% niclosamide toxicity ratios of less than 1.5, indicating that significant mortalities may occur from treatment concentrations approaching 1.5 times MLC. Black bullhead was found to be slightly less sensitive than the other two species. In field toxicity studies (Schuldt et al. 1996), no black bullhead, yellow bullhead or tadpole madtom held in cages survived TFM treatments in Great Lakes streams. However, only one or two individuals per species were caged in treated water and there were none held in untreated control cages (Schuldt et al. 1996; Table VII-16) .

In the Great Lakes, the stonecat has suffered substantial mortalities and depressed population levels in some streams treated with lampricides between 1958 and 1979, but the species was not eliminated in any stream (Dahl and McDonald 1980). Currently, no stonecat population has been lost in any of these streams despite repeated treatments over the more than 40 years of the program (John Weisser, USFWS, Marquette, Michigan, personal communication).

Stonecat were noted among the highest nontarget fish mortalities during the experimental program (Table VII-14). Prior to the experimental program, the Great Chazy River was the only treated stream known to contain stonecat (Bouton 1986). Stonecat populations were also documented from mortalities recorded in the first and second round experimental program TFM treatments of the Salmon and Little Ausable Rivers, and also in the only treatment of the Saranac River (Fisheries Technical Committee 1999). Stonecat mortalities were noted again in the third round of treatments of the Salmon and Little Ausable Rivers in 1998, and the Great Chazy River in 2000, which indicates that these populations have persisted (Neuderfer 1998a, 1998b and 2000c).

Although brown bullhead were among the moderately higher numbers in experimental program mortality counts (Table VII-14), large numbers were not found in any particular treatment (Fisheries Technical Committee 1999). Brown bullhead are ubiquitous throughout the Lake Champlain Basin, so treatment-induced mortalities experienced would be inconsequential at the greater population level.

______Catostomids

Sucker species are marginally sensitive to lampricides and mortalities have frequently been observed during Great Lakes stream treatments. These incidents most often involve spring spawning adults, but juveniles are occasionally involved at any season. Through the 1970's, large kills have sometimes resulted from TFM treatments over spawning concentrations of white suckers and longnose suckers in Great Lakes tributaries (Dahl and McDonald 1980). Such losses are not known to have ever caused significant population declines. More recently, significant fish kills have become increasingly rare as lampricide applications have become more rigorously controlled to minimize nontarget impacts (John Weisser, USFWS, personal communication). White suckers, like brown bullhead, were among the more common nontarget mortalities observed during the Lake Champlain experimental program (Table VII-14), but population impacts from continued treatments should be negligible due to their high natural abundance and widespread distribution.

There was no mortality of caged white suckers exposed to TFM in eight Great Lakes stream treatments (Table VII-16). The cages were in locations where the pre-determined stream MLC's were exceeded for an average of about 11 hours; this included the 1986 treatment of Conneaut Creek, Ohio, where the stream MLC was exceeded for 18.6 hours and the concentration equivalent to 1.5 times MLC was exceeded for 13.5 hours (Schuldt et al. 1996). In this same study, there was no mortality noted for caged redhorse suckers (not identified to species) held in a treatment of the Shiawassee River, Michigan; the stream MLC was exceeded for only 3.0 hours in this treatment. Boogaard et al. (in review) found white suckers to be intermediate in sensitivity, and more resistant to the TFM/1% niclosamide mixture of than to TFM alone (Table VII-17).

Quillback have been a sucker species of concern regarding potential application of lampricides in the Winooski River. It is possible that quillback may experience limited mortality if exposed to typically used lampricide stream treatment concentrations, based on treatment-related mortality observations of other sucker species. This species is uncommon, but widespread in Lake Champlain, with recorded observations in all basins except for the South Lake. The Winooski River is the only documented spawning area, based on presence of young-of-year, however (Anderson 1986). The quillback was listed as threatened in Vermont in 1987, mainly due to concerns about the effects from potential lampricide use in the Winooski River. This species was de-listed in 1994, however.

Although quillback are relatively common in the Great Lakes drainage, only one treatment in the

Service's Great Lakes nontarget database resulted in documented mortality. In 1988, nine quillback were noted among a fish kill of an estimated 8,000 fish of several species following treatment of the Pine River, Michigan (tributary to Saginaw River, Lake Huron). The pre-determined target TFM concentration for this treatment was overestimated, being 1.8 times the sea lamprey MLC based on the current pH chart (Appendix D), which had not yet been developed (John Weisser, USFWS, Marquette, Michigan, personal communication).

______Darters

Logperch are known to be sensitive to TFM. Neuderfer (1987) found significant logperch mortality in a static TFM toxicity test and concluded that substantial losses may occur from stream treatments. Dahl and McDonald (1980) indicated that logperch are sometimes adversely affected during Great Lakes tributary treatments. However, cage studies (Table VII-16) showed moderate losses in only two out of seven stream treatments (Schuldt et al. 1996). The johnny darter and fantail darter also show some susceptibility to TFM (Dahl and McDonald, 1980; Table VI-16).

Weisser et al. (1994) collected 10 fish species, including fantail darter, johnny darter, rainbow darter *(Etheostoma caeruleum)* and greenside darter (*Etheostoma blennioides*) from the Grand River, Ohio and placed them in cages in the river three days prior to a TFM treatment there in 1987. The stream MLC was determined from the alkalinity prediction chart (Appendix D). Control cages were placed upstream of the application point and the treatment cages were placed in a section of the river that received an average concentration of 1.3 times MLC for 10 hours. All of the caged darters survived the treatment (Table VII-19).

Logperch mortality was observed in 14 of 24 stream treatments during the experimental program (Table VII-14). Tesselated darter mortality was also observed in most treatments, but in much lower numbers than logperch (Table VII-14). Most darter mortalities occurred in stream sections directly below TFM application points, in isolated areas where the chemical was not uniformly mixed in the water column (Fisheries Technical Committee 1999). Since both species are common and abundant throughout the Lake Champlain Basin, no significant population-level impacts are anticipated from continued lampricide use.

The eastern sand darter (T-NY, T-VT) has been shown to be one of the more TFM-resistant darter species. Neuderfer (1987) assessed eastern sand darters collected from the Lamoille River, Vermont, in a laboratory static TFM toxicity test and concluded that little, if any mortality would be anticipated from treatments in tributaries which contain sand darters at concentrations of up to1.5 times MLC. In 2000, a flow-though toxicity test conducted in a mobile laboratory on the Poultney River using eastern sand darters collected from the Grasse and St. Regis Rivers, New York, resulted in a NOEC of 1.4 times the sea lamprey MLC (Neuderfer 2000a).

Table VII-19. Number of fish caged in treatment and control sites in the Grand River in Lake County, Ohio, 3 days before a TFM treatment and the number live after the treatment, April 26-27, 1987. The average TFM concentration at the treatment site was equivalent to 1.3 times the sea lamprey MLC for 10 hours. From Weisser et al. (1994).

	Treatment Site		**Control Site**	
Species	**Number Caged**	**Number Live**	**Number Caged**	**Number Live**
Central stoneroller	9	9	9	9
Common shiner	19	18	11	11
Hornyhead chub	14	14	8	8
Rosyface shiner	3	3	2	2
Bluntnose minnow	4	4	6	5
Rock bass	6	6	3	3
Greenside darter	9	9	3	3
Rainbow darter	6	6	13	13
Fantail darter	21	21	16	16
Johnny darter	3	3	7	7

Four cage studies assessed impacts to eastern sand darters collected from the Lamoille River, Vermont, and held in cages in TFM treatments of Lewis Creek in 1990 and 1994, and the Poultney River in 1992 and 1996 (Table VII-20). No mortality was noted for 59 eastern sand darters exposed to 1.3 times MLC in the 1990 Lewis Creek treatment (Anderson 1991; MacKenzie 1991). In the 1994 Lewis Creek Treatment, 2 of 14 eastern sand darters exposed to 1.1 times MLC died, and another one was missing at the end of the treatment (Neuderfer 1995b; MacKenzie 1995). There were external signs of physical stress on one of the fish in the treatment group, which may have contributed to the observed mortality (MacKenzie 1995). Caged eastern sand darters held in the Poultney River during TFM treatments in 1992 and 1996 resulting in no mortalities (Anderson 1993; Neuderfer 1997b). No mortality of resident eastern sand darters was observed during post-treatment mortality surveys following these treatments as well (Fisheries Technical Committee 1999).

In 1996, a flow-through TFM toxicity test at the Poultney River was performed on channel darters collected from the Kentucky River, Kentucky. The NOEC was between 1.0 and 1.1 times the sea lamprey MLC; however, the test specimens were stressed and in poor health as a result of their handling and transport from Kentucky (Neuderfer 2001). A flow-through channel darter toxicity test was repeated in 2000 at the Poultney River with the same methodology used as in the 1996 study and channel darters collected from the Grasse and St. Regis Rivers, New York. The resulting NOEC from this test was 1.2 times the sea lamprey MLC (Neuderfer 2000b). Caged channel darters were also exposed to the 2000 TFM treatment in the Great Chazy River conducted by NYSDEC. The caged darters were exposed to a TFM block averaging 1.4 times the sea lamprey MLC, which resulted in 34% of them being killed. This result was consistent with the laboratory toxicity data obtained in 2000 (Neuderfer 2000c).

Table VII-20. Number of eastern sand darters caged in treatment and control sites before experimental program TFM treatments in Lewis Creek and the Poultney River, and the number live after the treatment. Eastern sand darters used in these cage studies were collected in the Lamoille River, Vermont.

Stream	Year	Cage Location	Average TFM Concentration	Number Caged	Number Live
Lewis Creek	1990	Treatment	1.3 x MLC for 10 hours[a]	20	20
		Control	0	59	59
	1994	Treatment	1.1 x MLC for 11 hours[a]	14	11[d]
		Control	0	13	13
Poultney River	1992	Treatment	0.8 x MLC for 9 hours[b]	24	24
		Control	0	24	24
	1996	Treatment	1.0 MLC for 8 hours[c]	24	24
		Control	0	16	16

[a] Stream MLC determined from alkalinity prediction chart (Appendix D)

[b] Stream MLC determined from pH/alkalinity prediction chart (Appendix D)

[c] Stream MLC determined from a pre-treatment toxicity test.

[d] Two eastern sand darters were dead and one was missing after treatment. The missing fish apparently escaped at one of the observation checks. There were external signs of physical stress on one of the fish in the treatment group, which may have contributed to the observed mortality (MacKenzie 1995).

Walleye

There has been some concern about the toxicity of TFM to walleye, particularly if TFM is applied during spring walleye spawning run or egg hatching periods. Seelye et al. (1987) tested the toxicity of TFM to walleye eggs, sac fry and swim-up fry in the laboratory. They found that the LC_{25} for walleye gametes exposed to TFM during fertilization was 4.1 times the sea lamprey MLC, while this differential was lower for newly fertilized eggs at 2.6 times MLC. Eyed eggs were very resistant to TFM with an LC_{25} exceeding 14 times MLC; sac fry and swim-up fry produced LC_{25} to sea lamprey MLC ratios of 3.9 and 2.5, respectively. The authors concluded that routine TFM treatments during walleye spawning periods are unlikely to adversely affect early life stages of walleye. Juvenile walleye were found to be moderately tolerant to TFM and somewhat more tolerant to the TFM/1% niclosamide combination (Table VII-17).

______Cyprinids

Minor kills of various species of minnows have been commonly encountered during stream treatments, often directly below application points. Dahl and McDonald (1980) found that common shiner, blacknose dace, longnose dace and spottail shiner were most commonly observed cyprinid mortalities in Great Lakes treatments. Bluntnose minnow, blacknose dace and longnose dace accounted for the heaviest overall cyprinid losses from Lake Champlain experimental program treatments (Table VII-14), while mortalities of 13 other cyprinid species were identified in small numbers (Fisheries Technical Committee 1999).

Applegate and King (1962) studied the toxicity of TFM to both larval sea lamprey and 11 fish species. In this study, 24-hour LC_{25}'s for blacknose shiners, golden shiners and fathead minnows ranged from 3.2 to 4.1 times the 24-hour sea lamprey MLC.

Five of the ten fish species caged during the 1987 Grand River, Ohio TFM treatment (Weisser et al. 1994) were cyprinids. All the caged rosyface shiners, bluntnose minnows, central stonerollers (*Campostoma anomalum*) and hornyhead chubs (*Nocomis biguttatus*) survived the treatment, while 18 of 19 caged common shiners survived (Table VII-19).

The blackchin shiner is of potential concern due to its general rarity and relatively limited distribution in the Lake Champlain Basin, including the Poultney River and Indian Brook (Table VI-4). It currently has no legal status in New York or Vermont. No blackchin shiner mortality was documented during the two experimental program TFM treatments of the Poultney River, or from any other treatment. A search of a comprehensive Great Lakes nontarget mortality database found no record of documented blackchin shiner mortality (John Weisser, USFWS, Marquette, Michigan, personal communication), and this species ranges widely throughout the Great Lakes drainage (Gilbert 1980).

Comparison of TFM and TFM/Niclosamide Toxicity to Fishes

Boogaard et al. (in review) compared the toxicity of TFM with the combination of TFM/1% niclosamide to a wide range of nontarget fish species in continuous flow-though tests in the laboratory and in field (streamside) environments. Comparisons of the two formulations for most species have been discussed above. The authors concluded that the combination had similar effects on nontarget fish relative to sea lamprey MLC’s as did TFM.

______Wetland Fishes

Table VII-21 is included in this analysis for the primary purpose of showing that effects of toxicity to fish does not increase appreciably from extended exposure to TFM (96 hours). This provides a basis for determining the effects to fishes of extended exposure to TFM in areas where the lampricide is present but where water circulation and/or flushing may be poor. The data in Table VII-21 generally suggest that if TFM does infiltrate wetland fish habitats, consequences to wetland fish would be minimal as there is not much change in LC_{50}'s between 24 and 96 hours of exposure. Dye studies conducted by Gruendling and Bogucki (1986) revealed that entrapment of lampricides in wetlands for extended periods was not likely to occur. Studies showed that dye did not penetrate deeply into emergent wetlands and that concentrations dissipated rather quickly. Conclusions of the dye simulation studies were reinforced by Gruendling and Bogucki (1993b), who found that TFM treatments of the Ausable and Little Ausable Rivers resulted in only low level TFM exposure to emergent wetlands near their mouths, which dissipated to trace levels within three days (See Section VII.A.1.c.).

Table VII-21. Toxicity of field grade TFM (35.7% active ingredient) over time to fingerling rainbow trout at selected temperatures, hardnesses, and pH's (modified from Marking and Olson 1975).

Temp. (°C)	Water Hardness	pH	LC_{50} (mg/L) at				
			1 h	3 h	6 h	24 h	96 h
7	Soft	7.5	10.2	6.68	4.78	4.37	3.68
12	Soft	7.5	5.83	4.83	4.46	3.83	3.83
17	Soft	7.5	4.10	3.40	3.40	2.79	2.37
12	Very Soft	6.6	3.77	3.27	-	-	-
12	Hard	7.8	50.3	26.0	19.0	14.1	8.38
12	Very Hard	8.2	88.3	45.9	36.6	27.2	19.0
12	Soft	6.5	4.12	2.82	2.56	2.52	2.52
12	Soft	8.5	74.0	42.4	36.7	20.5	-
12	Soft	9.5	>300	270	239	230	-

Toxicity of TFM Metabolites and Other Ingredients of the TFM Formulation

Table VII-22 summarizes static toxicity tests done on rainbow trout with reduced TFM (RTFM), which is one of the main biotransformed derivatives of TFM which are released in the water. It can be seen that RTFM poses relatively little threat to fish.

Adverse impacts on fishes, if any, from other ingredients in the TFM or TFM/niclosamide formulations, are included as a component of the overall adverse impact of these products on fishes as discussed above. See also discussion by Engstrom-Heg (1989) which indicates that isopropanol has a very low toxicity to fish.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

Mortalities to nontarget fish in granular Bayluscide treatments of the five Lake Champlain deltas were distributed over 27 identified species. Qualitative post-treatment shoreline surveys and offshore surveys by boat revealed that most of the mortalities were banded killifish, mimic shiner, spottail shiner and very small unidentified fish (probably a combination of juvenile killifish and minnows), most of which were in shallow near-shore areas. Visual estimates of fish mortality from the nine treatments (five in 1991 and four in 1995) totaled approximately 179,000 individuals, but most were very small (less than 4 cm total length) and the biomass lost was considered to be biologically insignificant when compared to the fish biomass in the Lake Champlain shoreline habitat not treated (Fisheries Technical Committee 1999).

Table VII-22. Toxicity of reduced TFM (RTFM) to fingerling rainbow trout in standard, reconstituted water at 12°C (modified from Marking and Olson 1975).

Water Hardness	LC_{50} (mg/L) at		
	24 h	48 h	96 h
Very Soft	30.0	30.0	29.0
Hard	64.0	60.0	49.0
Very Hard	52.0	50.0	48.0

In SCUBA transects following the 1982 Bayluscide treatment of a 101 acre plot in Seneca Lake, 192 johnny darters were observed dead along with 22 sea lamprey ammocoetes. Shoreline collections were substantially greater, with some 700 specimens observed as nontarget mortalities including (in descending order of abundance) silvery minnow, brown bullhead, banded killifish, smallmouth bass, spotfin shiner, white sucker, bluntnose minnow, hog sucker, largemouth bass, chain pickerel, and johnny darter. Most of that mortality was in the heated discharge (80°F) of a power plant. This may have an additive effect on toxicity as well as increasing the solubility of niclosamide. The remainder of the shoreline collections were adjacent to shallow (3-4 ft) water where there appeared to be a "hot spot" of high niclosamide concentrations through the entire water column (Table VII-10, Station F). During the 1986 Bayluscide treatment of the same plot, a very minor nontarget fish mortality occurred. It was limited almost entirely to the heated discharge area, with negligible numbers collected elsewhere (Engstrom-Heg 1983).

Native lamprey are sensitive to niclosamide, but were not collected during extensive Bayluscide sample plot surveys for sea lamprey in the Lake Champlain deltas prior to the experimental program. However, large numbers of American brook lamprey were killed on the Ausable River Delta during both experimental program treatments in 1991 and 1995 (Fisheries Technical Committee 1999). American Brook lamprey were also collected on the Ausable River Delta in a 1993 sea lamprey assessment survey using the same Bayluscide sampling method (NYSDEC, Ray Brook, New York, unpublished data). It is plausible that many larval American brook lamprey were driven out of the Ausable River by TFM blocks from the 1990 and 1994 stream treatments, where they recovered and re-burrowed on the delta.

Adverse impacts on fishes, if any, from other ingredients in the Bayluscide granule formulation are included as a component of the overall adverse impact of this product on fishes as discussed above. See Appendix F for further discussion of the toxicity of niclosamide and the Bayluscide granule formulation.

Trapping

Some smaller fish may be captured in spawning-phase sea lamprey traps and occasionally die from stresses within them, but most are released unharmed. Thus, significant impacts on nontarget fish are not expected.

Barriers

Impacts to fish by barriers primarily include the blocking of fish migrations and other in-stream movements of fish (Noakes et al. 2000). Porto et al. (1999) found that a significantly lower proportion of fishes moved across a real barrier on barrier streams than across a hypothetical barrier point on reference streams. The upstream decline in species richness was greater for barrier streams than for reference streams in spring, summer, and fall.

Dodd (1999) studied 24 pairs of Great Lakes streams, each pair included one stream with a low-head sea lamprey barrier dam and a nearby reference stream without a barrier. Barrier streams generally had a greater species richness than reference streams, with peaks in species richness directly downstream of the dams, but sharp declines in species richness above dams, which indicates a blocking of fish movement upstream. Barrier streams were more dissimilar in species composition between above and below sections relative to reference streams. On average, 2.5 fish species were lost above barriers, with sea lamprey, yellow perch and trout-perch most commonly absent. Logperch were also negatively impacted by barriers in terms of frequency of occurrence, abundance, and average size. Dodd's (1999) findings indicate that low-head sea lamprey barriers result in a biologically minor impact on the fish community of barrier streams. This is also considered a worst case evaluation, since only one of the barriers had a mechanical adjustable crest while the others were fixed crest, and also because these barriers had no fish passage facilities installed (Ellie Koon, USFWS, Ludington Michigan, personal communication).

Noakes et al. (2000) found that abundance of some fish species, including white sucker and brown bullhead, was positively affected by barrier dams, suggesting that barriers create favorable habitat for these species immediately upstream or downstream of the structure or serve as refuge from migratory predators. Abundance of American and northern brook lamprey was also greater above barriers, which the authors suggested was due to barriers acting as refuge from lampricide use and/or competition from sea lamprey.

h. Amphibians

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

Certain life stages of amphibians can be relatively sensitive to TFM and some losses can be expected for any gill breathing aquatic forms present in tributaries during treatments. Mortalities of mudpuppies and frog tadpoles have been commonly observed in lampricide treatments of Great Lakes tributaries (Gilderhus and Johnson 1980). Frog tadpoles, mudpuppies, eastern red-spotted newts and two-line salamanders dominated amphibian nontarget mortality counts from Lake Champlain experimental program TFM treatments and later TFM treatments of New York streams (Fisheries Technical Committee 1999; NYSDEC, Ray Brook, New York, unpublished data; Tables VII-23, VII-24, and VII-25). Fisheries Technical Committee (1999) incorrectly reported losses of dusky salamanders from the 1991 Stone Bridge Brook treatment, which have subsequently been correctly identified as two-lined salamanders (Jim Andrews, Middlebury College, Middlebury, Vermont, personal communication). Nontarget amphibian mortality counts from individual Lake Champlain stream treatments are detailed in Appendix E.

Mortalities of frog tadpoles were most frequently reported in Great Lakes treatments during late spring and early summer (Gilderhus and Johnson 1980). Gruendling and Bogucki (1986) anticipated that some tadpole mortality would occur during late summer/fall treatments of Lake Champlain tributary TFM applications, but concluded that the expected losses should not have serious ecological implications. Tadpole mortality was minor during the experimental program, except in three of the 24 TFM treatments where more than 50 dead individuals were found (Table VII-23). The two treatments of the Great Chazy River, which has extensive vegetated pool habitat accounted for 93% of the tadpole mortalities observed during the experimental program (Fisheries Technical Committee 1999).

In laboratory static and flow through toxicity tests with TFM in soft water (total hardness= 44 mg/L $CaCO_3$ and pH=6.8 to 7.0), Chandler and Marking (1975) obtained 96-hour LC_{50}'s of 1.98, 2.76, and 3.55 mg/L for tadpoles of gray tree frog, leopard frog and bull frog, respectively. In comparison, Dawson et al. (1975) determined a 96-hour LC_{50} of 0.57 mg/L for sea lamprey larvae under the same water chemistry conditions as in the Chandler and Marking (1975) study. In experimental TFM applications in fish culture ponds, Kane et al. (1985) and Kane and Johnson (1989) found that frog eggs, green frog tadpoles and young-of-year bullfrog tadpoles were more sensitive to TFM than second year bullfrog tadpoles. More recently, Johnson and Stephens (in review) found LC_{50}'s of green frog tadpoles to be about 2.4 times that of sea lamprey larvae in flow-through TFM toxicity tests conducted on-site at the Bad River, Wisconsin. Breisch (1996) observed numerous living frog adults and tadpoles and small numbers of dead tadpoles in post-treatment assessments of the Ausable and Little Ausable Rivers in 1990.

In contrast to earlier treatments, higher rates of mortality were observed among tadpoles in the 1999 TFM treatment of the Ausable River (Tables VII-24 and VII-25). A large portion of the mortality was noted in a section through which the TFM block traveled in early morning darkness hours. Stream pH during these hours may have been lower than that encountered during the pre-treatment toxicity test, causing increased TFM toxicity. Weather conditions on the following morning were overcast and rainy, keeping pH depressed and toxicity high. Another possible reason for the observed level of mortality was low river discharge that resulted in isolated pools with slowly-moving water along substantial portions of the river's course. Discharge was so low that the channel leading to the Lower Mouth was completely isolated from the river's main-stem by a sand bar. Until the channel reached lake level, it contained large, shallow pools of water. The isolated pools along the main-stem and in the channel leading to the Lower Mouth required secondary application of TFM with backpack spray units. Little flowing water in these pools may have resulted in longer than anticipated exposure to TFM concentrations. Assessment crews observed live tadpoles in both the section from which a large portion of the mortality was noted and in the channel leading to the Lower Mouth.

Table VII-23. Mortality counts resulting from routine surveys for nontarget amphibian species associated with 24 TFM treatments of Lake Champlain tributaries during the 1990-1997 experimental sea lamprey control program. Additional mortalities observed as a result of special effort studies are reported separately in Table VII-25.

Species/stage	**Observed Mortality Count**	**Number Streams with Observed Mortality**	**Number Treatments with Observed Mortality**	**Number Treatments with >50 Dead Individuals**	**Number Dead per Stream Mile Treated**[a]
Frog/tadpole (*Rana* sp.)	5,461	7	10	3	62.5
Unidentified salamander[b]	1,832	9	15	3	14.5
Red-spotted newt	362	1	2	2	124.8
Mudpuppy	91	4	6	0	1.8
Two-line salamander[c]	41	2	3	0	7.1
Frog/adult (*Rana* sp.)	34	7	9	0	0.3
North. spring salamander	0	0	0	0	0.0
Dusky salamander	0	0	0	0	0.0

[a] Based on total stream mileage exposed to TFM for streams where mortality was noted for the species during at least one treatment. For example, 6.1 miles of the Little Ausable River were exposed to TFM twice from 1990-1997 for a total of 12.2 miles. No tadpoles were observed dead after the first treatment, but six were observed dead after the second. The number dead per stream mile treated in this example is 6/12.2=0.5.

[b] Unidentified salamanders are likely to include mudpuppy and two-line salamander. A sample from 1,651 specimens enumerated from the 1992 and 1996 Great Chazy River treatments (Fisheries Technical Committee 1999) was identified by Breisch (2000a) to contain only mudpuppies; samples from the remainder were found to be a combination of mudpuppies and two-lined salamanders Breisch (1996).

[c] Includes 14 specimens initially misidentified as dusky salamanders in Fisheries Technical Committee (1999).

Table VII-24. Mortality counts resulting from routine surveys for nontarget amphibian species associated with eight TFM treatments of Lake Champlain tributaries during the 1998-2000 period. Additional mortalities observed as a result of special effort studies are reported separately in Table VII-25.

Species/stage	**Observed Mortality Count**	**Number Streams with Observed Mortality**	**Number Treatments with Observed Mortality**	**Number Treatments with >50 Dead Individuals**	**Number Dead per Stream Mile Treated[a]**
Frog/tadpole (*Rana* spp.)	4,144	4	4	3	206.2
Two-line salamander	687	6	6	4	24.6
Red-spotted newt	190	2	2	1	44.2
Mudpuppy	160	2	2	1[c]	10.7
Unidentified salamander[b]	30	4	4	0	2.0
North. spring salamander	9	2	2	0	1.3
Frog adult (*Rana* spp.)	3	1	1	0	0.4
Dusky salamander	2	1	1	0	0.3

[a] Based on total stream mileage exposed to TFM only for treatments conducted from 1998-2000 in which mortality was noted for the species.
[b] Unidentified salamanders during the 1998-2000 period were mostly specimens that were observed, but unable to be collected due to water depth; or recorded as collected, but determined missing in the laboratory setting.

[c] If mudpuppies collected in special effort studies had been included in this table, this value would be 2. The other values in this column would remain unchanged regardless of whether special study specimens were included.

Table VII-25. Mortality counts for nontarget amphibian species resulting from special effort studies following the 1990 TFM treatment of the Little Ausable River and the 1990, 1994 and 1999 TFM treatments of the Ausable River. Mortalities observed as a result of routine surveys are reported separately in Tables VII-23 and 24.

Species/stage	**Little Ausable**	**Ausable**			**Total**
	1990	**1990**	**1994**	**1999**	
Frog tadpole (*Rana sp.*)	25	32	0	3,493	3,550
Mudpuppy	0	24	40	145	209
Two-line salamander	6	0	0	29	35

The toxicity of TFM and TFM/1% niclosamide treatments to adult mudpuppies was investigated with continuous flow-through toxicity tests in the laboratory (Boogaard et al. in review). Mudpuppies and sea lamprey ammocoetes were exposed together in each test to enable direct comparisons of toxicity. Mudpuppies were 2.3 to 2.4 times more resistant to TFM, and 2.2 to 2.5 times more resistant to TFM/1% niclosamide, than were the sea lamprey, based on a comparison of estimated 12-h LC_{50}'s for each species (Table VII-26). The NOEC's were 1.6 times greater than observed sea lamprey MLC's in tests with TFM, and were 1.5 times greater in tests with TFM/1% niclosamide (Table VII-26). As with invertebrates and fishes tested, the similarities between relative toxicity of TFM and the TFM/niclosamide mixture to mudpuppies suggest that the effects of TFM/niclosamide on other amphibian species should not markedly differ from the effects of TFM.

The above toxicity results suggest that lampricides applied to streams at concentrations equivalent to 1.5 times MLC should not affect mudpuppies. However, mudpuppy mortalities were noted in some TFM treatments of Lake Champlain tributaries during the experimental program (Fisheries Technical Committee 1999) and in the third round of treatments in New York streams (Breisch 2000a and 2000b; Neuderfer 1999a and 2000c), where most TFM concentrations were at or below 1.5 MLC. The following factors may explain this discrepancy:

The mudpuppies tested by Boogaard et al. (in review) were purchased from a commercial bait wholesaler and held in the U. S. Geological Survey Upper Midwest Environmental Sciences Center (UMESC) aquaculture facility for one month before the lampricide exposure to assess their overall health. The facility's fish culturist determined when they were acceptable for use, in conformance with established animal care and health guidelines. This suggests that the test animals were in excellent physical condition. Some portion of wild mudpuppy populations, as well as populations of other species, can be expected to be stressed by natural environmental factors such as disease, parasites, injuries, or due to mating or spawning behavior, and therefore may die from exposure to lower lampricide concentrations than were observed in controlled laboratory tests with healthy captive animals.

Table VII-26. Toxicity of TFM and TFM/1% niclosamide (TFM component) to adult mudpuppies and sea lamprey ammocoetes (from Boogaard et al. in review).

Lampricide	Trial	Mudpuppy 12-h LC_{50} (mg/l)	Sea Lamprey 12-h LC_{50} (mg/l)	Mudpuppy 12-h NOEC (mg/l)	Sea Lamprey 12-h MLC (mg/l)
TFM	1	3.60	1.57	3.3	2.1
	2	3.60	1.47	2.7	1.7
TFM/1% niclosamide	1	2.11	0.95	1.8	1.2
	2	2.15	0.86	1.8	1.2

Differences in observed mudpuppy mortality between stream treatments and laboratory exposures may also be due to diurnal pH fluctuations, which are common in natural stream systems. The streams where most post-treatment mudpuppy mortalities were observed also tended to have substantial diurnal pH shifts, sometimes approaching ± 0.5 pH units in a 24-h period (NYSDEC, Avon, New York, unpublished data). Stream water pH typically increases during daylight hours and decreases at night. The toxicity of a TFM block increases as pH declines, so the block may sometimes become significantly more toxic for short periods of time in the predawn hours, which may in turn may lead to somewhat greater nontarget mortality than predicted. In contrast, the pH of UMESC laboratory water source was more stable, varying about ± 0.25 pH units (Boogaard et al. in review).

No information from laboratory toxicity testing is available for juvenile mudpuppies. There is speculation that juvenile mudpuppies could be more sensitive than adults. Large proportions of juveniles relative to adults were noted from nontarget mortality collections from Lake Champlain TFM treatments (Breisch 1996, 2000a, 2000b). It is also possible that these mortalities occurred in general proportion to the population's natural age distributions, but it would be difficult to verify since pre-treatment efforts to sample mudpuppy populations in the Lake Champlain Basin have been unsuccessful (Breisch 1996). Weisser et al. (1994) noted that 100% of caged mudpuppies greater than 50 mm in length survived the 1987 TFM treatment of the Grand River, Ohio, at concentrations up to 1.3 times the sea lamprey MLC, determined by the alkalinity prediction chart (Appendix D), but no caged mudpuppies less than 50 mm in length survived (Table VII-27). The authors suspected that the small cages confining the less than 50 mm-long mudpuppies may have stressed them and contributed to their mortality, but since none of this size were held in control cages upstream of the application point, the effect of holding conditions could not be assessed. The significance of the mortality results of each size class is limited by the relatively small sample sizes of caged mudpuppies tested, particularly in the smaller size classes (Table VII-27).

Matson (1990) sampled the Grand River mudpuppy population before and after the 1987 TFM treatment and did not find evidence of size-selective mortality. In the same study, Matson (1990) calculated mark and recapture population estimates in a 600-m reach of the Grand River which showed a minimum 29% decrease in mudpuppy abundance in 1988, compared with a pre-treatment estimate in 1987. This study did not include sampling of a population in an untreated control site. Therefore, the proportion of the population decline attributed to the TFM treatment relative to natural year to year variability is unclear.

Gilderhus and Johnson (1980) acknowledged that mudpuppy mortalities have been common occurrences in Great Lakes lampricide treatments, and that they sometimes occurred in large numbers. There is evidence that mudpuppy populations have persisted through repeated treatments in the Great Lakes based on mortalities which have occurred in every successive treatment. There is no evidence that any Great Lakes tributary which has received lampricide applications has lost its mudpuppy population over the more than 40-year history of the program (John Weisser, USFWS, Marquette, Michigan, personal communication).

Table VII-27. Number of mudpuppies caged in one control and two treatment sites in the Grand River in Lake County, Ohio, three days before a TFM treatment and the number live after the treatment, April 26-27, 1987. The average TFM concentration was equivalent to 1.3 times the sea lamprey MLC for 10 hours at treatment site1, and reached 1.0 times MLC for 6.5 hours at treatment site 2. From Weisser et al. (1994).

Mudpuppy	**Control Site**		**Treatment Site 1**		**Treatment Site 2**	
Size class	**Caged**	**Live**	**Caged**	**Live**	**Caged**	**Live**
<50 mm	0	0	3	0	2	0
51-199 mm	2	2	5	5	3	3
>199 mm	4	3	13	13	13	13

Similar to some Great Lakes tributaries, the Ausable and Great Chazy Rivers yielded substantial mortalities of mudpuppies each of the three times they were treated with TFM, indicating that either individual treatment losses are not critical or large-scale recovery occurred in the 4 to 5 year intervals between treatments (Fisheries Technical Committee 1999; Breisch 2000a, 2000b; Neuderfer 1999a, 2000c; Tables VII-23, VII-24 and VII-25). Slight changes in size class distribution have been observed among dead mudpuppies collected in successive treatments, which may be indicative of treatment-related effects on mudpuppy populations (Alvin Breisch, NYSDEC, Delmar, New York, personal communication.). Natural variability in year class strength may also be a factor.

Adverse impacts on amphibians, if any, from other ingredients in the TFM or TFM/niclosamide formulations, are essentially included as a component of the overall adverse impacts of these products on amphibians.

<u>Bayluscide Treatments on Lake Deltas and Selected Stream Sections</u>

Despite some sensitivity to niclosamide, observed amphibian mortalities during experimental program delta treatments in Lake Champlain were rare, and limited only to small numbers of frog tadpoles (Fisheries Technical Committee 1999; Breisch 1996). There were no losses of amphibians noted during the 1982 and 1986 Bayluscide treatments at Seneca Lake (Engstrom-Heg 1983; Engstrom-Heg and Kosowski 1991).

Most amphibians do not typically inhabit the types of open-lake habitat on the Lake Champlain deltas which received Bayluscide treatments. The possible exception is the mudpuppy. Mudpuppy habitat is very diverse, including clear waters of lakes and streams, muddy and weed-choked bays and coves, canals, and drainage ditches (Bishop 1943). There are reports of mudpuppies being caught by anglers in Lake Champlain (Alvin Breisch, NYSDEC, Endangered Species Unit, Delmar, New York, personal communication; Chet MacKenzie, VTDFW, Pittsford, Vermont, personal communication). No mudpuppy mortality was observed after any

Lake Champlain delta Bayluscide treatment.

Adverse impacts on amphibians, if any, from other ingredients in the Bayluscide 3.2% granule formulation, are included as a component of the overall adverse impacts of this product on amphibians.

Trapping

Several amphibian species may potentially be incidentally captured in spawning-phase sea lamprey traps. Mudpuppies, salamanders, frogs and toads are commonly noted incidental catches in Great Lakes sea lamprey assessment traps. A total of 4,370 amphibians were noted caught in 55,014 trap days on an average of 37.4 Great Lakes tributaries per year from 1979 to 2000; 93 percent of these were released alive. Mudpuppies comprised 86% of all amphibians caught. Mudpuppies were commonly noted in incidental catch data from a trap at a site on the Grand River, Ohio, with 1,716 individuals captured from 1984 through 1999. Only 19 (1.1%) of the mudpuppies captured during this period were killed as a result of capture (USFWS, Marquette, Michigan, unpublished data).

Nontarget catches in Lake Champlain sea lamprey assessment traps have not been well documented. Frogs appear to be the only commonly caught amphibian, and they are usually released alive (Wayne Bouffard, USFWS, Essex Junction, Vermont, personal communication).

Barriers

Barriers are not expected to adversely affect most amphibians. There is the potential for permanent low-head barriers to affect in-stream migratory movements of mudpuppies, but the significance of such effects is unknown. Impoundments by certain barriers may enhance habitat for some amphibians.

i. Reptiles

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

No adverse effects are anticipated for reptiles (turtles, lizards and snakes) either through direct exposure to treatment level concentrations of TFM or by eating organisms such as lamprey, which are killed during treatment. The major lines of evidence to support this conclusion is the absence of reports of adverse effects on reptiles in the Great Lakes stream treatment impact summaries, and results from toxicity tests conducted on turtles (NRCC 1985). Nontarget effects from Great Lakes treatments are carefully compiled by sea lamprey control personnel of the Service and the Department of Fisheries and Oceans, Canada (Schnick 1972; Gilderhus and Johnson 1980). No reptiles were observed to have been affected by TFM treatments in the Seneca Lake and Cayuga Lake systems in New York (Hulbert 1983; Chiotti et al. 1987; Kosowski et al. 1987), or during experimental program treatments of Lake Champlain tributaries

(Fisheries Technical Committee 1999) .

Studies cited by the NRCC (1985) indicate that turtles are resistant to TFM as no mortalities have been reported at exposure concentrations up to 10 mg/L. One study involved painted and snapping turtles, species which are present in the Lake Champlain system. Laboratory studies have not been conducted on snakes. Because most are not aquatic species, few except water snakes are expected to be exposed to TFM at all.

Since no impacts of significance have been noted for reptiles from direct exposure to TFM or TFM/niclosamide, none are expected from other ingredients in these formulations.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

No laboratory studies are available from which to determine the effects of niclosamide on reptiles. However, no adverse effects have been noted in Canada, where Bayluscide 5% Granular has been used at up to 200 lb/acre in habitats similar to those proposed for treatment in Lake Champlain (Stanley Dustin, Department of Fisheries and Oceans, Sault Ste. Marie, Ontario Canada, personal communication). No affected turtles or snakes were observed in the two delta areas of Seneca Lake, New York treated with Bayluscide in 1982 and 1986 (David Kosowski, NYSDEC, Avon, New York, personal communication), or in nine Lake Champlain delta treatments during the experimental program (Fisheries Technical Committee 1999). Both Seneca Lake treatment sites were offshore, in open-lake habitat typically not associated with reptiles. In Lake Champlain, delta areas proposed for continued treatment with Bayluscide are, with one exception, located in open-lake habitat with exposure to heavy wave action (Gersmehl and Baren 1985; Gruendling and Bogucki 1986). These areas are not considered typical habitat for reptiles although turtles may occasionally move through them. The Little Ausable River Delta is much more protected than the other deltas and contains some areas covered with dense growths of aquatic vegetation in close association with emergents (Gruendling and Bogucki 1986). This area is probably more attractive to reptiles (particularly turtles) than the other deltas, although information to confirm their presence is lacking.

Based upon the nature of the habitat proposed for treatment in Lake Champlain, it is unlikely that significant numbers of reptiles will be exposed to niclosamide because they are not expected to be present in much of the treated area. Furthermore, extensive field experience provides no evidence to suggest that reptiles are sensitive to or adversely affected by niclosamide.

Adverse impacts on reptiles, if any, from other ingredients in the Bayluscide 3.2% granule formulation, are a component of the overall adverse impact of this product on reptiles. Since none have been noted over the history of Bayluscide use, none are expected.

Trapping

It is possible for water snakes and small turtles to occasionally become trapped and die in spawning-phase sea lamprey traps. The Service recorded 188 snakes (most identified as northern water snakes) in 55,014 trap days on an average of 37.4 Great Lakes tributaries per year from 1979 to 2000; 176 (94%)of these were released alive. During this same period, 310 turtles were caught (most identified as snapping turtles), and 304 (98%) of these were released alive (USFWS, Marquette, Michigan, unpublished data).

Barriers

Construction and operation of sea lamprey barrier dams are not expected to have any adverse impacts on reptiles. Small impoundments behind low-head barrier dams may enhance habitat for turtles.

j. Birds

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

TFM is not expected to cause adverse effects on birds either through direct exposure to treatment level concentrations or by eating organisms killed during treatment.

A study by Hudson (1979) determined that the LD_{50}'s of field grade TFM for mallards, ring-billed gulls and California quail were 308, 250 and 546 mg/kg, respectively. These levels are much higher than those that could be encountered by drinking treated water or by eating invertebrates affected by a TFM treatment. Biomagnification of TFM in invertebrates studied is quite low (Sanders and Walsh 1975; Maki and Johnson 1977). Further information on biomagnification is discussed in Appendix F.

In water exposure tests, Hudson (1979) found that 6-8 week-old mallards were unaffected after 48 hours in a 5 mg/L TFM solution. However, they showed some signs of intoxication at 15.8 mg/L (higher than maximum treatment levels experienced for Lake Champlain tributaries), and stronger signs of toxicity at 50 mg/L, although none died. Symptoms included a mild lack of coordination and lethargy at 15.8 mg/L, with increased effects at 50 mg/L. The birds returned to normal when placed in fresh water. Year-old ducks were unaffected at 50 mg/L.

Gulls have been observed feeding heavily upon dead and dying sea lamprey ammocoetes during TFM treatments (Moffett 1958; Chiotti et al. 1987). Chiotti et al. (1987) reported that mallards, as well as gulls, fed heavily upon sea lamprey ammocoetes which were surfacing in lower Cayuga Inlet during the 1986 treatment. Similar avian feeding events were noted during several Lake Champlain experimental program treatments, particularly at the mouth of the Saranac River in 1992 (Fisheries Technical Committee 1999). No mortalities or unusual behavioral patterns were noted for birds involved in these feeding events.

These observations are consistent with the conclusions drawn by Gilderhus and Johnson (1980) and EPA (1999). Namely, vertebrates other than fish and amphibians have not been observed to be affected by lampricide treatments for sea lamprey control. As was noted in the preceding discussion on reptiles, observations for TFM-related mortalities of large nontarget organisms are routinely made and recorded by treatment personnel.

The combination of laboratory studies and field surveys during treatments leads to two conclusions: (1) That birds are quite resistant to TFM, and (2) That after more than 40 years of use in more than 2,600 stream treatments, there is no evidence to indicate that any species of birds have been adversely affected by exposure to TFM or the TFM/niclosamide combination. EPA (1999) concluded that, based on the available toxicity data, use of lampricides pose very little risk from either acute oral, acute dermal, subacute dietary exposure or chronic exposure to birds.

Since no impacts of significance have been noted for birds from direct exposure to TFM or TFM/niclosamide, none are expected from other ingredients in these formulations.

There is slight potential for treatment effects on birds through temporary adverse impacts in localized areas from TFM to fishes or aquatic invertebrates which serve as their food supply. This could include fish-eating birds such as herons, ducks and kingfishers or those species that feed upon aquatic invertebrates, especially the broad-billed ducks.

The most probable impacts of lampricides to fishes and invertebrates are expected to occur in streams during treatment. Stream-dwelling organisms will be exposed to treatment levels of TFM or TFM/niclosamide for the 12-hour application period and for an additional period of a few days of lesser concentrations until the lampricide block completely clears the stream and enters the lake. No impacts are expected in the lake due to rapid dilution and dispersion of the TFM plume. This was confirmed by TFM treatment simulation studies using Rhodamine WT dye on seven Lake Champlain streams in the late spring and summer of 1986 (Myers 1987a; Laible and Walker 1987), and by post treatment monitoring during the experimental program (Gruendling and Bogucki 1993b).

Because fish losses during stream treatments are typically minor, and because repopulation will quickly occur from surviving stocks and/or through migration from untreated adjacent areas, any impact upon the food supply for fish-eating birds is expected to be insignificant.

As previously discussed, stream treatment effects on invertebrates are extremely variable. The greatest impacts will occur to sensitive species exposed to treatment or near-treatment concentrations for the longest period of time. This occurs within stream channels and near stream mouths. Impacts in the lake, within the lampricide plume area, are negligible as a result of rapid dilution and dispersion of the chemical (Myers 1987a; Laible and Walker 1987; Gruendling and Bogucki 1993b).

TFM or TFM/niclosamide impacts to stream-dwelling invertebrates are not expected to significantly limit food availability to birds (particularly ducks) for several reasons. First, most invertebrate forms will not be significantly affected by treatment concentrations (see discussion in Section VII.A.1.f.); second, recovery of affected invertebrate populations is expected to be rapid (see discussion in Section VII.A.1.f.); and third, the organisms most likely to be affected by treatments are generally minor constituents of the invertebrate components of bird diets (see discussion below under Bayluscide).

Impacts on invertebrate food supplies for ducks in wetlands exposed to TFM are also be expected to be very minor to negligible. The study by Gruendling and Bogucki (1993b) revealed that TFM treatments of the Ausable and Little Ausable River Deltas did not cause significant impacts to invertebrate communities on the deltas of these rivers and their associated wetlands.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

No adverse effects are anticipated for birds exposed to treatment level concentrations of niclosamide or to those which eat organisms killed by Bayluscide treatments. EPA (1999) concluded that use of Bayluscide posed very little risk to birds.

Laboratory studies show that birds are very tolerant of niclosamide. Hudson (1979) provides the following information on acute oral toxicities (LD_{50}'s, or dose that would cause death in 50 percent of animals tested) for three species: mallard ducks - greater than 2000 mg/kg; ring-billed gulls -500 mg/kg and bobwhite quail - greater than 2000 mg/kg. These values are from 900 to 3500 times greater than the maximum concentration of Bayluscide in water (0.573 ppm), and from 600 to 2300 times greater than the maximum concentration of Bayluscide found in muscle tissue of caged fish (0.858 ppm) during the 1982 treatment at the Dresden site in Seneca Lake (Ho and Gloss 1987). Thus, birds exposed to levels of niclosamide associated with approved field application rates of Bayluscide granules are not expected to be harmed. This was confirmed during the 1982 and 1986 treatments at Dresden, and the 1991 and 1995 treatments in Lake Champlain, where 100 lb/acre of formulation was used in the treatment. Gulls were observed feeding heavily upon surfacing sea lamprey ammocoetes. No signs of chemical intoxication or mortality were noted either from eating ammocoetes or from frequent exposure to water containing niclosamide for a period of several hours.

Hubert et al. (1999) analyzed niclosamide residues in sea lamprey ammocoetes exposed to Bayluscide in the laboratory to simulate conditions of a planned application in the St. Marys River, which connects Lakes Superior and Huron. They addressed concerns that common terns may receive harmful doses of niclosamide from feeding on sea lamprey ammocoetes killed by the treatment. It was concluded that a tern, with a body mass of approximately 135 grams, would have to consume approximately 2269 g of ammocoete tissue (1,801 ammocoetes), or 16.8 times its body mass, at one feeding, to receive the expected LD_{50}.

Since no impacts of significance have been noted for birds from direct exposure to Bayluscide formulations, none are expected from other ingredients in these formulations.

Because niclosamide is expected to kill some fish and aquatic invertebrates under treatment conditions, there could be a localized but temporary reduction in the food supply for several species of birds. Those potentially affected by late summer or early fall treatments include fish-eaters such as herons, kingfishers and mergansers and those which utilize invertebrates, including diving and puddle ducks. With regard to the latter group, it is well established that aquatic invertebrates are very important in the diets of breeding females and young ducks during the spring and summer (Bartonek and Hickey 1969; Krapu 1974; Landers et al. 1977). The relative importance of plant material in diets of some duck species increases in the fall. In others, such as the lesser scaup, invertebrates continue to be important (Bartonek and Hickey 1969). Invertebrates most frequently mentioned as important dietary components include snails, dipteran larvae, caddisfly larvae, dragonfly nymphs, aquatic bugs (Hemiptera), beetle larvae and scuds.

Fish mortalities from experimental program Bayluscide treatments on Lake Champlain deltas were expected to range from insignificant to moderate based on results of the 1982 and 1986 treatments in Seneca Lake (Engstrom-Heg 1983; Kosowski et al. 1987). Observed fish mortalities varied widely among the five Lake Champlain deltas treated during the experimental program, and primarily involved very small fish less than 4 cm in total length; it was concluded that the relative total biomass of fish killed was biologically insignificant (Fisheries Technical Committee 1999).

Minor losses of fish will have little or no impact on the food supply for fish-eating birds. Moderate losses will, at worst, have only a modest impact on food availability because such losses will quickly be replaced from nearby untreated sources, and birds will shift their feeding to areas unaffected by the treatments.

Invertebrate collections made in five delta areas in the summer of 1986 were generally characterized by a few taxa. Dominant forms included aquatic worms and dipterans, followed by snails and clams (Gruendling and Bogucki 1986). Each of these groups is sensitive to niclosamide (see Section VII.A.1.f.).

Gilderhus and Johnson (1980) concluded that Bayluscide treatments can be expected to have the following effects: significant short-term declines in aquatic worm and midge populations; moderate declines in microcrustaceans and molluscs with losses heavier among mussels than snails; and modest to no losses among the more tolerant invertebrates. Recovery of most of the organisms affected by treatments is expected to be fairly rapid (weeks to months), except for molluscs which may require a longer period. This expectation was consistent with the findings of Gruendling and Bogucki (1993a) in a post-treatment study of the Ausable and Little Ausable deltas (see Section VII.A.1.f.). Because a small fraction of the bottom of Lake Champlain is proposed for continued periodic treatment with Bayluscide granules, and these species are widely distributed in Lake Champlain, net impacts on invertebrate populations would be insignificant on a lake-wide basis (Lyttle 1996).

Trapping

Activities associated with spawning-phase sea lamprey trapping are expected to have no impacts on birds.

Barriers

Construction and operation of barriers are expected to have no impacts on birds.

k. Mammals

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

No adverse effects are expected to occur to mammals, either through direct exposure to treatment level concentrations of TFM or the TFM/niclosamide mixture, or by eating organisms, such as sea lamprey or other fishes, which are killed by TFM during treatment. Two major lines of evidence support this conclusion. The first is the results of laboratory studies on mammals which are described below. The second is the absence of field reports of adverse effects on mammals over the 40-year history of sea lamprey control (EPA 1999). Gilderhus and Johnson (1980) reported that no vertebrates other than fish and amphibians have been observed to be affected by lampricides. No mammals were observed to have been affected by TFM treatments in the Seneca and Cayuga Lake systems in New York (Hulbert 1983; Marsh and O'Connor 1986; Chiotti et al. 1987; Kosowski et al. 1987), or by Lake Champlain experimental program treatments (Fisheries Technical Committee 1999).

Mammalian safety studies required to meet EPA mandates are conducted under the supervision of the U.S. Geological Survey Upper Midwest Environmental Sciences Center at LaCrosse, Wisconsin (formerly known as the U.S. Fish and Wildlife Service National Fishery Research Laboratory). These studies were reviewed in EPA's Reregistration Eligibility Decision for TFM and niclosamide (EPA 1999). Major findings are summarized below:

______Dermal Toxicity

Applications of undiluted TFM formulation (37.9% active ingredient) to the abraded skin of New Zealand white rabbits for eight-hour intervals and repeated for five days each week for three consecutive weeks yielded no effects other than a slight thickening of the skin in the application area (WARF 1965). Similar studies have found that acute dermal toxicity is minimal, as indicated by a LD_{50}>2000 mg/kg (Lemen 1988a; Glaza 1990a). TFM produced slight skin irritation and caused eye irritation which was cleared within seven days after application (Lemen 1988b; Glaza 1990b, 1990c). TFM was not a dermal sensitizer (Glaza 1990d).

Oral Toxicity

Adult male rats weighing approximately 200 g each were dosed with TFM by gastric intubation. The acute LD_{50} was 1.01 g/kg over a 2-week post-treatment observation period (WARF 1962a). Lemen (1988c) and Glaza (1990e) found LD_{50}'s equal to 1.60 and 1.41 g/kg, respectively.

The MTD (maximum tolerated dose) of TFM for rats and hamsters was determined in four separate trials (WARF 1962b, 1971a, 1971b, 1971c). Formulations included purities of 30, 82.4, and 90% administered to animals in their water or diet for 90 days at dose levels ranging from 30 to 5,248 ppm. The highest exposure level of 5,248 ppm in the diet had essentially no measurable effect on body weight, food consumption, feeding efficiency, and other clinical data for all groups of males and females. This concentration is considered the MTD for TFM.

Chronic toxicity of TFM has been studied in rats, hamsters, and dogs (WARF 1975a, 1975b, 1973c). Animals that were fed 0, 300, 1,250 and 5,000 ppm of TFM for a two-year period developed normally. Lower feed consumption and consequently slightly lower body weights were noted for all three species, but only at the highest concentration of 5,000 ppm. No clinically significant differences were apparent among the different treatment groups regarding organ weights and histopathological evaluations.

Effects on Growth

Daily ingestion of TFM at levels of 5,000 ppm or more for 90 days, two years, and over three generations in rats and hamsters did not affect growth, health or survival. A slight depression in body weight was noted, perhaps because of taste avoidance. Dogs fed 5,000 ppm in their diet showed only a slight depression in body weight (WARF 1973c).

Physiological and Metabolic Effects

Radio-labeled isotopes were used to study the uptake and excretion of TFM in dairy cows. The dose given was equivalent to drinking 15 gallons of water containing 20 ppm TFM. This concentration is from 2-6 times greater than concentrations usually applied to streams. Most of the compound was excreted in the urine within 24 hours. Milk contained some TFM but the level had dropped by 80% at the second milking. At 26 hours after dosing, no residues were detected in the fat and only parts per billion levels were present in muscle, liver and kidney (WARF 1973a).

The acceptance of TFM-treated water to deer was evaluated by administering the larvicide in drinking water (Blouch 1957). The deer in one test had a choice of treated or untreated water and deer in another test had only treated water. The deer drank freely from both the treated and untreated water during 4½ days of confinement. The treatment level of 13 ppm of the larvicide had no apparent effect on the acceptance of the treated water. Cattle given the same concentration of TFM in drinking water did not show any harmful effects. However, they apparently objected to the taste because they drank less of the chemically treated water than control animals that were given untreated water (Dobias 1958).

Lactating dairy cattle were given drinking water in doses of 15 gallons per day that contained 20 to 60 ppm of TFM (WARF 1973b). Milk production and feed consumption were considered normal for the test subjects. No symptoms of toxicity or discomfort were observed. The urine from exposed cows was the major route of excretion. Levels ranged from 870 ppm at 9 hours post-treatment to 112 ppm at 19 hours post-treatment (WARF 1973a). Milk from exposed cows contained 0.55 to 0.995 ppm of TFM and related compounds at the first milking and 0.197 to 0.199 ppm at the second milking, suggesting that milk is a secondary route of excretion. Tissue levels of TFM and related compounds at 26 hours post-exposure were less than 10 ppb in fat, 10 to 19 ppb in muscle, 162 to 166 ppb in liver, and 702 to 721 ppb in kidney.

A study of the metabolism of TFM in rats revealed that TFM is rapidly excreted as free TFM, reduced TFM or a glucuronide conjugate. Urine is the primary route of excretion and approximately 60% of an injected dose of radio-labeled TFM was excreted in 24 hours (Lech 1971).

Reproduction

Possible effects of TFM and TFM/niclosamide on the reproduction of warm-blooded animals were evaluated in studies on rats and hamsters. Levels up to 5,000 ppm of TFM and 100 ppm niclosamide in the diet for 16 weeks prior to mating and fed daily through three generations, did not affect reproductive performance. Viability, survival, and growth were good in all three generations and litter sizes were normal. Fertility, mating, gestation, and lactation were not affected (WARF 1975d, 1975e).

Mutagenicity

The Ames microsomal mutagenicity test was used to test technical grade TFM (90% active ingredient) for mutagenic activity. Results were negative (WARF 1977).

Brusick (1988), following a review of data on the genetic toxicity of TFM, drew the following conclusions:

> TFM does not seem to be intrinsically genotoxic based on the results from three *in vitro* assays. Its clastogenic activity appears to be a compound-specific response related to the phenol nucleus of the structure. The effect also appears to be unique to *in vitro* methods and is not predictive of rodent chronic toxicity. The Ames test and the rat hepatocyte assay are both better predictors for chronic toxicity and they were both negative with TFM. I would recommend that TFM be subjected to one *in vivo* assay for clastogenicity. The rodent micronucleus would be suitable and if negative, should resolve any concern that might have developed as a result of the

positive *in vitro* assay. If the micronucleus assay produces positive results, concern for both carcinogenesis and heritable mutation would be increased and would require a) a test of the affects of TFM in a germ cell assay for mutation and b) a reassessment of the conclusions generated from the initial rat oncogenicity study.

Using the current toxicological assessments and the assumptions made regarding the mechanism of aberration induction by TFM in CHO cells *in vitro* and the low probability for genetic effects *in vivo*, I can see no reason to alter current use levels and application practices for treatment of sea lamprey with this agent.

The rodent micronucleus study recommended by Dr. Brusick was completed by Ivett (1989). This study concluded that TFM "did not induce a significant increase in micronuclei in bone marrow polychromatic erythrocytes under the conditions of this assay and is considered negative in the mouse bone marrow micronucleus test."

Cifone (1988) also found TFM to be negative for mutagenicity in an unscheduled DNA synthesis assay with primary rat hepatocytes. However, TFM caused a statistically significant and dose related increase in chromosomal aberrations, consisting of simple chromatid and chromosome breaks in a cytogenetic assay of Chinese hamster ovary cells (Murli 1988).

Teratology

Studies were conducted in rats and rabbits to determine if ingestion of TFM by pregnant animals would lead to birth defects in the offspring. Levels up to 125 mg/kg of body weight were given daily by gavage to rats during days 6 through 15 of pregnancy. Rabbits were dosed on days 6 through 18.

The results showed no teratological effects and no changes in the number of uterine implants, litter size, sex ratio, or fetal weights (WARF 1975c; Hazelton Raltech 1983).

Carcinogenicity

The question of whether or not TFM, or TFM/niclosamide, might cause cancer was addressed in long-term, multigeneration studies in which the animals continuously received the lampricides in their diet. Ninety-day, two-year, and three-generation studies were conducted in rats and hamsters. Dogs were used in a six-month study. No evidence of carcinogenic effects were observed in any of these studies (WARF 1971a, 1971b, 1971c, 1973c, 1975a, 1975b, 1975d, 1975e; Hazelton-Raltech 1983).

Although no information was found which specifically deals with the effects of TFM on horses, the lack of significant effects on cows, deer, dogs, hamsters and rabbits suggests that an exposure of horses or other farm animals to treatment levels of TFM poses no threat to them.

Effects of Other Constituents in the TFM Formulation

Isopropanol is the major inert ingredient in liquid TFM. Engstrom-Heg (1989) drew the following conclusion from his analysis of the available literature on isopropanol.

> Previous solubilizers used in the TFM formulation were dimethylformamide (DMF) and polyethylene glycol-200 (PEG-200). Isopropanol is intermediate between these two compounds in acute toxicity ..., but has fewer and milder sub-lethal and chronic effects than either. None of the three compounds, as used in a TFM treatment, poses a credible risk to aquatic or terrestrial wildlife, domestic animals or the general human population (Engstrom-Heg 1987, 1988).

An independent analysis of the literature on isopropanol was conducted by the New York State Department of Health (NYSDOH 1989). A letter of transmittal from Dr. John K. Hawley, Director of NYSDOH's Bureau of Toxic Substance Assessment to Mr. Herbert E. Doig, Assistant Commissioner for Natural Resources in DEC, noted that:

> Although isopropanol is not a highly toxic or environmentally persistent compound, its toxicological data base is inadequate to fully characterize the health risks associated with exposure. To improve this database, the US EPA recently proposed under section 4(a)(1)(B) of the Toxic Substance Control Act (TSCA) that manufacturers and processors of isopropanol be required to perform a variety of toxicological tests on isopropanol.
>
> Concerns about the limited data on the reproductive/developmental toxicity of isopropanol are supported by evidence that structurally similar short-chain alcohols (e.g., ethanol, n-butanol) are reproductive/developmental toxicants and that isopropanol is a developmental toxicant in rats at maternally toxic doses. In addition, results of a Russian reproductive study indicate adverse effects in rats given relatively low doses of isopropanol (0.18 mg/kg/day). Our confidence in this latter study is weak, however, because it was poorly designed and reported.

It was the New York State Department of Health's recommendation that:

> If isopropanol is used as the carrier in the Lake Champlain TFM formulations, public notification with respect to TFM and the above advisories should include a statement that there is limited evidence that isopropanol, the solvent/carrier in TFM formulations, has caused adverse effects on reproduction in rats. The notification should also emphasize that women of childbearing age should pay particular attention to the advisory statements because they may be at increased risk.

Based on findings of the above studies and other available data, EPA (1999) concluded that use of lampricides pose very little risk from either acute oral, acute dermal, subacute dietary exposure or chronic exposure to mammals. Effects of niclosamide that would be present in stream TFM/niclosamide treatments are presented in the following Bayluscide discussion.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

No adverse effects are expected to occur to mammals from exposure to niclosamide, either through direct exposure to treatment level concentrations or by eating organisms such as sea lamprey ammocoete which are killed during Bayluscide treatment. The major lines of evidence supporting this conclusion are the combined results of laboratory studies described below which indicate a high tolerance to high levels of this chemical, and the absence of reports of adverse effects to mammals resulting from field applications of this lampricide (Engstrom-Heg 1983; Kosowski et al. 1987; Fisheries Technical Committee 1999).

Dermal toxicity

Andrews et al. (1983) in their review of studies dealing with the toxicity of molluscicides, concluded that niclosamide, its ethanolamine salt and related formulations administered by various routes, including cutaneous contact and inhalation, has an extremely low toxicity to laboratory animals and man. Eye irritation effects were noted in some laboratory animals. Frost et al. (1988) found that niclosamide was a moderate dermal sensitizer on guniea pigs.

Oral toxicity

Rats and hamsters fed diets containing 0, 300, 1,250, and 5,000 mg/kg active ingredient daily for 90 days experienced no mortality. Treated rats lost weight at the two highest levels as did treated hamsters, but no other pathological changes were noted as a result of treatment (WARF 1974a, WARF 1974b). Dogs fed 62.5, 250 and 1,000 mg/kg active ingredient in their daily diet for 180 days exhibited no differences from controls in body weights, food consumption, hematology, blood chemistry or urinalysis (Proctor et al. 1974). Andrews et al. (1983) concluded that the following oral doses were tolerated without harmful effects: (1) niclosamide ethanolamine salt: dogs (both sexes) - 100 mg/kg body weight for 252 days; rats (both sexes) - 25,000 mg/kg of feed for 319 days; (2) niclosamide: dogs (both sexes - 100 mg/kg of body weight for 366-393 days; rats (both sexes) - 25,000 mg/kg in feed for 365 - 381 days. Hecht and Gloxhuber (1962) reported that LD_{50}'s resulting from oral administration of the ethanolamine salt of niclosamide exceeded 10,000 mg/kg for rats, 4,000 mg/kg for rabbits and 500 mg/kg for cats.

Niclosamide or its salts have been the drug of choice in many countries for treating tapeworm infestations in human and veterinary medicine since 1960. Treatment doses in dogs, cats, cows, sheep, goats and horses have varied from 50 - 750 mg/kg, depending upon the type of cestode to be controlled and the animal to be treated (Andrews et al. 1983). Results indicated extremely low toxicity of niclosamide and its formulations due to low absorption and rapid excretion.

Physiological and Metabolic Effects

Griffiths and Facchini (1979) found that in rats treated with 20 mg of ^{14}C-Bayer 2353, 51.5% was detected in the urine, 47.4% in the feces and 1.1% in the bile as various metabolites. The primary metabolite in urine was 2' 5-dichloro-4'-aminosalicylanilide. Duhm et al. (1961), as reported in Andrews et al. (1983), treated male rats with one oral dose of 50 mg/kg body weight with carbonyl-^{14}C-labeled niclosamide ethanolamine salt. Two-thirds of the dose was excreted in feces while about one-third was absorbed. The absorbed portion was excreted in the urine within 24 hours (half-life 6 hours) and the major excretion product was 2' 5'-dichloro-4'-amino-salicylanilide. Absorption and excretion patterns were the same for male rats given the same dose seven times. No accumulation of active ingredient was found in any organ.

A study on lactating cows (WARF 1976) given a dose 10 times higher than that which would be found in 15 gallons of treated water, indicated that residues in milk, blood, fat and muscle tissue were less than 10 *u*g/kg (ppb) after 24 hours. This was further confirmed in livestock studies reviewed by Andrews et al. (1983), who concluded that: "The residues in livestock and fish constitute no risk for the consumer because their levels are extremely low. This assessment is further corroborated by the low, limited absorption and rapid elimination in man."

Mutagenicity

A dominant lethal mutagenicity test with mice gave no indication of mutagenic effects (Machemer 1975) as reported in Andrews et al. (1983). Ames test studies showed no mutagenic effects of the ethanolamine salt of niclosamide when conducted without activation of mouse liver homogenates. A slight mutagenic effect was obtained in *Salmonella typhimurium* when liver homogenate was activated with Aroclor (Oesch 1977) as reported in Andrews et al. (1983). Lemma and Ames (1975) found no mutagenic effect for the 70% wettable powder formulation while MacPhee and Podger (1977) found no mutagenic effect for niclosamide using a modified Ames test. Cortinas de Nava et al. (1983) found mutagenic activity in two of five strains of *Salmonella typhimurium* in the urine of mice treated with niclosamide. Ostrosky-Wegman et al. (1984) found dissimilar responses in the frequency of cell aberrations (CA's) and sister chromatid exchanges (SCE's) in *in vitro* cultures of human lymphocytes from four healthy donors following exposure to niclosamide. Lymphocytes from two donors showed an increase in CA's and one showed a small increase in SCE's, together indicating weak mutagenic activity. Studies reviewed by Andrews et al. (1983) led them to conclude that niclosamide and its various formulations are free of relevant mutagenic effects in mammals. They also concluded that the finding by Oesch "must be evaluated in the light of the low rate of absorption and the rapid elimination of niclosamide ethanolamine salt in mammals which may be the reason why no mutagenic effects were seen in *in vivo* experiments. Unlike the situation within the animal, bacteria are exposed to much higher concentrations of the test compounds in the *in vitro* test and the contact with the test compound may also be more intimate." This assessment is supported by the studies of Crossen (1982) and Stevenson and Patel (1973) which indicate that lymphocytes suffer less damage when exposed to mutagens *in vivo* than *in vitro*.

A review of studies on the genetic toxicity of Bayluscide prepared for the Service (Brusick 1989) lead to the following conclusions:

> In my opinion, Bayluscide metabolites should be viewed as having genotoxic potential. The Ames data, *per se*, has low to moderate impact on a consideration of health effects because it represents a type of damage which should be readily repaired by normal organisms. The human lymphocyte results both *in vitro* and *in vivo* suggests that Bayluscide might induce chromosome damage, but individual variability in some important parameter (perhaps DNA repair) makes an unequivocal extrapolation of the effect to small populations impossible. The human clinical studies used dose levels that are probably far above those that would be encountered environmentally from use of Bayluscide as a lamprey deterrent and therefore may not be very relevant. Environmental exposures associated by the general population to water that has been treated for mollusks and lampreys would likely involve little or no genetic risk. However, exposures to those involved with carrying out water treatment might be worth determining and comparing the levels to those used clinically.

Brusick (1989) indicated that "clinical applications Bayluscide (generally designated niclosamide) are at the level of an initial oral dose of 1-2 gm of the material followed by a daily dose of 0.5 gm for 6 or more days." He also suggested the worst case environmental exposure should be compared to clinical exposures and "if there is a suitable safety factor (approximately 100), the effects observed clinically are probably not relevant." Such a comparison is made in Table VII-28 using maximum levels of niclosamide observed at specific intervals in Lake Champlain water samples collected during the1991 treatment of the Little Ausable River Delta (see Table VII-3) at 100 lb/acre of the 5% granule formulation (active ingredient equivalent to 156 lb/acre application rate for the current 3.2% granule formulation), and daily human consumption of two liters of water. It is clear that the intake of niclosamide by a person drinking water treated at the rate allowed under the EPA registration would be very low compared to clinical doses.

Staff of the Bureau of Toxic Substance Assessment and NYSDOH were asked to review the Brusick (1989) report to determine if it would lead to a change in water-use advisories previously recommended by DOH for Bayluscide. DOH responded that "Staff have reviewed the report on the genetic toxicity of the lampricide Bayer 73 (Bayluscide) which you sent with your letter of February 8, 1990. This information provides no basis to change our Lake Champlain water use advisories for Bayer 73."

Table VII-28. Comparison of maximum observed niclosamide concentrations from the 1991 Bayluscide 5% Granular application in the Little Ausable Delta (Gruendling and Bogucki 1993a) with human oral clinical doses described in Brusick (1989), assuming daily human consumption of 2 L of water.

Time after Bayluscide Application	Clinical Dose (mg)	Highest Delta Concentration (mg/L)	Amount of Bayluscide in 2 L of water (mg)	Safety Factor
Initial (3 h)	1,000	0.627	1.254	797
24 h	500	0.424	0.848	590
48 h	500	0.146	0.292	1,712
72 h	500	0.061	0.122	4,098

Murli (1995) found no evidence of chromosome aberrations in mouse bone marrow cells following single niclosamide doses of 1,250, 2,500 or 5,000 mg/kg. Cifone (1995) found no increase in mutant frequency in mouse lymphoma cells cultures *in vitro* from niclosamide doses of 2.5 *u*g/ml up to cytotoxic doses (25.0 *u*g/ml in absence of mammalian metabolic activation, or 40 *u*g/ml in the presence of mammalian metabolic activation).

Teratology

Rabbit studies revealed that niclosamide did not affect fetal body weights or cause malformations when administered at doses of up to 180 mg/kg between days 8 and 18 of pregnancy (Dyck and Chappel 1975). A dose of 140 mg/kg administered from days 6-16 of pregnancy was not embryotoxic according to Levinsky and MacFarland (1974). Two unpublished studies reported in Andrews et al. (1883) [Harper and Palmer (1965) and Lorke (1964)], found no embryotoxic or teratogenic effects when niclosamide was orally administered on a number of days to pregnant rabbits and rats at doses of 1000 mg/kg of body weight.

Carcinogenicity

Studies reviewed in NRCC (1985) conclude that there is no evidence of increased incidence of tumors in rats and mice treated with high doses of niclosamide. Andrews et al. (1983) conclude that there was no evidence of tumor induction resulting from animal and human exposure to niclosamide or its various formulations.

Human Effects

Niclosamide is used worldwide in human and animal health as an antihelminthic and as an extremely effective molluscicide in the control of snails, which serve as vectors of schistosomiasis. The latter is a widespread trematode infection that afflicts more than 200 million people in over 70 countries (Andrews et al. 1983).

A number of studies report on dosages of niclosamide used for tapeworm control in humans. Gonnert (1961) reported that since its introduction in 1960, Yomesan (niclosamide) has been used in the treatment of many millions of human tapeworm cases. For treating most tapeworm infections in humans, he recommended the use of a dosage of 30 mg/kg of body weight, or single oral doses of one gram for children of 2 to 6 years of age and two grams for persons 6 years and older. In one study in the U.S., Perera et al. (1970) used doses ranging from two grams for one day to two grams for each of 5-7 days for patients 125 lb and heavier. Different doses were used to insure effectiveness because niclosamide is a safe, simple and effective agent against human tapeworm infections. Most et al. (1971) reported no signs of intolerance or toxicity in 62 children treated with 40 to 80 mg/kg per day for 5 days. Adults (both sexes) treated once or twice with 1000 mg niclosamide/person and children (6-15 years) given doses of 750-1000 mg niclosamide/person showed no signs of intoxication (Hecht and Gloxhuber 1960; Harinasuta and Bunnag 1972 as cited by Andrews et al. 1983). The study by Harinasuta and Bunnag provided no evidence of damage in liver and kidney function tests, urinalysis and hematological tests. Andrews et al. (1983) indicate that no report of damage to humans had ever been received from use of a treatment dose of two grams per adult or child over 6 years of age since use of niclosamide as a cestocide in humans was started more than 20 years prior.

The risk to humans from drinking water and eating fish containing niclosamide residues can be put into perspective by comparing the maximum concentrations found in water (573 ppb) and fish (858 ppb) during the Seneca Lake study (Ho and Gloss 1987) and the single oral treatment doses in humans of one gram for 2-6 year old children and two grams for persons older than 6 (Gonnert 1971). To reach the treatment dose of one gram, a young child would have to consume, at one sitting, either 1,844 quarts of water or 2,568 pounds of fish containing the maximum residue levels observed in the Seneca Lake study. Older persons would have to consume either 3,688 quarts of water or 5,139 pounds of fish containing the maximum concentrations observed in the Seneca Lake study to reach the two gram dose. Because the Bayluscide 5% Granular formulation was applied to Lake Champlain deltas during the experimental program at the same rate used in Seneca Lake (and measured concentrations in water were similar or slightly higher in Lake Champlain; see Tables VII-3, VII-4 and VII-10), and proposed future treatments with Bayluscide 3.2% granules will be applied to achieve the same levels of active ingredient, there is no reason to believe that concentrations in water and fish would be substantially different in Lake Champlain than in Seneca Lake. The comparisons are therefore reasonable.

In their assessment of risks for users, Andrews et al. (1983) concluded:

> The active substances niclosamide and niclosamide ethanolamine salt as well as their formulations are of an extremely low toxicity to many laboratory animals and man. This holds especially for those types of exposure relevant for the user, e.g. cutaneous contact and inhalation. Additionally it has been shown that the absorption is low even after oral application of high dosages to either man or animals. Furthermore, elimination of the absorbed fraction is very rapid (1-2 days). The active substances were free of cumulative effects and were also of low

> toxicity in long term studies. There were no significant indications of mutagenic or embryotoxic effects, nor was tumor induction observed. No skin irritation was observed in man, although this could be provoked in animals after very long exposure. Eye irritant effects were seen in animal experiments ...

Elsewhere they stated: "It is concluded that the use of niclosamide or of niclosamide ethanolamine salt as a molluscicide or of niclosamide as a drug in either human or veterinary medicine is without risk to the health of the user, consumer or livestock." Following review of the literature cited above, as well as other studies, EPA (1999) determined that human risks from exposures to niclosamide do not exceed levels of concern for the currently registered uses.

Effects of Other Constituents of the Bayluscide Formulation

Adverse impacts on mammals, if any, from other ingredients in the Bayluscide 3.2% granule formulation, are a component of the overall adverse impact of this product on reptiles. Since none have been noted over the history of Bayluscide use, none are expected.

Trapping

Activities associated with spawning-phase sea lamprey trapping are expected to have no impacts on mammals.

Barriers

Construction and operation of barriers are expected to have no impacts on mammals.

l. User Conflicts

Increased Angler Use

Improved angling opportunities in Lake Champlain, both quantitatively and qualitatively, would be anticipated for landlocked Atlantic salmon, trout and some other game fishes as the effects of sea lamprey control stimulate survival and growth of these populations. Increases in sport fishing activity and angler usage of Lake Champlain facilities would be expected to develop as: (1) individual anglers now fishing Lake Champlain and tributaries begin to fish more frequently and as (2) additional anglers who currently are not fishing these waters are attracted to improved angling opportunities.

Adverse Impacts of Growth From Sportfishery Development

A critical element in the success of the sea lamprey control program will be the establishment of sufficient, available infrastructure capacity to meet the needs of current and future anglers. The extent to which public and private infrastructure should expand depends on the additional growth of the sportfishing activity and angler usage of Lake Champlain facilities. The 1997 Lake Champlain Angler Survey (Gilbert 1999b) indicated that there were 3.8 million angler trips to Lake Champlain in 1997 and that there would be a 31% expected increase in annual number of trips if sea lamprey control continued. Based on the survey methodology used by Gilbert (1999b), this number of fishing trips may not necessarily represent separate fishing trips. For instance, an angler may have fished specifically for lake trout, salmon, steelhead and brown trout on the same day and this outing would thus be counted as four trips. The actual number of separate 1997 trips and the estimated expected increase in fishing pressure are more likely to be lower than these findings would suggest. The survey methodology for this study did account for anglers targeting multiple species in the estimation of economic value, however.

Growth in the recreational fishery may be reflected in the sale of fishing licenses. The Service's 1996 survey of fishing license sales indicate that in New York, as well as nationally, the number of fishing licenses sold has not changed significantly since 1991 (USFWS 1997). Vermont, however, had experienced a decline of 17% over the same period, and from 1990 to 1999, the number of fishing licenses sold in Vermont has declined 15%. This data suggests that the total number of anglers fishing Lake Champlain may remain fairly stable in the near future, but it is reasonable to expect anglers to fish more often if the quality of the fishery substantially improves.

Competition and Sharing

It has been demonstrated that decreases in sea lamprey parasitism resulted in increased survival of salmonids (Fisheries Technical Committee 1999). With increased survival, migratory salmonid runs into tributaries are expected to increase. There will be some places within these tributaries such as at barriers, where migrating salmonids will congregate, attracting anglers and increasing the chances of angler, and occasionally landowner conflicts. It is also expected, however, that other tributaries may attract more salmonids as the abundance of adult salmonids in the lake increases. Fishways on some of the tributaries are being planned and the upstream passage of salmonids will provide additional fishing opportunity to stream anglers. These new locales will help to spread the fishing pressure over a greater area, thereby reducing angler density and decreasing conflicts.

There may also be an increase in spring salmonid fishing pressure in some tributaries simultaneously with other non-salmonid fisheries such as walleye. However, most of the spring salmonid tributary fishery will occur where other fishing angling opportunities are limited. Section V.F.3. provided additional analysis suggesting that serious problems relative to the use of restaurants, motel rooms, boat launching sites and other amenities is not anticipated. Also see the discussion of infrastructure capacity in Section VII.A.6.e.

Government Services

The general population of the region may continue to grow, which will create a need for increased law enforcement, refuse disposal, sewage treatment facilities, parking space development or other public services. These services will increase regardless of the Proposed Action or other fisheries management activities, and there should not be a need to increase these services solely as a result of this program. Minor additional increases in rescue, medical and firefighting staff, equipment training and facilities may be needed as seasonal use of improved fisheries increases. See Section VII.A.6.e.

Trespass and Safety

The increase in total angling activity which results from this program is not expected to have a substantial impact associated with trespass and safety. The FEIS discussed the need for anglers/boaters to get to the water efficiently and safely. Owners of tow vehicles, trailers, recreational vehicles and autos expect secure, safe parking areas. If facilities are not available, inevitable problems with trespass across private lands and unsafe parking along public roads could occur. Boats, vehicles and trailers could be damaged while users attempt to launch and retrieve boats at inferior sites. News of excellent fishing could tempt anglers to boat or wade in potentially dangerous weather or water conditions. Incidents such as these have occurred in the past and will continue to occur at some level regardless of specific fisheries management actions taken. The impacts of the experimental program on these issues was insignificant and similar impacts as a result of the Proposed Action are not expected to be different.

Resource User Group Conflicts

Population growth and increased use of Lake Champlain's resources could create conflicts between groups such as anglers and other boat launch and/or marina users. These conflicts will likely increase in spite of this program. Lake access area expansion and/or improvements are planned regardless of implementation of the Proposed Action. Marinas have limited capacity and competition for dock space and services already occurs. Expected benefits of the Proposed Action may cause increases in that demand and these conflicts will continue to exist until desired services can be provided. The demand for additional lodging caused by this program should not put an increased burden on the existing capacity. Section V.F.3 provided additional analysis suggesting capacity problems relative to restaurants, motel rooms, and boat launching sites are not anticipated.

In addition to the above, some groups and/or individuals who may be considered users of stream resources philosophically disagree with the sea lamprey control program or aspects of it. Some feel that their long-term use and enjoyment of certain streams may be negatively impacted by the program, and are concerned that lampricide treatments may compromise a stream's ecosystem integrity and values an educational resource. Measures to minimize potential environmental impacts of the Proposed Action are discussed in Section VII.2.

Growth and Environmental Impact

Construction of new facilities can have significant adverse environmental impacts if not properly planned, built and monitored. Of particular concern are increased non-point source runoff from developed land, the potential for diminished aesthetic values of Lake Champlain communities and landscape, inadequate sewage treatment and wetland encroachment. Preferred areas for marina development are often found in protected estuaries or embayments where wetland or productive littoral areas could be impacted. Lodging accommodations concentrate many people in small areas where sewage treatment may pose engineering challenges. Inadequate local zoning may permit improper construction of facilities to quickly meet the demand, but which could ultimately cause adverse environmental impacts and discourage more compatible and desired development over the long term. These are all potential problems that may occur regardless of implementation of the Proposed Action.

2. Mitigating Measures

a. Water

Stream and Delta Lampricide Treatments

Chemical Treatment Methods

Initial training and assistance from the Service’s Great Lakes sea lamprey control staff and experience gained during the eight-year experimental sea lamprey control program has allowed Lake Champlain sea lamprey control personnel to become proficient in conducting lampricide treatments. A total of 24 TFM stream treatments on 14 streams and nine applications of Bayluscide granules to five deltas were conducted during the program. Since termination of the experimental program in 1997, eight TFM treatments have been conducted on eight Lake Champlain tributaries in New York. Members of the NYSDEC Lake Champlain staff have also assisted with several Finger Lakes TFM tributary treatments.

Future lampricide treatments will be conducted by personnel from the Service, NYSDEC and VTDFW. All personnel handling and applying lampricides in Vermont, New York or Quebec must meet pesticide applicator certification requirements in the respective jurisdictions. Any use of the TFM/niclosamide combination in stream treatments will be initially conducted under direct on-site supervision of Service staff experienced in this form of application from the Great Lakes sea lamprey control program. Lampricide application and monitoring procedures will follow Great Lakes Fishery Commission standard operating procedures (Klar and Schleen 1999). Following these procedures will ensure that lampricide concentrations will remain within effective and restrictive ranges, while minimizing the risk of impacts to nontarget species. Low-level lampricide concentrations are monitored in treated waters in accord with a lampricide monitoring plan developed by Neuderfer (1989) which is currently under consideration for revision based on experience gained during the experimental sea lamprey control program (1990-

1997) and during New York's 1998-2000 treatments.

Bayluscide delta treatments and monitoring will be directed by New York State personnel who are fully trained and experienced with Bayluscide treatments on Lake Champlain. Personnel from the Service and the Vermont Department of Fish and Wildlife will assist in supportive activities associated with Bayluscide treatments.

Empty TFM containers will be triple rinsed or rinsed with an automated container-washer and properly disposed of in an approved landfill or returned to the manufacturer for recycling. Disposal of these and other lampricide containers will be consistent with the requirements of federal and state regulations. Lampricide dispensing equipment and gear will be thoroughly rinsed at application sites.

Storage, Accidental Spillage and Contingency Plans

No accidental lampricide spills occurred during the eight-year sea lamprey control program. TFM is a liquid formulation that is packaged in heavy-duty five gallon plastic drums. The plastic drum and its TFM product weigh a total of 53.5 pounds. TFM bars are individually packaged and weigh approximately two pounds each. Bayluscide 70% Wettable Powder formulation is packaged in two sizes of plastic packages, that weigh either one-half or three pounds. Bayluscide 3.2% granules are packaged in plastic pails containing 50 pounds of formulated product. This type of packaging, moderate container size, stacking restrictions and the use of pallets significantly minimizes the likelihood of accidental spillage of either lampricide during storage, transport or handling.

A heated building at Ray Brook, New York which meets New York State pesticide storage guidelines is utilized for bulk storage of TFM formulations and may be used for potential future storage of Bayluscide 20% Emulsifiable Concentrate. This facility has the capability to contain an accidental spill if it occurred within or at the storage building. Bayluscide 3.2% granules and 70% Wettable Powder formulations may be stored both in this building and nearby facilities. Accidental spills would be mitigated by the implementation of the *Contingency Plan for Accidental Spillage of Lampricides During Lake Champlain Sea Lamprey Control Operations* (Durfey 2001). Each vehicle carrying TFM also has a copy of the spill contingency plan, absorbent materials, tools (shovels, brooms, etc.) and protective clothing to handle a spill if one occurred during transportation. The spill contingency plan calls for immediate steps to stop and contain the spilled lampricide at its source and notification of the NYSDEC Spill Response Program for spills in New York, or the VTDEC Hazardous Materials Management Program, Vermont Department of Agriculture and Vermont Department of Health for spills in Vermont. If a spill occurs near, or into a water body not scheduled for immediate lampricide treatment, the spill plan specifies taking immediate action to prevent or minimize movement into the waterway. Also, the spill plan requires immediate notification and consultation with the State/County Health Office and issuance of an emergency advisory on water-use restrictions at, and downstream of the spill location. Other actions are also specified in the spill contingency plan to mitigate the impacts of accidental spills. There were no spills of lampricides that required activation of the spill contingency plan during the experimental program, or in association with the later TFM treatments in New York .

Human Exposure

Procedures to minimize contact with lampricide-treated water will be accomplished by implementing the requirements of the following plan.

Prior to the eight-year experimental sea lamprey control program, a water supply survey was conducted by NYSDEC and VTDFW. Riparian landowners within the predicted lampricide treatment and plume areas were contacted to determine their source(s) of drinking/cooking, livestock watering and irrigation/dairy processing water (Sausville et al. 1988). Survey findings were used to develop New York and Vermont's *Prior Notification, Posting and Water Supply Plan* (Durfey 1990, 1998; Johnston 1990; Chipman 2001) which detail procedures for meeting drinking water needs of stream and lake shore property owners who would be otherwise impacted by lampricide treatments.

This plan calls for project sponsors to update a list of potentially affected landowners from tax rolls, and complete a new water-user survey of every riparian landowner at least one month prior to each scheduled control treatment. This will continue as part of the Proposed Action. All potentially affected riparian landowners, as well as other identified, vested or consumptive water users will be sent a letter approximately 15 days before a scheduled treatment that will describe the intent to treat and the impending water-use advisories. These advisories recommend no drinking or other household water uses, no swimming, no fishing, no irrigation and no livestock watering in or with the treated water until analyses indicate that TFM concentrations have dropped below the threshold level (20 ppb). Advisory periods for previous treatments ranged from 2-6 days in most streams, but lasted up to 12-14 days for lake shore users associated with treatments of the Poultney/Hubbardton River, Mt. Hope Brook and the Great Chazy River, due to larger or longer lasting TFM plumes in these lake shore areas.

Households identified in the water user survey that withdraw lake or river water for drinking and other household purposes will be notified door-to-door by project personnel during the week of scheduled treatments. They will be asked if they need drinking water, and, if so, a supply of commercially bottled water will be provided free of charge. A printed notice and water will be left at each residence. The notice includes the exact water-use advisories and a toll-free number to call for additional drinking water or advisory updates and information. Water for household purposes other than drinking/cooking will be furnished from centrally located, bulk water tankers. Locations of these tankers will be provided to landowners during the door-to-door notification process.

Beginning approximately two weeks prior to treatment, staff will personally contact agricultural users of water that is withdrawn from any stream or lake area scheduled for treatment. These water users will be provided schedule and advisory information. Landowners will be asked if they need delivery of water for their livestock and if they need temporary electric fencing to restrict livestock from access to treated water. To avoid unnecessary adverse impacts on agricultural crops, use of water during treatment for agricultural irrigation and spraying, as well as garden watering will be advised against for as long as TFM is >20 ppb and for four days following Bayluscide application (See following Bayluscide advisory discussion.).

Public notification of treatments and water-use restrictions will be conducted via paid newspaper advertisements and voluntarily cooperating broadcast media. Advisories developed in consultation with the New York State and Vermont Departments of Health will be publicized to minimize the potential for public contact with lampricide. Project staff will post water-user advisories at public access sites in affected areas beginning about 24-hours prior to actual treatments. Voluntary broadcast media announcements and updates on the toll-free “hotlines” of both New York and Vermont will be used to notify the public of the expiration of water-use advisories. Project staff will attempt to personally contact representatives of households that had their potable water supplies impacted by treatments and inform them of the expiration of water-use advisories. These households will be given a notice explaining the advisory expiration, or if no one is home, a notice will be left on their door.

The New York State Department of Health has concluded in 1987 that “...The toxicological literature indicates that exposure to TFM- or Bayer 73-treated water (after proper use) should not be associated with adverse health effects.” The Vermont Department of Health stated in 1989 “...It is our opinion that if TFM and Bayer 73 are applied and monitored as outlined in the draft EIS and draft aquatic nuisance control permit, and if the current landowner and public notification procedure is followed, there will be negligible risk to the public health.”

No municipal water supply was exposed to treatment or diluted levels of TFM during the eight-year experimental sea lamprey control program. The Essex County, New York fish hatchery on Putnam Creek was exposed to TFM in 1994. Treatment impacts to the water supply were successfully mitigated when New York treated the stream independently in 1998 by applying TFM below the hatchery intake. Table VII-1 summarizes public water supply systems, impacts and mitigation during lampricide treatment.

A total of 1,208 private water users were identified through riparian landowner surveys in treatment areas (Table VII-29). Forty-eight percent of the users requested alternative drinking water. A total of 5,071 gallons on bottled drinking water was provided to these users. Water was provided to farms that needed it for livestock. Overall household use of the bulk water was very low.

The water-user summary in Table VII-29 excludes water requested and supplied for industrial and agricultural purposes. For instance, the Georgia-Pacific paper mill was supplied with approximately 5 million gallons of process water per day via the city of Plattsburgh’s municipal water supply during each day of the advisory periods associated with TFM treatment of the

Saranac River and Bayluscide treatment of the Saranac River Delta. The high cost of pipeline construction and water usage fees were funded by NYSDEC. A substantial supply of bulk water was also provided to agricultural users on many tributaries. One of the larger consumers was a 550-head dairy cattle herd, supplied by fish hatchery pump truck on a two- to three-times daily, as-needed basis during each treatment of the Great Chazy River.

During the 1992 Saranac River TFM treatment, potential exposure to Georgia-Pacific's paper mill water supply intake was mitigated by temporarily connecting the mill to the City of Plattsburgh's water supply. A lampricide treatment of the Pike River may impact Philipsburg, Quebec's water supply, and mitigating measures such as installing an activated carbon water filtration system may be necessary.

Several public beaches could be affected by lampricide treatments (Table VII-2). Access points to public beaches within lampricide plume areas will be posted with advisory signs.

The following additional actions, based upon recommendations from the New York State and Vermont Health Departments, will be employed to minimize exposure to the lampricides and to mitigate water-use impacts.

<u>TFM and TFM/Niclosamide Combination in Streams</u>: Toxicological data indicate dermal exposure to lampricide-treated water at anticipated concentrations will not result in any adverse health effects (see Section VII.A.1.k.). Advisories will be issued against the use of water for drinking and cooking, swimming, fishing, livestock watering, and irrigation until 24 hours after the lampricide plume has passed and reached a concentration of 20 ppb or less. The niclosamide fraction of any TFM/niclosamide combination treatment (0.5 to 2.0% of the total amount of active ingredient) would be below detection levels when TFM concentrations reach 20 ppb or less. Therefore, any advisory due to niclosamide levels in a combination treatment could be lifted simultaneously with a TFM advisory. Provisions will be made to provide ample supplies of free bottled water for these uses to persons whose supplies are exposed to lampricides and who request this service. Centrally located bulk supplies of tanker-transported water, will be available for impacted stream water users wishing to avoid use of treated stream water for non-drinking purposes. Lampricide concentrations will be monitored as described in Neuderfer (1989) unless this plan is revised and a new version is approved by the state health departments.

In addition to restrictions on water use during the period of time that lampricide is likely to be present at TFM concentrations equal to or greater than 20 ppb, the advisories will include a statement that there is limited evidence that isopropanol, the solvent in the TFM formulation, has caused adverse effects on reproduction in rats and therefore, that women of childbearing age should pay particular attention to the advisory statements because they may be at increased risk.

Table VII-29. Summary of water users, alternative water requests, water provided, and duration of water-use advisories for the eight-year experimental sea lamprey control program.(1990-1997).

Year River/Delta	**No. of Water Users**	**No. of Drinking Water Requests**	**Water Provided (gal.)**		**Duration of Water-use Advisories (days)**	
			Drinking	**Bulk**	**Stream**	**Lake**
1990						
Salmon River					3	3
Little Ausable R.					6	5
Ausable River					4	5
Overlap Zone[a] (for above 3 rivers)	70	60	450	800		
Boquet River	23	7	57	400	2	2
Beaver Brook	18	4	30	400	4	3
Putnam Creek New York	20	3	24	400	5	4
Putnam Creek Vermont	4	0			NA	4
Lewis Creek	85	54	648	5,000	2	4
1991						
Saranac Delta	51	24	226		NA	4
Salmon Delta					NA	4
L. Ausable Delta					NA	4
Ausable Delta					NA	4
Overlap Zone (for above 3 deltas)	59	53	450	1,200		
Boquet Delta	19	6	67	400	NA	4
Mt. Hope Brook	15	3	15	400	combined stream/lake: 10	
Stone Bridge Bk.	6	0	0	1,300	2	6

[a] Salmon, Little Ausable and Ausable Rivers are so close to each other that their advisory zones overlap and cannot be separated. Information for these rivers is listed below the individual rivers/deltas, in rows designated "overlap zone". The "overlap zone" rows contain totals for the whole area.

Table VII-29 (continued).

Year River/Delta	No. of Water Users	No. of Drinking Water Requests	Water Provided (gal.)		Duration of Water-use Advisories (days)	
			Drinking	Bulk	Stream	Lake
1992						
Great Chazy River	149	62	972	1,600	upper river:[a] 10 lower river:[a] 12	10
Saranac River	60	36	452	400	2	5
Poultney River New York	21	2	30		upper river:[b] 2 lower river:[b] 6	s. lake:[b] 14 n. lake:[b] 15
Poultney River Vermont	47	4	168	1,200	upper river:[b] 2 lower river:[b] 6	s. lake:[b] 14 n. lake:[b] 15
Hubbardton River	see Poultney River					
1994						
Salmon River					3	4
L. Ausable River					5	5
Ausable River					4	5
Overlap Zone (for above 3 rivers)	56	52	696	800		
Boquet River	24	14	168	400	2	4
Putnam Creek New York	18	0	0		5	4
Putnam Creek Vermont	11	6	48		NA	4
Lewis Creek	134	36	570	2,000	2	6

[a] "Upper river" refers to river section between dam in Mooers and Old Waterworks Dam (OWD) ~ 1 mi. upstream of Village of Champlain, "lower river" refers to section between OWD and Lake Champlain.

[b] "Upper river" refers to section between Carvers Falls and confluence of Hubbardton River, "lower river" refers to section between Hubbardton River confluence and outlet of South Bay, "s. lake" refers to Lake Champlain between outlet of South Bay and Dresden/Putnam town line, "n. lake" refers to Lake Champlain between Dresden/Putnam town line and Ticonderoga Ferry crossing.

Table VII-29 (continued).

Year River/Delta	No. of Water Users	No. of Drinking Water Requests	Water Provided (gal.)		Duration of Water-use Advisories (days)	
			Drinking	Bulk	Stream	Lake
1995						
Saranac Delta	9	6	94		NA	4
Salmon Delta					NA	4
Ausable Delta					NA	4
Overlap Zone (for above 2 deltas)	49	45	612	800	NA	
Boquet Delta	19	7	120	400	NA	4
Mount Hope Brook	12	9	72		combined stream/lake: 11	
Trout Brook	27	21	252	800	2	3
1996						
Great Chazy River	135	62	1,236	1,600	upper river:[a] 7 middle river:[a] 4 lower river:[a] 5	lake: 11
Poultney River New York	21	3	78	2,400	6	s. lake:[b] 15 n. lake:[b] 15
Poultney River Vermont	46	7	244	600	6	s. lake:[b] 15 n. lake:[b] 15
Hubbardton	see Poultney River					

[a] "Upper river" refers to section between bridge in Mooers and Rt. 11 crossing at Twin Bridges, "middle river" refers to section between Twin Bridges and Old Waterworks Dam (OWD), "lower river" refers to section between OWD and Lake Champlain.

[b] "S. Lake" refers to Lake Champlain between outlet of South Bay and Dresden/Putnam town line, "n. lake" refers to Lake Champlain between Dresden/Putnam town line and Ticonderoga Ferry crossing.

TFM and TFM/Niclosamide Combination in Lake Deltas: Dye plume study findings by Myers (1987a, 1987b) and Laible and Walker (1987) established water-use advisory zones (where TFM concentrations can be expected to temporarily exceed 20 ppb) within a radius of 0.5 to 4.0 miles from the mouths of most treated streams (Table VII-30). Dye plume studies will also be conducted in new streams proposed for lampricide treatment, to establish appropriate water-use advisory zones prior to obtaining permits for treatment. Advisory zones may also be estimated for some of the smaller streams if dye study data is already available for streams of similar flow and surrounding lake shore characteristics.

Household water will be made available to lake shore users whose potable water supplies could be exposed to lampricides within these zones. Advisories will be issued for the use of water from the lampricide plume area in the lake for drinking and cooking from the time that lampricide is detectable at the stream mouth and continue until 24 hours after no part of the plume exceeds 20 ppb. Provisions for potable water use and TFM monitoring will be the same as outlined above for streams. Decreases in the advisory distances north or south of some tributaries may be proposed in the future based on actual TFM treatment plume data. State health department approvals would be obtained before reducing any advisory areas. The inconvenience of water-use advisories may be mitigated for some riparian landowners by scheduling treatments of the Salmon, Little Ausable and Ausable Rivers within a short time interval in the same year. This will reduce the duration and frequency of advisories for those water users in a zone where advisory areas for these three tributaries overlap.

Bayluscide 3.2% Granules: The routes for human exposure to niclosamide are the same as for TFM (see Section VII.A.1.a.). Use of water from the plume area for drinking and cooking purposes will be advised against during and for four days after treatment except for the Little Ausable Delta where concentrations above 20 ppb have persisted for five days following treatment. The NYSDOH advised that water from the niclosamide plume should not be used for other household purposes until 48 hours after application. To simplify our advisories, however, we have maintained a four-day advisory period to coincide with the drinking and cooking advisory. Therefore, persons in affected lake areas who wish to further minimize low-level exposure will be provided with centrally located bulk supplies of tanker transported water for non-drinking purposes for four days following treatments.

The public will also be notified of the potential for low-level exposure from consuming fish caught in Bayluscide treated areas within 14 days of treatment. The public will be advised not to swim or fish in Bayluscide treated lake areas associated with potential exposure to low levels of niclosamide for approximately four days thereafter. The NYSDOH recommended only a 48 hour advisory, but again this has been conservatively extended to simplify the overall advisory. Advisories will be handled in the same manner as previously discussed for TFM and TFM/niclosamide. Advisories will be issued regarding the use of water from the plume area for drinking and cooking purposes during and for four days after treatment. Provisions will be made to supply bottled water or other alternative supplies for these purposes to lake-water users whose intakes are exposed to niclosamide will be made. Bayluscide treatments of the Salmon, Little Ausable and Ausable Deltas would be scheduled within a short time interval of the same year to reduce the duration and frequency of associated advisories for riparian water users in overlap areas.

Limited application of Bayluscide 3.2% granules may be proposed in estuarine areas of certain tributaries (See stream-specific discussions in Section VIII). It is likely that water-use advisories presented in the previous discussion of delta Bayluscide applications will be used, pending appropriate regulatory approvals.

Table VII-30. Projected exposure areas for streams treated with TFM during the experimental sea lamprey control program. Exposure areas for additional streams considered for lampricide treatment will be determined prior to obtaining regulatory approval for treatment.*

Stream	Maximum Projected TFM ≥ 20 ppb Exposure Area (mi)[a]		
	Stream	Lake North	Lake South
Great Chazy River	20.6	2 (2.5)*	4 (4.5)
Saranac River	3.3	2 (2.5)*	3.5 (4.0)
Salmon River	4.0	2	2
Little Ausable River	6.1	2	2
Ausable River	6.0	2 (2.5)*	2.5
Dry Mill Brook	0.5	-	-
Boquet River	2.6	2 (2.5)*	2 (2.5)
Beaver Brook	2.5	0.5	0.5
Putnam Creek	4.8	1.5 (2.5)*	1
Mt. Hope Brook	1.3	4 [b]	-
Poultney River	10.5	20 [c]	-
Hubbardton River	2.0	-	-
Lewis Creek	9.4	1.5	1.5
Trout Brook	1.3	0.5	0.5
Stone Bridge Brook	2.9	1	1

[a] Based on Laible and Walker (1987), Myers (1987a, b) and Neuderfer (1989). Lake mileages are radii from stream mouth.

[b] South Bay.

[c] Twenty miles north from outlet of South Bay.

* **Special note:** As a result of negotiations between the NYSDEC's Project Sponsor and regulatory review groups TFM exposure areas were increased for the Great Chazy River, Saranac River, Ausable River, Boquet River and Putnam Creek (north only) beginning with treatments conducted in 1998. Numbers in parentheses represent adjusted boundaries.

Treatment Personnel Precautions

Direct contact by treatment personnel with TFM, TFM/niclosamide, or Bayluscide granules during handling and application will be avoided. Use of protective clothing, gloves, protective glasses, face shields and respiratory masks will be in accordance with lampricide labeling requirements.

Trapping

No mitigation is necessary as water or human impacts associated as a result of trapping spawning-phase sea lamprey are negligible.

Barriers

Mitigation to reduce flooding potential and minimize impoundments created by low-head barriers may include levees and stream bank stabilization. Careful planning to design the lowest possible effective barrier generally results in little flood risk. During non-operating periods, slide-gates, if present, can be removed to reduce or eliminate any water impoundment. The same effect will be accomplished with an adjustable crest barrier by lowering the crest height. Stream bed scouring below the dam may be minimized by placement of a concrete splash-way or by use of stone fill directly below the weir, if warranted in specific locations. In most cases, however, scour pools should be encouraged to allow jumping fish to pass over the barrier. Electrical barriers are expected to have no water impacts that require mitigation. Barriers constructed on streams navigable by watercraft may have human impacts. Risk of potential injury from boats passing over a low-head dam can be reduced by posting warning signs upstream of the barrier and providing portage routes around the structure. Electrical barriers will be enclosed within a fence on the streambank, and by using floating buoy lines across the channel, with warning signs informing the public of the risks associated with the barrier.

b. Human Exposure

See Section VII.A.2.a.

c. Wetlands

Gruendling and Bogucki (1993a, 1993b) found that experimental program stream TFM treatments had little or no adverse impacts, and delta Bayluscide treatment impacts on wetlands associated with the Ausable and Little Ausable River Deltas were largely confined to macroinvertebrates. Wetland exposure was minimized during the experimental program by following the recommendations in Gruendling and Bogucki (1986). Given the minimal impact of lampricides on exposed wetlands (Gruendling and Bogucki 1993b), these recommendations were of little consequence. Little or no adverse impact due to TFM or TFM/niclosamide is anticipated on wetlands from application of these formulations under conditions practical for treatment at any time of the year. Accordingly, there is no need to limit application of these lampricides to late summer or early fall, or to construct intrusion barriers in an attempt to keep lampricides out of wetlands. Application of Bayluscide granules would be expected to result in nontarget mortality similar to that observed in the experimental program.

No significant wetland impacts are expected from the construction of low-head barrier dams. Low-head barrier dams may create new wetlands associated with the limited impoundment behind the dam. However, it's likely that the use of slide gates or an adjustable crest would negate any permanent ponding effects.

d. Endangered and Threatened Species

No federally-listed endangered and threatened species will be affected by application of lampricides, implementation of barriers, or spawning-phase sea lamprey trapping, as described under the Proposed Action; therefore no mitigation is necessary. Mitigation may be required for seven Vermont-listed mussel species (Table VI-1); the eighth Vermont-listed mussel species (eastern pearlshell) does not inhabit Vermont waters accessible to sea lamprey. Four Vermont-listed fish species and two fish species listed both in Vermont and New York (Table VI-3) may also require mitigation. The New York-listed mooneye does not inhabit areas proposed for sea lamprey control, and no state-listed plants, amphibians, reptiles, birds or mammals will be significantly affected by lampricide treatments. Mitigation may also be required for certain amphibians or fish on Quebec's Susceptible species list which may inhabit the Pike River system (Tables VI-3 and VI-5).

Mitigation to avoid mortality of state-listed species may range from not applying lampricides in waters inhabited by such species, to applying lampricides at concentrations at or above sea lamprey MLC's that do not exceed the respective listed species' NOEC determined through toxicity testing (See Sections VII.A.1.f. and VII.A.1.g.). Other mitigation strategies may be explored to protect the Vermont-listed American brook lamprey. In some cases, implementation of barriers or trapping activities may also require mitigation. Specific actions and factors that are expected to mitigate impacts to listed species are discussed in the following Sections VII.A.2.f. and VII.A.2.g. Proposed mitigating measures will undergo scrutiny through each state's lamprey control permitting process (see Section II.D.), under laws and regulations protecting state-listed endangered and threatened species. Special mitigating measures to protect these species may be applied only in the jurisdiction where each species is legally listed. The mitigation standard may be different in other waters where the species is not protected.

e. Plants

<u>Stream Lampricides (TFM or TFM/Niclosamide) Treatments</u>

Water-use advisories associated with stream lampricide treatments will advise against irrigating or spraying agricultural crops or gardens with treated stream water until the advisories are discontinued (See Section VII.A.2.a.). No other mitigation is needed since stream lampricide treatments do not pose significant adverse impacts to aquatic or riparian plants.

<u>Granular Bayluscide Treatments on Lake Deltas and Selected Stream Sections</u>

Water-use advisories associated with treatments using Bayluscide 3.2% granules will advise against irrigating or spraying agricultural crops or gardens with treated lake water until the advisories are discontinued (See Section VII.A.2.a.). No other mitigation is needed since Bayluscide treatments do not pose significant adverse impacts to aquatic or riparian plants.

Trapping

No mitigation is needed since there will be no significant adverse impacts on plants from trapping.

Barriers

No mitigation is needed since there will be no significant adverse impacts on plants from installation and operation of sea lamprey barriers.

f. Invertebrates

Stream Lampricide (TFM or TFM/niclosamide) Treatments

Some temporary losses in invertebrate populations will be unavoidable during lampricide stream treatments. Repopulation among temporarily affected species will occur, however through recolonization by downstream drift from untreated waters above application points and from reproduction by invertebrates which survive treatment. Mitigation for most invertebrates will not be necessary because overall populations will not be significantly affected. An in-depth, discussion of lampricide impacts on invertebrates was given in Section VII.A.1.f.

Several studies discussed in Section VII.A.1.f. showed that burrowing mayfly (*Hexagenia* spp.) populations, if significantly impacted, may take somewhat longer to recover from lampricide treatments due to their multi-year nymphal life stage. It was also shown that impacts largely affect age 2 nymphs. Based on these findings, the risk of lampricide impacts to burrowing mayflies can be minimized by scheduling treatments after the early summer mayfly hatch, and also by treating in even year increments, preferably once every four or more years (John Weisser, USFWS, Marquette, Michigan, personal communication).

Mitigation will be required to protect mussels listed as threatened or endangered in Vermont waters (Table VI-1). Lampricide application will be limited to concentrations of less than or equal to the lowest tested NOEC for listed mussel species inhabiting a particular stream. Acute lampricide toxicity tests on the pink heelsplitter (E-VT), black sandshell (E-VT), pocketbook (E-VT), eastern floater and eastern elliptio indicate that TFM and TFM/1% niclosamide combination concentrations of between 1.0 and 1.3 MLC have no significant adverse impact on the survival of any of these species (Table VII-13). The discussion in Section VII.A.1.f. suggested that there is no appreciable difference between the relative toxicity of the TFM/1% niclosamide and TFM alone. Specific mitigating measures to protect endangered and threatened mussels are discussed for each Vermont tributary system in Section VIII.

Lampricide toxicity testing efforts are underway, or being planned for three other Vermont-listed endangered mussels (fragile papershell, fluted shell, cylindrical papershell) and one Vermont-listed threatened mussel (giant floater). Furthermore, flow-through toxicity testing of the pink heelsplitter simultaneously with larval sea lamprey has been scheduled to address concerns with the study design for the original test of this species (See Section VII.A.1.f.). A coordinated program of long-term monitoring of threatened and endangered mussel species in treated and untreated Vermont streams may be developed, and the feasibility of conducting toxicity testing of early life stages of Vermont-listed mussels (younger than age 2) may also be investigated.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

Niclosamide is toxic to most invertebrates at much lower concentrations than TFM or the TFM/niclosamide mixture. Some temporary losses in invertebrate populations will occur during Bayluscide treatments conducted in accordance with the EPA label (See Section VII.A.1.f). As with stream lampricide treatments, repopulation among temporarily affected species will occur through recolonization by drift into treated deltas (or treated stream areas) and from reproduction by invertebrates which survived treatment. An in-depth discussion of lampricide impacts on invertebrates and population recovery was given in Section VII.A.1.f.

Mussels are particularly sensitive to niclosamide. Nontarget mussel mortality may be reduced using deepwater electrofishing methodologies to better define sea lamprey infestation boundaries and larval densities on proposed treatment areas. Once identified, only the more densely populated areas may be treated, and areas with few sea lamprey could be avoided, thus reducing nontarget mortality. In some cases, pre-treatment mussel surveys in proposed Bayluscide treatment areas may also be conducted, and areas of high mussel density could potentially avoided.

Trapping

Trapping requires no mitigation since this activity will not cause significant adverse impacts to invertebrates.

Barriers

Mussel reproduction and recruitment above barriers could potentially be affected if they are dependent upon fish hosts which are only seasonally distributed upstream of barrier sites, and if barriers prevent fish passage. Therefore, mitigating measures for minimizing potential impacts to mussels revolve around fish passage and is discussed under barriers in Section VII.A.2.g.

g. Fish

Stream Lampricide (TFM or TFM/Niclosamide) Treatments

Evaluations of previous lampricide treatments have demonstrated little adverse population-level or community-level impacts to nontarget fish. Pre-treatment larval sea lamprey toxicity tests may be conducted on-site, along with pre-treatment water chemistry analyses, to determine the specific stream MLC for the treatment; use of lampricide prediction charts (Appendix D) and data from previous treatments are also used to set safe and effective application rates. Regular monitoring of TFM concentrations throughout the treatment, and prompt adjustment of application rates, if necessary, will closely maintain the target concentration and minimize the risk of significant nontarget fish mortalities.

Native Lamprey

The two Vermont-listed nonparasitic lamprey, northern brook (endangered) and American brook lamprey (threatened) will require mitigation in Vermont tributaries to avoid unacceptable levels of mortality. Lampricide treatments will not be conducted in the Malletts Creek/Indian Brook drainage to protect the resident northern brook lamprey. Trapping spawning-phase sea lamprey may be effective in the small Vermont streams containing American brook lamprey, and should not result in adverse impacts to this species. In the event that TFM applications are later deemed necessary in any of these streams, measures similar to actions taken during the 1995 Trout Brook TFM treatment, or other potential mitigation strategies deemed acceptable by the Vermont Endangered Species Committee may be implemented. Prior to the 1995 treatment, 280 American brook lamprey were removed from Trout Brook, held during treatment and released after the treatment was complete. This mitigative action minimized impacts to the American brook lamprey population, but was not without ancillary adverse impacts to other nontarget fishes (See Section VII.A.1.g.).

Silver lamprey are slightly less sensitive to TFM than are sea lamprey. Stream populations of the silver lamprey are found throughout the Lake Champlain drainage. Several of the streams in which they are known to occur are either not proposed for control at this time or control strategies proposing alternatives to lampricides are recommended (See Section VIII).

Silver lamprey populations will continue to be monitored in streams in conjunction with routine sea lamprey population assessments. More directed silver lamprey monitoring may be proposed in some streams.

Lake Sturgeon

The lake sturgeon, listed as threatened in New York and endangered in Vermont, is known to be sensitive to lampricides (See Section VII.A.1.g.). The Winooski River is the only tributary presently being considered for a lampricide treatment, where juvenile lake sturgeon have been documented (VTDFW, Essex Junction, Vermont, unpublished data). Any treatment of the Winooski River would be conducted following the Service's "TOP:011.1A Interim Protocol for Conducting Treatments of Streams with Populations of Young-of-Year Lake Sturgeon (*Acipenser fluvescens*)" in Klar and Schleen (1999). The interim protocol allows TFM to be applied at up to 1.0 times MLC, or the combination TFM/1% niclosamide to be applied at up to 1.2 times MLC; such treatments are scheduled after August 1, when young-of-year lake sturgeon attain lengths of 100 mm or greater, and are less sensitive to lampricides than are smaller individuals. Updates to the protocol also will be incorporated into future treatment strategies.

Salmonids

Juvenile landlocked Atlantic salmon are relatively tolerant of TFM. No landlocked Atlantic salmon mortality was observed in TFM treatments during the experimental program. Juvenile salmon will be exposed to lampricides in the Ausable and Saranac Rivers as nursery habitat exists downstream from the TFM application points. In the Boquet River system the TFM application point is downstream from the nursery areas and juvenile salmon will not be exposed. Adult salmon returning to the above three streams as well as the Winooski River during the fall would likely be in spawning condition and as a result could be less tolerant of TFM. To minimize the potential for exposure to fish stressed by spawning, lampricide treatments for these streams will be scheduled to avoid peak salmon spawning activity which typically occurs in October. Other technical considerations may suggest spring treatments for the Ausable River, which would likewise avoid exposing the salmon spawning runs (see Section VIII.A.6).

Esocids

Members of the pike family are relatively sensitive to TFM, however relatively little overall mortality was noted of the five esocid species found in Lake Champlain during the experimental program. With the exception of the muskellunge, these species are abundant throughout Lake Champlain and specific mitigation will not be necessary. Muskellunge are stocked in the Great Chazy River. The Old Water Works Dam on the river has been refurbished to act as a sea lamprey barrier, allowing the TFM application point to be moved downstream of the prime muskellunge habitat, mitigating any potential adverse impacts to this species.

Ictalurids

Substantial stonecat mortalities were noted in four New York rivers during TFM treatments even after the second and third treatment cycles indicating that these populations have persisted. The stonecat is endangered in Vermont, where it has only been found in the LaPlatte River. This tributary is not currently proposed for lampricide treatment, but if future sea lamprey production warrants treatment, the toxicity of TFM to stonecat will need to be evaluated by toxicity testing. If feasible, TFM would then be applied at or below concentrations shown not to cause stonecat mortality. It may also be possible to apply TFM at a point on the LaPlatte River downstream of stonecat habitat, which differs markedly from larval sea lamprey habitat.

Catostomids

White suckers are marginally sensitive to lampricides and limited nontarget mortalities primarily involving juveniles of this species were noted during the experimental program. However, because of their high abundance and widespread distribution throughout the Lake Champlain Basin, population impacts from continued treatments will be negligible and specific mitigation unnecessary.

The quillback is a locally uncommon sucker species known to use the Winooski River as a spawning and nursery area. Treatment of the Winooski River using the Service's "TOP:011.1A Interim Protocol for Conducting Treatments of Streams with Populations of Young-of-Year Lake Sturgeon (*Acipenser fluvescens*)" (See lake sturgeon discussion above) is also likely to safeguard the river's quillback population. It is also likely that lampricide toxicity testing of quillback will be conducted prior to obtaining permits to treat the Winooski River.

Three species of redhorse suckers occur primarily in the larger tributaries (Table VI-4), with the shorthead redhorse being most widely distributed and common. Less is known about the population characteristics and distribution of the more uncommon silver redhorse and greater redhorse in Lake Champlain, thus there is some concern over the potential for adverse impacts on these species from use of lampricides. Available information on the effects of lampricides on redhorse and other sucker species suggests that adverse impacts would be minor (See Section VII.A.1.g.). Scheduling treatments in late summer or early fall will also avoid the large spring spawning concentrations of redhorse and other suckers in the rivers, as well as many young-of-year which tend to drift out of the rivers and into lakeshore areas through the summer. In the event of treatments, most of the major tributaries known to contain significant redhorse populations would likely receive lampricide concentrations at or near 1.0 times MLC to mitigate impacts to other sensitive species (See Section VIII).

Darters

Of the two state-listed darter species, the eastern sand darter (T-NY, T-VT) has been shown to be relatively resistant to TFM at routine treatment concentrations (see Section VIII.A.1.g.). TFM toxicity tests performed on the channel darter (E-VT), however, resulted in a NOEC of 1.2 times sea lamprey MLC. This suggests any potential adverse impacts from exposure to lampricides may be mitigated by maintaining stream treatment concentrations of less than or equal to 1.2 times MLC in Vermont tributaries inhabited by channel darters.

Walleye

No significant adverse impacts to walleyes necessitating special mitigation are anticipated from proposed stream lampricide treatments.

Cyprinids

No significant adverse impacts to cyprinids necessitating special mitigation are anticipated from proposed stream lampricide treatments.

Bayluscide Treatments on Lake Deltas and Selected Stream Sections

The majority of nontarget fish mortality in treatments of the five Lake Champlain deltas with Bayluscide granules were of banded killifish, mimic shiners, spottail shiners and very small unidentified fish (probably a combination of juvenile killifish and minnows), most of which were in shallow near-shore areas. Nontarget mortality may be reduced by better defining sea lamprey infestation limits and larval densities on deltas using deepwater electrofishing methodologies (Klar and Schleen 1999). Once identified, the more densely populated areas may be treated, eliminating treatment over areas with few lamprey, and thus reducing nontarget mortality.

Past delta treatments followed a procedure where Bayluscide was applied in transects starting at an offshore point and finishing on the shoreline. Most fish mortality occurred close to shore where the small fish could not escape the active ingredient. Reversing this procedure by beginning the application at the shoreline and proceeding outward away from shore would allow more fish to escape the chemical and disperse away from the treatment area.

Trapping

Nontarget lamprey and other trapped fish incidentally captured in traps will be released during routine trap monitoring.

Barriers

Barriers proposed under the Proposed Action could result in impacts to fish. Even though these barriers would be low-head, they may prevent the movement of non-jumping fish upstream. Mitigation can include a variety of measures to improve fish passage such as the incorporation of fish traps (which would require manual sorting and passing of trapped fish other than sea lamprey), fish ladders, or jump pools. Some barriers could have slide-gates or an adjustable crest that can be removed or lowered, respectively, when the sea lamprey are not migrating. Electrical barriers can be de-energized when there are no spawning lamprey in the streams. Specific stream strategies will depend on the fish species utilizing each particular tributary.

h. Amphibians

Stream Lampricides (TFM or TFM/niclosamide) Treatments

Mortalities of mudpuppies were observed during some experimental control program treatments, as anticipated. Though toxicity tests indicate NOEC's for adult mudpuppies were about 1.5 times that of observed sea lamprey MLC's (Table VII-26), some stream treatments at these concentrations may result in limited mudpuppy mortality. Similar tests will be conducted on juvenile mudpuppies, if possible, to determine if relative toxicity differs from that of adults.

Efforts to collect biological data on dead mudpuppies encountered in post-treatment mortality assessments should continue, to assess lampricide impacts on their populations in some streams. Techniques recently employed to sample live mudpuppies in Lake Champlain tributaries have not been successful. However, efforts to investigate effective methods to sample mudpuppies in some streams will continue.

Frog tadpoles, eastern-spotted newts and two-lined salamanders also suffered mortalities during some experimental program TFM treatments. Mitigation strategies directed at minimizing mudpuppy mortality should also reduce the risk of impacts on these amphibians.

<u>Bayluscide Treatments on Lake Deltas and Selected Stream Sections</u>

Few amphibian mortalities were observed during Bayluscide treatments on Lake Champlain. Therefore, additional no mitigation to protect amphibians is not necessary.

<u>Trapping</u>

Few amphibians have been captured during past Lake Champlain sea lamprey assessment trapping efforts. Any amphibians incidentally captured in traps will be released during routine trap monitoring.

<u>Barriers</u>

There should be no significant impacts to most amphibian species caused by barriers. Low-head barriers should not present passage problems because most amphibians are mobile and able to use the stream banks to move past barriers. Adjustable crest and electrical barriers can be disabled outside the spring sea lamprey spawning period, allowing generally unrestricted movements of stream amphibians during most of the year.

i. Reptiles

No additional mitigation actions are needed since there will be no significant adverse impacts to reptiles from any of the sea lamprey control strategies proposed. Spawning-phase sea lamprey traps may pose a slight threat for incidental capture of water snakes and small turtles. Traps are often more efficient in capture of sea lamprey when placed or designed so the tops are slightly above the water level; this also provides air space for incidentally caught reptiles, which usually then can be released unharmed (See Section VII.A.1.i.).

j. Birds

No additional mitigation actions are needed since there will be no significant adverse impacts to birds from any of the sea lamprey control strategies proposed.

k. Mammals

No additional mitigation actions are needed since there will be no significant adverse impacts to mammals from any of the sea lamprey control strategies proposed.

l. User Conflicts

User conflicts and need for mitigation are discussed in Section VII.A.1.l.

3. Unavoidable Adverse Impacts

Under Alternative 1 there will be some unavoidable adverse impacts. During lampricide treatments, some non-municipal water supply systems and private water supplies will be briefly exposed to the lampricides TFM, TFM/niclosamide, or Bayluscide granules. Water-use advisories intended to preclude human exposure to lampricides will inconvenience affected persons for short periods of time (see Sections VII.A.1.a and VII.A.2.a).

TFM or TFM/niclosamide treatments could cause short-term losses of aquatic worms and leeches, black flies, burrowing mayflies, certain caddisfly species, and some other invertebrates. TFM-sensitive fish species may suffer mortality in some stream treatments. However, only American brook lamprey, silver lamprey, stonecat, logperch, bluntnose minnow and blacknose dace suffered mortality of greater than 500 individuals from 24 treatments totaling more than 141 stream miles during the entire eight-year experimental control program. For most fish species, substantially lower levels of mortality, or no mortality occurred. Stream lampricide treatments may also cause generally minor levels of mortality to frog tadpoles, mudpuppies and salamanders.

Applications of Bayluscide granules will likely result in mortalities of leeches, chironomids and most species of snails and mussels in habiting treated delta or estuarine tributary areas. during Bayluscide delta treatments. Bayluscide treatments in these areas will likely result in mortalities in several species of fish, but primarily juvenile banded killifish, mimic shiner, and spottail shiner, as was observed during the experimental program. These impacts can be reduced, however, if “spot” treatments can be conducted precisely targeting specific locations located sea lamprey infestations on delta areas and lower rivers.

Sea lamprey barriers will have physical habitat, biological, and aesthetic impacts. Low-head or adjustable crest barrier dams may increase the frequency of seasonal flooding upstream. They may also block in-stream movements of non-jumping fish species if not designed and constructed with proper fish passage facilities. Electrical barriers may also restrict the movements of nontarget species while energized. All barriers would impact the aesthetics of the natural stream channel. Some barriers may be located out of sight of normal viewing, however.

Improvement in salmonid abundance, size, survival and appearance would likely lead to the continued growth of the salmonid sport fishery. This could lead to some increases in conflicts among anglers, and between anglers and landowners, especially with respect to shore-based or stream fishing access sites near salmonid concentration points. Some conflicts did arise during the experimental program, but they were generally rare and isolated incidents.

4. Beneficial Impacts

Alternative 1 will result in substantial beneficial impacts. The implementation of a sea lamprey control program by the states of New York and Vermont, and the Service demonstrates that the agencies have responded to their mandated and professional responsibilities to effectively manage the natural resources of Lake Champlain for public benefit.

Alternative 1 limits the impact of a harmful invasive species to enable the restoration of native fisheries to Lake Champlain. After full implementation of the strategies under the Proposed Action, the fish community in Lake Champlain will be restored to a level that it may have historically supported. Salmonids will inhabit the under-utilized pelagic (open water) habitat and tributaries would support spawning runs that would create additional angling opportunities. The rare opportunity to fish for landlocked Atlantic salmon would be enhanced. Fishways constructed to pass salmonids and other species over dams will provide more opportunities for people to fish for and to watch these fish.

This program is expected to benefit imperilled or declining fish populations, in addition to more common fish species, in the Lake Champlain Basin by decreasing sea lamprey parasitism and their impacts on host-fish species. For example, lake sturgeon, a state-listed species (E-VT; T-NY) and a species of concern to the Service, was once moderately abundant in Lake Champlain, with populations approaching 3,000 adults (Moreau and Parrish 1994). Numerous factors have been blamed for its declining abundance, including habitat alterations, habitat degradation and water quality (Moreau and Parrish 1994). Sea lamprey heavily parasitize lake sturgeon but the effects are not as well understood. The long-term sea lamprey control program should decrease sea lamprey parasitism on lake sturgeon populations, and increase opportunities for restoration.

Increased survival of salmonids in response to a reduction in parasitic-phase sea lamprey abundance should lead to greater abundance of mature spawners and more natural reproduction, which would result in the need to stock fewer fish. This would reduce salmonid management program costs, while maintaining optimum salmonid fishery densities. The increased survival of lake trout, landlocked salmon, steelhead, and brown trout will be reflected in increased angler catch and greater abundance of trophy fish. The number of annual angler trips may increase generating economic benefits up to an estimated $42.2 million (Gilbert 1999b, 1999d).

Populations of native lamprey species may also benefit from reduced competition by sea lamprey in some tributaries where certain control methods and mitigating measures are employed. Sea lamprey control using barriers or trapping may have the greatest beneficial impacts on native lamprey.

Aesthetics and angler satisfaction will be improved by the reduction in lamprey-inflicted wounds on salmonids. Swimmers, snorkelers, SCUBA divers, windsurfers and other boaters will experience fewer sea lamprey attachments. Gilbert (1998) estimated that water-based recreationists would increase their recreation on Lake Champlain by over 1 million days per year if sea lamprey control were to continue. Increases in the number of anglers and the tourism industry in general will create a large clientele with vested interest in protecting Lake Champlain's aquatic resources. Public and political support on future environmental initiatives will likely be enhanced by the proposed program.

5. Irreversible and Irretrievable Commitments of Resources

Alternative 1 will not result in any substantial loss of environmental resources. Lampricide treatments will not cause any irreversible or irretrievable impacts on the resources of Lake Champlain, except for mortalities to individual sea lamprey and some individuals of various nontarget species. The exhaustive body of evidence discussed in this document demonstrates that there will be no irreversible loss or extirpation of any population of any Lake Champlain species (including sea lamprey) as a result of the Proposed Action. Some proposed low-head barrier dams may result in minor semi-permanent loss of lotic habitat, but such barriers can also be removed and the stream channels restored to their natural condition. Substantial funding would be committed to definitive feasibility studies at each potential sea lamprey barrier site as well as land acquisition, construction, operation and maintenance. Irreversible and irretrievable commitments of public funds in the form of time, personnel and materials will be made to conduct the sea lamprey control program.

6. Growth Inducing Impacts

The FEIS predicted increases in sport fishing activity as well as subsequent economic growth as a result of the eight-year experimental control program. This section describes the growth inducing impacts of Alternative 1 as expected through reference to what occurred during the experimental control program. The discussion below is based on several economic-related studies conducted by Gilbert (1997, 1998, 1999b-e) which culminated in the benefit:cost analysis of the eight-year experimental sea lamprey control program. Estimated increases in use of Lake Champlain (i.e. angling, boating, swimming, etc.) and expenditures were calculated from data obtained from random mail surveys. The survey methodology was designed to measure, among other things: (1) the planned annual increase in participation if the demonstrated success of the eight-year experimental sea lamprey control program continues and, (2) respondents willingness to pay if the demonstrated success of the eight-year experimental sea lamprey control program continues.

a. Types of growth

Estimated angler trips for anglers targeting salmonids increased by 47 percent between 1990 and 1997 (Gilbert 1997, 1999b). The FEIS separated potential growth in angler activity into several categories and Gilbert (1998, 1999b) evaluated what effects a continued sea lamprey control program would have on them. Non-anglers and anglers estimated they would fish a total of 1.5 million more days annually on Lake Champlain if the control program maintains or continues to improve the fishery.

Stimulation of local, resident nonanglers to begin fishing, because of proximity to quality angling: Planned participation of local resident nonanglers (local is defined as users residing within an approximately 35-mile wide zone around lake Champlain) if sea lamprey control is continued, is estimated at 190,925 total days per year (Gilbert 1998). When New York and Vermont households are compared, New York generated the higher planned participation total of 146,715 days. The Vermont generated planned participation was estimated at 44,210 total days per year.

Local, resident anglers would fish more because of improved angling quality: Similarly, New York and Vermont current resident anglers would increase their fishing activities if the control program improved the angling quality. An anticipated increase of 350,876 and 659,138 total days per year were estimated from New York and Vermont anglers, respectively (Gilbert 1999b).

Intrastate transfer of resident effort from New York and Vermont waters to Lake Champlain: Anglers fishing other bodies of water also plan to increase their fishing activity on lake Champlain should sea lamprey control continue. New York anglers planned to increase their fishing an average of 18.2 days per year or a total of 103,722 days on Lake Champlain, while Vermont resident increases are estimated at an average of 16.4 days or 170,380 total days (Gilbert 1999b).

Transfer of effort by nonresident anglers from other New York or Vermont waters to Lake Champlain: As with the resident anglers, nonresidents fishing other bodies of water also plan to increase their fishing activity by 56,540 days per year; an average increase of 13.1 days per angler (Gilbert 1999b).

The growth in fishing activity will also result in economic growth. Gilbert (1999d) estimated that an additional $42.2 million will be spent annually on fishing-related items. Gross business income of 98 fishing and fishing related businesses that sold fishing goods increased 32.9 percent during the experimental control program (1991 to 1997)(Gilbert 1999d). Furthermore, 35.4 percent of these business owners had definite plans to expand should the sea lamprey control program continue.

b. Characterization of the Lake Champlain fisheries

Alternative 1 would result in an increase in lake angling for more and larger lake trout and landlocked salmon and improved tributary fishing for salmon, steelhead trout, and to a lesser extent, brown trout.

Total catch of lake trout increased 76 percent during the experimental sea lamprey control program, from an estimated 23,450 in 1990 to 41,162 in 1997, while average weight of harvested lake trout increased 7 percent (Fisheries Technical Committee 1999). The proportion of examined lake trout in the harvest greater than 25 inches in total length increased 42 percent, from 20 percent in 1990 to 28.3 percent in 1997.

The eight-year experimental program improved survival of adult salmon, as evidenced by increased numbers returning to Lake Champlain tributaries. The median annual number of 1-lake-year and 2-lake-year salmon captured at the Willsboro Fishway in the Boquet River increased from 5 to 29 and from 1 to 8.5, respectively, during the post-treatment period (Fisheries Technical Committee 1999). Improvements were also seen in the Saranac River fall creel survey results in 1996 versus 1991, with a doubling in estimated numbers of 1-lake-year fish caught. Greater gains were also estimated in 2- and 3-lake-year fish caught from the Saranac and three 4-lake-year fish were caught in 1996 compared with none in 1991. Implementing Alternative 1 will further increase the quality of the salmonid fishery, increase numbers of salmonids caught by anglers and increase numbers of salmonid fishing trips.

c. Ancillary growth

Non-fishing related growth has occurred as a result of the experimental sea lamprey control program and will likely continue to increase under Alternative 1. Gilbert (1998) surveyed heads of households within a 35-mile radius of Lake Champlain to determine the impacts of sea lamprey control on water-based recreation. Respondents who participated in water-based activities including boating, swimming, windsurfing, skin diving, bathing, and waterskiing increased their recreational use of the lake 153,539 days per year, on average, during the experimental program. If sea lamprey control continues, planned participation in water-based recreation on the lake is estimated to increase 578,280 days annually by people currently using the lake and by 338,671 days by those not yet recreating on the lake. In all three cases, boating and swimming represented the majority of the increase. The increased participation during the experimental program by households within the 35-mile study zone generated an estimated $5.3 million. Planned participation in water-based recreation on the lake is estimated to annually generate an additional $17.7 million by people currently using the lake and $8.5 million by those not yet recreating on the lake (Gilbert 1998).

Increased lake use by non-anglers will likely stimulate further economic growth in the region. Ancillary growth of visitation, economic growth and need for services are difficult to project, however. The Champlain Valley has many attractive features that draw interest from a host of different clientele. Historic sites, museums, fall foliage, hunting, hiking, and skiing are but a few of the attractions that the region has to offer. The proposed alternative which provides effective sea lamprey control will likely augment these other recreational attractions and the Champlain region will be known to also have an exceptional salmonid fishery.

d. Competition for growth

Anglers tend to utilize areas which provide the best angling opportunities and facilities that accommodate their personal and boating needs. In Lake Champlain, these areas can be expected to be in Plattsburgh, Peru, Port Kent, Keeseville, Port Douglas, Willsboro Bay, Willsboro, Essex, West Port and Port Henry in New York and East Alburg, Swanton, St. Albans Bay, Grand Isle, Isle La Motte, North and South Hero, Burlington, Shelburne, Charlotte, Vergennes, and Chimney Point in Vermont.

While ease of access to prime fishing areas is important, these communities' ability to provide desired services such as boat access, dockage, food, lodging, guides, fuel, tackle, bait, and fishing licenses, would also contribute heavily to their ability to compete for business. For example, anglers may choose to fish for salmon in the Boquet River or for lake trout off Willsboro Point. However, lack of desired lodging or camping accommodations in the immediate area may deflect them to other communities, alternative rivers, or other access locations with adequate services. Thus, unless local accommodations can meet site-specific demand, use may be concentrated in areas/communities with necessary facilities and services, rather than dispersed more geographically according to fish resource availability.

e. Infrastructure capacity

Prior to the eight-year experimental sea lamprey control program, NYSDEC and VTDFW conducted an infrastructure capacity survey of the three New York counties and five Vermont counties adjacent to Lake Champlain. The purpose of the 1987 survey was to obtain information regarding the capability of each county's tourist related infrastructure to adequately handle anticipated angling growth. The resulting correspondence and questionnaires can be found in the FEIS, Appendix J, while a summary of the survey responses is given in Table VI-26 of the FEIS. Generally, the survey indicated that, at that time, the existing infrastructure was capable of sustaining the anticipated increase in use, but that some improvements were necessary, particularly since results of the control program were expected to impose further demands on these systems (NYSDEC et al. 1990).

In 1997, a similar study was conducted to estimate the current and planned (1998-2004) capacity of the public and private boat launching sites, shore-based fishing sites, law enforcement, and search and rescue units that serve Lake Champlain (Gilbert 1999c). There are 84 boat launching sites and 10 dedicated shore-based fishing sites on Lake Champlain and its major tributaries. The percentage of total parking at the launching sites available during the summer of 1997 was 81 percent and 53 percent for weekdays and weekend/holidays, respectively. Available capacity is fairly evenly distributed from north to south along Lake Champlain and the overall condition of the sites is good.

Law enforcement and search and rescue units did not experienced any measurable impact from the eight-year control program on their activities and did not anticipate any substantial changes in the immediate future (Gilbert 1999c).

The states of New York and Vermont, the federal government, and towns and cities bordering Lake Champlain spent $2.2 million between 1990 and 1997 on fishing-related infrastructure and plan to spend an additional $2.1 million between 1998 and 2004 (Gilbert 1999c). The amount of these existing and proposed expenditures attributable to sea lamprey control is unknown, however, because the providers of these services were unable to differentiate between use by anglers that benefit from sea lamprey control and other anglers and users (e.g. pleasure boaters) that received little or no benefit from sea lamprey control (Gilbert 1999c).

As was the case with the eight-year control program, the existing infrastructure is capable of sustaining the anticipated increase in use under Alternative 1, but some improvements will be necessary, particularly since the long-term control program will lead to greater participation resulting from the higher quality fishery. The accuracy of the infrastructure data gained in the two studies and, therefore, the extent of the improvements necessary, may be enhanced by conducting intensive, site-oriented surveys of infrastructure use (Gilbert 1999c).

B. Alternative 2. Maintain Reduced Sea Lamprey Wounding Rates Attained During the Experimental Period by Applying Chemical Lampricides.

1. Adverse Impacts

Adverse impacts discussed under Alternative 1 in Section VII.A. would also apply to this alternative but would be limited to impacts related to the use of lampricides only.

a. Water

The water impacts associated with Alternative 2 would be less than Alternative1 due to sea lamprey control being limited to primarily those river systems included in the eight-year experimental control program.

b. Human Exposure

The potential for human exposure associated with Alternative 2 would be reduced compared to Alternative1 due to sea lamprey control being limited to primarily those river systems included in the eight-year experimental control program.

c. Wetlands

Wetland impacts associated with Alternative 2 would be minimal and similar to those associated with Alternative 1, or further reduced due to sea lamprey control being limited to primarily those river systems included in the eight-year experimental control program.

d. Endangered and Threatened Species

Potential for adverse impacts to endangered and threatened species associated with Alternative 2 would be minimal and similar to those discussed for lampricide treatments under the Proposed Action (See Section VII.A.1.d).

e. Plants

No significant adverse impacts to plants are expected from implementing Alternative 2. See Section VII.A.1.e. for a discussion of plants relative to lampricide treatments.

f. Invertebrates

No significant adverse impacts to invertebrates are expected from implementing Alternative 2. See Section VII.A.1.f. for a discussion of invertebrates relative to lampricide treatments.

g. Fish

Fish impacts associated with Alternative 2, in terms of sea lamprey attack damage, would be greater than the Proposed Action. Alternative 2 constrains the flexibility of the program by limiting sea lamprey control only to lamprey infested streams, deltas, and methods included in the eight-year experimental program. Recent investigations have found additional sea lamprey populations in streams such as the Winooski and Pike River and Morpion Stream. Many of these expanding populations may be the result of improvements in stream water quality. If that is the case, then other Lake Champlain tributaries may also harbor sea lamprey populations in the future. Sea lamprey populations will also continue to flourish in streams where chemical control is not recommended due to sensitive species, or control methods otherwise feasible in such cases (e.g. trapping and barriers) could not be employed.

Nontarget fish impacts associated with Alternative 2 would be similar to those discussed for lampricide treatments under the Proposed Action. See Section VII.A.1.g. for a discussion of nontarget fish impacts relative to lampricide treatments.

h. Amphibians

Amphibian impacts associated with Alternative 2 would be similar to those discussed for lampricide treatments under the Proposed Action. See Section VII.A.1.h.

i. Reptiles

No adverse effects are anticipated for reptiles through direct exposure to treatment level concentrations of TFM or by eating organisms killed during treatment (see Section VII.A.1.i). Any difference in impacts that may result from either Alternative 1 or 2 would be undetectable.

j. Birds

TFM is not expected to cause adverse effects on birds through direct exposure to treatment level concentrations of TFM or by eating organisms killed during treatment (see Section VII.A.1.j). Any difference in impacts that may result from either Alternative 1 or 2 would be undetectable.

k. Mammals

No adverse effects are anticipated for mammals through direct exposure to treatment level concentrations of TFM or by eating organisms killed during treatment (see Section VII.A.1.k). Any difference in impacts that may result from either Alternative 1 or 2 would be undetectable.

l. User Conflicts

It is expected that user conflicts associated with Alternative 1 would not be substantial (see Section VII.A.1.l.). Therefore, user conflicts under Alternative 2 would similarly be low. Alternative 2 would still achieve a reduction in sea lamprey, and the quality level attained by the fishery would dictate whether angler use would increase (along with the potential for conflicts), remain stable or decrease.

2. Mitigating Measures

Mitigating measures to minimize environmental impacts outlined under Alternative 1 for lampricide treatments would also apply for Alternative 2.

3. Unavoidable Adverse Impacts

Unavoidable adverse impacts outlined under Alternative 1 for lampricide treatments would also apply for Alternative 2. Under Alternative 2, however, the flexibility of the program is limited by neglecting use of other control methods and additional lamprey infestations not included in the eight-year experimental control program. Lightly and newly infested stream systems in which no control techniques are implemented may attract additional sea lamprey that would contribute substantially to lake-wide lamprey abundance. Untreated sea lamprey populations would limit the potential of the lake’s fisheries. Sea lamprey from these untreated streams would be available to “re-seed” previously treated streams, and thereby could cause some streams to be treated more frequently at additional environmental and monetary costs.

4. Beneficial Impacts

Beneficial impacts outlined under Alternative 1 would also apply for Alternative 2. However, these benefits would be reduced due to sea lamprey control being limited to primarily those river systems and control methods included in the eight-year experimental control program. By generally disregarding other potential sea lamprey producing stream systems and methods to control them, the full benefit of a sea lamprey program would not be realized under Alternative 2.

5. Irreversible and Irretrievable Commitments of Resources

Irreversible and irretrievable commitments of resources outlined under Alternative 1 would also apply for Alternative 2. However, no funding will be committed to definitive feasibility studies for sea lamprey barriers.

6. Growth Inducing Impacts

Growth inducing impacts outlined under Alternative 1, Section VII.A.6 would also apply for Alternative 2.

C. Alternative 3. Abandon Sea Lamprey Control as a Fisheries Management Tool for Lake Champlain. (No Action Alternative)

1. Adverse Impacts

The termination of sea lamprey control in Lake Champlain will result in adverse impacts to the lake's fish populations, salmonid sport fishery, non-fishing related lake activities, and economic benefits derived from them. Sea lamprey parasitism will increase on both cold and warm-water fish. Sea lamprey wounding rates on salmon and lake trout will increase to pre-control levels of over 50 wounds per 100 fish. Lack of sea lamprey control will severely limit the opportunity for lake trout and landlocked salmon fishery enhancement due to the increase in sea lamprey-induced mortality rates on lake trout and landlocked salmon. Efforts to restore and enhance salmon and steelhead returns to Lake Champlain tributaries would likewise suffer. Survival of lake trout will decrease to pre-control levels of between 35 and 45 percent. Salmon survival as indicated by the numbers of fish returning to the Willsboro Fishway and the Saranac River (as measured by the fall creel surveys), will also decrease.

Increased wounding rates and decreased survival will result in a decline in the salmonid fishery. Low survival will result in fewer older, large lake trout (greater than 25 inches) available to the angler. Lake trout total catch could decrease to pre-control levels, estimated at 23,345 fish in 1990. Salmon catch in the Main Lake would decrease to pre-control levels estimated at 3,790 fish in 1990. Actual catch under Alternative 3 is difficult to estimate as the above catch estimates are the result of heavy stocking and the presence of sea lamprey. Under Alternative 3, salmonid stocking strategies may be different (i.e. fewer fish or selected species may be stocked;

see Mitigating Measures below) than prior to the sea lamprey control program. Furthermore, sea lamprey abundance would likely be much greater than before the control program. This is due to continued efforts by the states to improve water quality in the many tributaries to Lake Champlain which in turn, provides a better environment for the sea lamprey to thrive.

With fewer and less aesthetically acceptable fish available to the angler, the recreational fishery will decline. Gilbert (1997, 1999b) estimated angler trips targeting salmonids increased 47 percent during the sea lamprey control program and that anglers would plan to spend 21 percent more on fishing-related items if the program continued. Termination of the lamprey control program on Lake Champlain would result in a reduction of fishing trips and fishing-related expenditures.

Non-fishing related lake activities would also suffer adverse impacts. Swimmers, skin-divers, windsurfers, boaters and other water-based recreationalists would experience undesirable sea lamprey encounters or attachments, producing psychological fears associated with lamprey attachment. The economic benefits of increase non-fishing activities due to lamprey reductions would not be realized.

The opportunity for research and development of more environmentally friendly and effective sea lamprey control techniques would be lost.

2. Mitigating Measures

Adverse impacts identified under Alternative 3 would best be mitigated by effective sea lamprey control. Short of an effective control program, fisheries managers may provide a limited salmonid fishery by (1) increasing numbers of salmonids stocked, (2) selecting strains that have shown to have lower attack rates, (3) choose not to stock those species that are highly susceptible to sea lamprey predation, (4) stock specific lake areas or tributaries, (5) implement different management strategies within each lake basin (Main Lake, Malletts Bay, Inland Sea). Fisheries managers may also choose to reduce the diversity of the fishery or place more emphasis on other species (walleye, northern pike, panfish).

3. Unavoidable Adverse Impacts

Uncontrolled sea lamprey parasitism in Lake Champlain would continue to cause the adverse impacts discussed under Alternative 3.

4. Beneficial Impacts

Beneficial impacts associated with Alternative 3 would include a lack of temporary water-use restrictions associated with lampricide use, no risks to aquatic species from lampricides, and agency funds being redirected to other fisheries programs. Riparian landowners would not be inconvenienced during lampricide treatments of streams and deltas. There would be no restrictions on the use of stream or lake water including drinking, bathing, irrigation, and livestock watering. Farmer's cattle with access to streams and/or lakeshore areas would not need to be moved or fenced away from the water. Arrangements for extra feed or water for these animals would not be necessary.

Non-landowners would likewise not be impacted under Alternative 3. Public beaches that may be temporally closed due to possible lampricide exposure under Alternatives 1 and 2 would not be affected under Alternative 3. Anglers would be able to fish in areas proposed for treatment under Alternatives 1 and 2 with no treatment-related restrictions. The boats at the marina at the mouth of the Salmon River would not require moving during delta Bayluscide treatments.

Georgia-Pacific Company in Plattsburgh, New York would not need to use city water during the Saranac River and delta treatments. The potential to affect the public water supply of Philipsburg, Quebec would be eliminated.

Minor impacts to plants and wetlands by TFM and Bayluscide treatments would not occur.

Organisms sensitive to lampricide treatments would not be exposed to chemicals. Nontarget fish species that are particularly sensitive to lampricides such as northern brook lamprey (E-VT), American brook lamprey (T-VT), stonecat (E-VT), and silver lamprey would not be affected. Macroinvertebrate losses associated with stream and delta treatments would not occur. Special toxicity tests of potentially sensitive species would not be needed.

There would be beneficial impacts from not constructing sea lamprey barriers on rivers as proposed under Alternative 1. Definitive feasibility studies, purchase of land or easements, construction, and maintenance would not occur, at a substantial monetary savings. No restriction of stream flow would occur, which could have resulted in minor flooding of upstream areas including wetlands and/or landowners property. Minor increased stream temperatures that may result from lower water velocities behind the barrier would not occur. There would be no impact to in-stream fish movement or to fish spawning migrations. Mussel recruitment dependent on some of these fish species as host, would not be impacted.

There are beneficial monetary impacts associated with not funding a sea lamprey control program. These funds as well as state and federal fisheries staff time can be redirected to other fisheries priorities. Management could focus on other non-salmonid predator species (walleye, bass, pike), panfish, and forage fish.

5. Irreversible and Irretrievable Commitments of Resources

Federal funds and staff time for sea lamprey control on Lake Champlain would be lost.

6. Growth Inducing Impacts

There would be no growth inducing impacts if sea lamprey control is not implemented on Lake Champlain.

D. Cumulative Impacts

The Council on Environmental Quality (CEQ) defines cumulative impact as "the impact on the environment [Lake Champlain] which results from the incremental impact of the action [sea lamprey control] when added to other past, present, and reasonably foreseeable future actions regardless of what agency or persons undertakes such other actions. Cumulative actions can result from individually minor but collectively significant actions taking place over a period of time."

There are recognized cumulative impacts associated with sea lamprey control on Lake Champlain. Fishery impacts are the most apparent and include those associated with the ongoing salmonid restoration efforts initiated in the 1970's and continuing today. There are additive impacts to those restoration efforts and ancillary impacts to other important recreational fisheries (walleye and smelt). The fish community dynamics of Lake Champlain are changing, and this program would markedly impact and modify changes currently taking place. Interactions between native and non-indigenous species have become important problems within the Lake Champlain watershed, and resulting trophic changes may be exacerbated by the results of a successful sea lamprey control program. Finally, there are predictable social and economic changes associated with successful sea lamprey control.

Fishery Impacts: Lake Champlain salmonid restoration efforts are summarized in *A Strategic Plan for Development of Salmonid Fisheries in Lake Champlain* (Fisheries Technical Committee 1977) and in *Status Report - Conservation of Interjurisdictional Salmonid Species and Habitats in the Lake Champlain Basin* (Lake Champlain Fish and Wildlife Management Cooperative 1998). Salmonid stocking rates may change as a result of forage assessments or changes in management strategy. The recognition that Lake Champlain walleye and salmonids are primarily utilizing the same rainbow smelt forage, warrants consideration in management decisions regarding allocation of predator forage resources supporting competing fisheries. A management strategy geared toward salmonid restoration could potentially impact concurrent walleye fishery restoration efforts. Sea lamprey management favoring salmonid restoration may not, likewise, favor walleye populations because salmonids are expected to benefit more from sea lamprey control than would walleye. The Cooperative recognizes that smelt populations must be maintained to provide adequate forage for predators and to support the existing recreational fishery for smelt.

An additive fisheries impact could be attributed to the establishment of sea lamprey barriers (physical or electrical) on Lake Champlain tributaries. Over the tenure of human development in the basin during the past three hundred years, many of the tributaries were dammed to harness water power. Today, hydropower is responsible for the majority of dammed tributaries existing in the Lake Champlain area. Unless sea lamprey barriers incorporate effective fish passage facilities, development may add additional obstacles to fish migrations. Regardless of fish passage provisions, barriers may alter within-stream movements of some fish (Noakes et al. 2000).

Fish Community Dynamics: Interacting species and the energy input to Lake Champlain from internal and external sources determines the energy distribution within the Lake Champlain ecosystem. Clearly the addition of new species or the resurgence of depressed species changes that energy distribution. The recent establishment of zebra mussels and the resurgence and proliferation of double-crested cormorants and ring-billed gulls may be affecting Lake Champlain aquatic resources in ways that are difficult to predict. Zebra mussels are prolific filter feeders that channel nutrients from the water column to bottom habitats, thus altering the pattern of energy flow. In addition to sea lamprey, cormorants and gulls are voracious fish predators that may impact fish populations through increased predation associated with population expansion. Predation by cormorants and gulls may be changing the population structure of certain fish species and those impacts will continue to occur with or without sea lamprey control. If cormorant and gull predation is resulting in reductions in Lake Champlain fish populations, then sea lamprey control may directly or indirectly add or detract from those influences. Direct effects (increased salmonid populations), or indirect effects (increased predation or competition by fish species that benefit from sea lamprey control), may exert additional pressures on those fish populations.

It is also recognized that other prolific invaders are poised to enter the Lake Champlain system unless interdicting measures are implemented and are successful. Alewife are established within the watershed, but have not yet established in Lake Champlain. Alewife are very efficient, size selective feeders and are known to alter zooplankton size, abundance and community structure. Alewife compete directly for zooplankton with other planktivorous fish or life stages and have been implicated in the decline of many native fish species (VTDFW 2001). Alewife are also noted for population instability and unpredictability as a salmonid forage base (Brown 1972; O'Gorman and Schneider 1986) and they are implicated in salmonid reproductive problems due to nutritional insufficiencies when salmonids utilize alewife in their diet (Fisher et al. 1996). In Lake Champlain we would expect population declines of yellow perch, lake whitefish. lake herring and rainbow smelt, the primary forage base for Lake Champlain's salmonid populations (VTDFW 2001).

Effective sea lamprey control on Lake Champlain will likely result in larger healthier salmonid populations. Increases in salmonid survival will inevitably result in increased predatory pressure on Lake Champlain's forage base. If alewife invade Lake Champlain, we would expect fish predatory pressure to act together with increased competition from alewife and cause forage base instability.

Non-native ruffe (*Gymnocephalus cernuus)* and round gobi (*Neogobius melanostomus)* are now well established in the Great Lakes and are increasing their geographic distributions, such that Lake Champlain may be at risk of infestation via connecting waterways or direct transfer. These exotic fish species pose very real disruptive threats to the population structure within Lake Champlain. Displacement of native or naturalized species may result from exotic species introductions, and those potential effects may alter species interactions and energy flow for the resources targeted to benefit from sea lamprey management.

Current efforts to reduce nutrient inputs to Lake Champlain may alter the base of the food web by reducing the overall productivity of the aquatic system. Phosphorous is normally the limiting nutrient in aquatic systems and efforts to reduce this nutrient input to Lake Champlain are meeting with some success. The overall productivity of Lake Champlain is experiencing a downward trend due to phosphorous reductions. These reductions in nutrient input to the lake will manifest upward through the food web to affect the abundance of phytoplankton, zooplankton, planktivorous fish and eventually fish predators (ie. salmonids, walleye). Lake Champlain fisheries managers recognize the potential for reduced Lake Champlain fish carrying capacity and are and will continue to monitor the forage base to anticipate future abundance and make appropriate stocking or regulatory adjustments where they are warranted to decrease predatory pressures.

Delta and Estuarine Mussels: Species impacts of sea lamprey control (including lampricide application) are detailed and discussed earlier in Section VII. However, some potential for a cumulative impact to mussel species occurring in delta or estuarine habitats needs recognition. Zebra mussel infestations are reducing and even eliminating native mussel populations in infested habitats (Nalepa 1994; Schloesser and Nalepa 1994; Ricciardi et al. 1996), and those pressures are apparent in Lake Champlain mussel populations where zebra mussels are colonizing mussel shells. Bayluscide (3.2% granules) application to localized delta or estuarine habitats where native mussels are stressed by zebra mussel colonization may compound zebra mussel impacts due to the toxicity of Bayluscide to mussels at treatment concentrations.

Social/Economic: It is recognized that additive changes will occur as a result of successful sea lamprey control. Salmonid restoration will affect the social and economic structure in a predictable way. Gilbert (1999a, 1999c, 1999d) details the costs and benefits due to increased recreational use and business expansion associated with the eight-year experimental sea lamprey program for Lake Champlain. These benefit:cost analyses indicated a 3.48 to 1 monetary benefit to the Lake Champlain region associated with that program. This economic benefit builds upon the already established sportfishing economy based on natural and managed Lake Champlain fisheries established in the absence of sea lamprey control. These changes are viewed as largely positive ones. Negative changes might be associated with increased development and increased burden on the social infrastructure and services. These things are viewed as manageable and well within the region's adjustment capacity. An increased tax base and increased external spending associated with economic expansion would compensate for the additive economic and social burden imposed through improved sportfishing participation and associated development on Lake Champlain.

VIII. DEVELOPMENT OF CURRENT RIVER/DELTA - SPECIFIC SEA LAMPREY CONTROL STRATEGIES FOR THE PROPOSED LONG-TERM CONTROL PROGRAM (Proposed Action).

A summary of sea lamprey control techniques being considered for implementation on each Lake Champlain tributary system with known sea lamprey infestations can be found in Table VIII-1. The sea lamprey control methods listed are those determined to be feasible for implementation under circumstances specified later in this section, and result from the screening process described in Section V. These techniques were selected following an analysis of variables unique to each tributary system. Other pertinent impacts and mitigation considered in this analysis was discussed in Section VII (Environmental Consequences). Locations of streams with a history of sea lamprey infestation were shown in Figure V-1 and other pertinent information including location, stream flows, and distances accessible to sea lamprey was listed in Table V-1. More detailed stream-specific maps pertinent to proposed sea lamprey control activities are included in this section. All cost estimates are listed in year 2000 funds.

Table VIII-1. Summary of potential control strategies (denoted by "X") for each Lake Champlain tributary known to produce sea lamprey. Specific strategies are presented in priority order at the end of each stream-specific discussion on pages 215-323. **A potential control strategy may not necessarily be implemented on a particular stream.**

Tributary System	**TFM**	**TFM/ Niclosamide**	**Bayluscide-** ***Delta***	**Barrier-** ***Maintain***	**Barrier-** ***Construct***	**Trapping** ***Implement***
1. Great Chazy R.	X	X		X		X
a. Bullis Bk.	X					
2. Saranac River	X	X	X	X		X
3. Salmon River	X		X		X	X
4. Little Ausable R.	X		X		X	X
5. Ausable R.	X	X	X			
a. Dry Mill Bk.	X					
6. Boquet R.	X	X	X	X		
7. Beaver Bk.	X				X	
8. Mullen Bk.	X				X	X
9. Putnam Ck.	X				X	X
10. Mt. Hope Bk.	X					
a. Greenland Bk.	X					
11. Poultney R.	X	X				
a. Hubbardton R.	X					
12. Lewis Ck.	X			X		
13. LaPlatte R.	X				X	X
14. Winooski R.	X	X				
a. Sunderland Bk.	X				X	X
15. Malletts Ck.					X	X
a. Indian Bk.					X	X
16. Trout Bk.	X				X	X
17. Stone Bridge Bk.	X				X	X
18. Missisquoi R.	X	X		X		
19. Youngman Bk.	X				X	X
20. Pike R.	X	X				
a. Morpion Str.	X				X	X

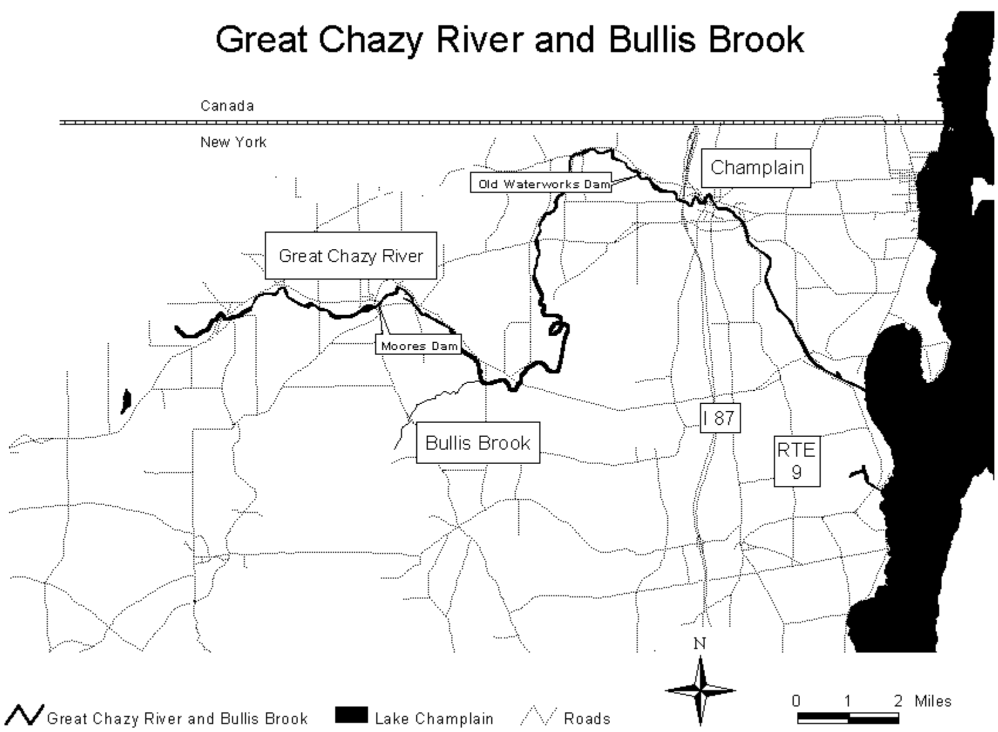
A. Tributaries With Known Sea Lamprey Populations:

1. Great Chazy River

Sea lamprey habitat

The Great Chazy River setting is shown in Figure VIII-1. The known Great Chazy River sea lamprey habitat begins near the Village of Champlain, New York, approximately 5.0 miles upstream from the river mouth, and extends 15.6 miles upstream to a dam in the Hamlet of Mooers. Sea lamprey have historically had access to 20.6 miles of this river. Estuarine portions of the lower Great Chazy are presumably unsuited for larval sea lamprey colonization. Bullis Brook, a tributary in the upper reaches of the Great Chazy River's sea lamprey infested area, was reported in 1996 (John Gersmehl, USFWS, retired, personal communication), to contain an estimated 0.5 miles of additional sea lamprey infested habitat.

Figure VIII-1.



Treatment history/results

The Great Chazy River TFM treatment history is summarized in Table VIII-2 (Steinbach 1992a; Neuderfer 2000c).

Table VIII-2. Great Chazy River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1992	20.6	91,090	41,706
1996	20.6	22,317	395
2000	7.5	10,442	247

The Old Waterworks Dam, located 7.5 miles upstream of the mouth of the Great Chazy River, was rebuilt in 1994-95 to act as a barrier to upstream spawning migrations of sea lamprey adults. Unfortunately, some sea lamprey discovered a way to pass upstream of the dam, apparently through fractures in the underlying bedrock, and recolonized upstream areas. Escapement of lamprey upstream beyond the barrier necessitated the second whole-river treatment. Additional efforts to make the barrier impenetrable to sea lamprey (placement of crushed stone and filter fabric in stream bed areas where sea lamprey infiltration was suspected), were expended in 1997 and 1999. Year 2000 sea lamprey assessment surveys indicated extremely low numbers of older-age larvae (all apparently members of the same year class) ready to transform and emigrate to Lake Champlain from areas upstream of the Old Waterworks Dam (also called the Frog Farm Dam). Most of these were sampled within the lowermost section of Bullis Brook where sea lamprey control has never been conducted. Only one ammocoete was collected from the river's main stem upstream of the dam. The insignificant number of larvae and the high cost and long duration of Great Chazy whole-river TFM treatment, lead to the decision to apply TFM at the Old Waterworks Dam, and treat only the river downstream of that point in September 2000. If the aforementioned or future modifications can be made to effectively eliminate sea lamprey colonization of areas upstream of the dam then subsequent treatments can take place at the Old Waterworks Dam. A sea lamprey trapping system has been incorporated into the structure of the new dam and has proven to be an effective means of capturing adult lamprey during upstream migrations.

Screening process

Estimated sea lamprey transformation

The Great Chazy has the potential to produce a minimum of nearly 42,000 sea lamprey transformers annually as determined from estimates generated from target mortality assessment during the experimental control program.

TFM

- <u>Technical considerations</u>: TFM application is technically feasible on the Great Chazy River. Diurnal pH shifts that affect TFM toxicity require careful treatment planning, especially during periods of very low flow. However, conducting treatment under higher flows in fall or late spring may make this problem more manageable. The Great Chazy River setting readily accommodates the positioning of TFM boost sites for maintenance of target chemical concentrations. The length of river requiring TFM treatment will determine the staffing necessary to accomplish such treatments. If the Waterworks Dam is not 100 percent effective against sea lamprey upstream passage future treatments may need to start at the Moores Dam (river mile 20.6). All associated treatment activities would be extended under this "upper" river treatment scenario (TFM primary application at Mooers with several TFM boosts required to maintain chemical concentrations at levels toxic to sea lamprey). Staffing requirements will include TFM boosting applications and considerably longer durations of chemical treatment and presence of chemical within the river. Some reductions in these durations may be achieved if treatments were conducted during higher spring discharges rather than during typically low fall flows. Sea lamprey infestations in Bullis Brook would require TFM treatment in conjunction with any TFM treatment of the upper Great Chazy River. Secondary treatment of backwater areas may occur to treat sea lamprey refugia that would not receive lethal TFM doses.

- <u>Nontarget concerns</u>: No threatened or endangered species are known to exist within lampricide treatment areas of the Great Chazy River. Nontarget mortality associated with two TFM treatments initiated at the Mooers Dam and occurring during experimental sea lamprey control, are listed by the Fisheries Technical Committee (1999). Nontarget mortality resulting from the third treatment in 2000, applied at the Old Waterworks Dam, was generally consistent with past treatments. Northern brook lamprey have never been observed downstream of the Old Waterworks Dam but, for the first time, a northern brook lamprey may have been collected from this reach. Nontarget animals most likely to experience mortality on the Great Chazy River are northern brook lamprey (if treatment occurs upstream of the Old Waterworks Dam), stonecat, log perch, two-lined salamanders, mudpuppies, and frog tadpoles. All salamanders collected in post-treatment assessments were identified to species only in year 2000. The presence of these affected animals among identified nontargets after each treatment of the same river segments indicates that their populations have been resilient in treated areas of the Great Chazy. Adverse impacts on these species were limited and temporary. Future TFM treatments would likely result in similar nontarget effects. Provision has been made to slightly reduce the TFM concentrations in river areas corresponding to prime muskellunge habitat. Spring walleye spawning runs reach the Waterworks Dam, and the presence of these fish in spring is a consideration regarding lampricide treatment timing and setting TFM target concentrations. However, the reduced diurnal pH fluctuation expected in the spring would likely reduce impacts to nontargets affected in previously conducted fall treatments. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: Long-duration water-use advisories associated with past Great Chazy River TFM treatments have required a substantial commitment of effort providing alternative water supplies for river and lake water users. It may be necessary to move or temporarily fence livestock from TFM-affected water and/or provide bulk water supplies to affected herds. In one livestock operation nearly 600 cattle may require alternate water supplies. Lush aquatic plant growth in King Bay slows TFM plume dissipation and extends advisories during fall treatments. Spring treatments, prior to full growth of aquatic plant beds, would be expected to reduce this impact to water users.

- Habitat impacts: No unique impacts.

- Cost: The projected cost associated with a TFM treatment of the Great Chazy River beginning at the Mooers Dam is estimated at $94,686 per treatment or $23,672 per year based on a four-year treatment cycle. If the Old Waterworks barrier dam can be made effective, substantial savings can be realized in terms of staffing and mitigation costs. Projected cost of a TFM treatment beginning at the Waterworks Dam is estimated at $75,683, or $18,921 per year based on a four-year treatment interval.

TFM/Niclosamide

- Technical considerations: Some Great Chazy River flows are such that use of the TFM/niclosamide combination treatment may be possible and result in a substantial reduction in the amount of lampricide used. The Great Chazy River has been one of the most demanding Lake Champlain streams to treat with TFM. Treatment durations have been several days long. Staffing requirements are extensive, necessitating personnel for round-the-clock laboratory analyses, lampricide application and application supervision for the duration of the treatment, and daily support staff for supplies, water deliveries, and fencing checks. Several boosts were necessary to maintain chemical concentrations in the stream. The complexity and additional staff necessary to accommodate TFM/niclosamide combination treatment make a full-river Great Chazy treatment more difficult but still feasible (see Section IV.A.2.). The more likely application point for TFM/niclosamide combined treatment is at the Old Waterworks Dam. If treatment were to occur at the Old Waterworks Dam, then complexity and staffing constraints become a lesser factor, and the consideration becomes stream flow. Decisions regarding the use of TFM/niclosamide combination treatment would be deferred until pre-treatment assessments provide the necessary information to guide decision-making. Secondary TFM treatment of backwater areas may occur to treat sea lamprey refugia that would not receive lethal TFM/niclosamide doses.

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: Human impacts would be similar to those listed under TFM. Water-use advisory durations may be reduced due to the overall reduction in concentrations of overall active ingredient applied during a TFM/niclosamide treatment.

- Habitat impacts: No unique impacts.

- Cost: TFM/niclosamide combination treatment would be cost effective if the river flows at time of treatment are high enough to warrant this type of lampricide treatment. A full river TFM/niclosamide combination treatment is projected to cost $76,438 per treatment or $19,110 per year based on a four-year cycle of treatment. The projected cost of a combined lampricide treatment with a single application point at the Waterworks Dam is $63,873 per treatment or $15,968 per year based on a four-year treatment cycle.

Bayluscide 3.2% Granules

- Technical considerations: No use of Bayluscide 3.2% granules is proposed for the Great Chazy River system. This formulation is most appropriate for use in estuaries or lake regions (deltas). However, the estuary and the delta of the Great Chazy are presumably not infested by sea lamprey.

Barriers

- Technical considerations: A sea lamprey barrier has been established on the Great Chazy River at the Old Waterworks Dam (river mile 7.5). However, fractures in the bedrock underlying the dam must be blocked to make the structure 100 percent effective as an adult sea lamprey barrier. Efforts to eliminate upstream escapement to date have included placement of crushed stone and filter fabric over leakage areas upstream of the dam. After assessment of these measures, additional efforts to improve the barrier will be considered if necessary. No other suitable barrier dam site(s) exist closer to Lake Champlain than the Waterworks Dam. Establishment of an electronic barrier is not feasible due to the presence of an important walleye spawning run. Therefore, no further barrier development is proposed.

- Nontarget concerns: No additional nontarget effects were created due to the reconstruction of the Old Waterworks Dam.

- Human impacts: Human impacts are favorable, as a dilapidated municipal structure was refurbished at no cost to the local community. Dam safety specifications were inadequate prior to rebuilding of the dam. Any other human impacts would be long-standing and associated with the original dam construction.

- Habitat impacts: No unique impacts. The Old Waterworks Dam was a pre-existing structure that has been reconstructed at the same site and elevation as the original dam.

- Cost: Future costs associated with the Old Waterworks Dam would involve short-term measures to make the barrier 100 percent effective against adult sea lamprey penetration to upstream areas, occasional maintenance, and refurbishment of the dam at the end of its workable life (estimated at 50 years). Costs should be minimal for the life of the current structure and are estimated at $1,898 per year.

Trapping

- Technical considerations: Provision for adult sea lamprey trapping has been made at the Old Waterworks Dam. A sea lamprey trap was incorporated into the design of the barrier and has been built into the structure.

- Nontarget concerns: No unique concerns.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The adult sea lamprey trap is already in place and is equipped with durable hardware. Associated costs are estimated at $5,308 per year including the staff necessary to operate and maintain the trap. The life expectancy of the trap is similar to the 50-year estimated life of the dam structure.

Great Chazy River Control Strategy

The control methods found technically feasible for the Great Chazy River include TFM and TFM/niclosamide application, maintenance of the existing barrier and trapping at the barrier. Lampricide treatments will be essential to reduce sea lamprey abundance here and anticipated impacts were found acceptable. The Old Waterworks Dam would be maintained and efforts to improve the structure as a sea lamprey barrier would continue. Trapping spawning-phase sea lamprey at the barrier also would continue. As other control methods become feasible for use on the Great Chazy River, the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Maintain a sea lamprey barrier at river mile 7.5. This includes work to make the dam 100 percent effective as a sea lamprey barrier.

2. Apply TFM or TFM/niclosamide combination at the barrier at approximately four-year intervals. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis. Springtime treatment will be considered as it may afford *more effective treatment conditions, reduce nontarget impacts and reduce advisory durations.*

3. Trap spawning-phase sea lamprey at the barrier.

4. Apply TFM or TFM/niclosamide at river mile 20.6 if necessitated by substantial upstream penetration of the Old Waterworks Dam by spawning-phase sea lamprey.

1a. Bullis Brook

Bullis Brook (see Great Chazy River site map, Figure VIII-1), has not been included among streams targeted for sea lamprey control in the past, but recent surveys (Neuderfer 2000c) have indicated larval sea lamprey presence in this tributary. Because a barrier has been established well downstream of this tributary at the Old Waterworks Dam, no control is planned for Bullis Brook unless sea lamprey are able to penetrate the barrier and reseed larval sea lamprey habitats in the brook and in the upper reaches of the Great Chazy River. Should sea lamprey penetrate the Old Waterworks Dam barrier in numbers sufficient to warrant control measures, then Bullis Brook would be included in those control activities.

Sea lamprey habitat

Bullis Brook is known to contain approximately 0.5 mile of sea lamprey habitat. Sea lamprey larval surveys will be required to better assess the extent and distribution of sea lamprey within the stream.

Treatment history/results

Bullis Brook was not included in the experimental control program.

Screening process

Estimated sea lamprey transformation

Preliminary Bullis Brook larval surveys were not designed to project the production of transformers to the Great Chazy River system and no transformer estimates are available. Future sea lamprey assessments may be conducted to determine the need for sea lamprey control on Bullis Brook.

TFM

- Technical considerations: There are no apparent logistical issues which would preclude TFM treatment of Bullis Brook. Secondary treatment of backwater areas may occur to treat sea lamprey refugia that would not receive lethal TFM doses.

- Nontarget concerns: There are no known nontarget concerns for Bullis Brook. No threatened or endangered species are known to be present within the proposed treatment area of Bullis Brook. Preliminary surveys are suggested prior to making definitive decisions regarding TFM application there. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts are known specific to Bullis Brook.

- Habitat impacts: No unique impacts.

- Cost: The costs of treating Bullis Brook are incorporated into the full-river TFM treatment of the Great Chazy River.

TFM/Niclosamide

- Technical considerations**:** The small size of Bullis Brook precludes the use of a TFM/niclosamide combination treatment. If a full-river combination treatment is proposed for the Great Chazy River then Bullis Brook would receive an application of TFM only.

Bayluscide 3.2% Granules

- Technical considerations**:** Application of Bayluscide 3.2% granules is inappropriate for use in the riverine environment of Bullis Brook**.**

Barriers

- Technical considerations**:** A barrier is not proposed. The technical feasibility of barrier establishment on Bullis Brook is unknown. However, sea lamprey encountering a barrier would probably redistribute to areas of the Great Chazy River.

Trapping

- Technical considerations: The small size of Bullis Brook would probably allow for effective trapping if a suitable site could be found. However, access difficulty (far side of the Great Chazy River from the nearest access point) and the probable insignificant net result of the effort compared to the available habitat and sea lamprey production potential of the Great Chazy River, would render a trapping effort difficult and ineffective as a meaningful control strategy. Should a lampricide treatment be required on the upper Great Chazy River it would probably be necessary to treat Bullis Brook with TFM at some location, regardless of trapping, to eliminate the tributary as a refuge from Great Chazy TFM concentrations. Trapping is not proposed for Bullis Brook.

Bullis Brook Control Strategy

TFM application is the only technically feasible control method for Bullis Brook. If the sea lamprey barrier at the Old Waterworks Dam prevents sea lamprey access to the upper Great Chazy River and Bullis Brook, sea lamprey control would not occur on Bullis Brook. If it becomes necessary to treat the upper Great Chazy River, however, Bullis Brook would be treated with TFM simultaneously with a TFM or TFM/niclosamide treatment of the Great Chazy River to eliminate the tributary as a refuge. The necessity of this lampricide treatment would preclude other sea lamprey control efforts. As other control methods become feasible for use on Bullis Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Apply TFM only in conjunction with full river TFM or TFM/niclosamide treatment on the Great Chazy River.

2. Saranac River and Delta

Sea lamprey habitat

Sea lamprey can access the Saranac River from its mouth to the Imperial Mill Dam at river mile 3.3 (see Figure VIII-2). Most sea lamprey are located in the lower reaches of the river near the mouth and on approximately 175 delta acres. Most of the uppermost habitat in the river is unsuited to sea lamprey larvae, and populations there are very small. Ammocoetes require softer sediments for burrowing than are typically available in all but the lowermost reaches of the river and its delta. Unchecked, the delta has the potential to produce large numbers of sea lamprey.

Treatment history/results

The Saranac River TFM and Delta Bayluscide treatment history is summarized in Tables VIII-3 and VIII-4 (Fisheries Technical Committee 1999; NYSDEC, Ray Brook, NY unpublished data). TFM application was technically straightforward except for troublesome fluctuations in stream flows attributed to hydroelectric dam flow manipulations occurring upstream. No boosts were necessary to maintain TFM concentrations and diurnal pH shifts were not a factor. Sea lamprey surveys prior to scheduled 1996 treatment indicated that sea lamprey numbers in the Saranac River at that time did not warrant treatment, and thus it did not take place. Bayluscide 5% granule applications on the delta were accomplished using cropduster aircraft.

Figure VIII-2

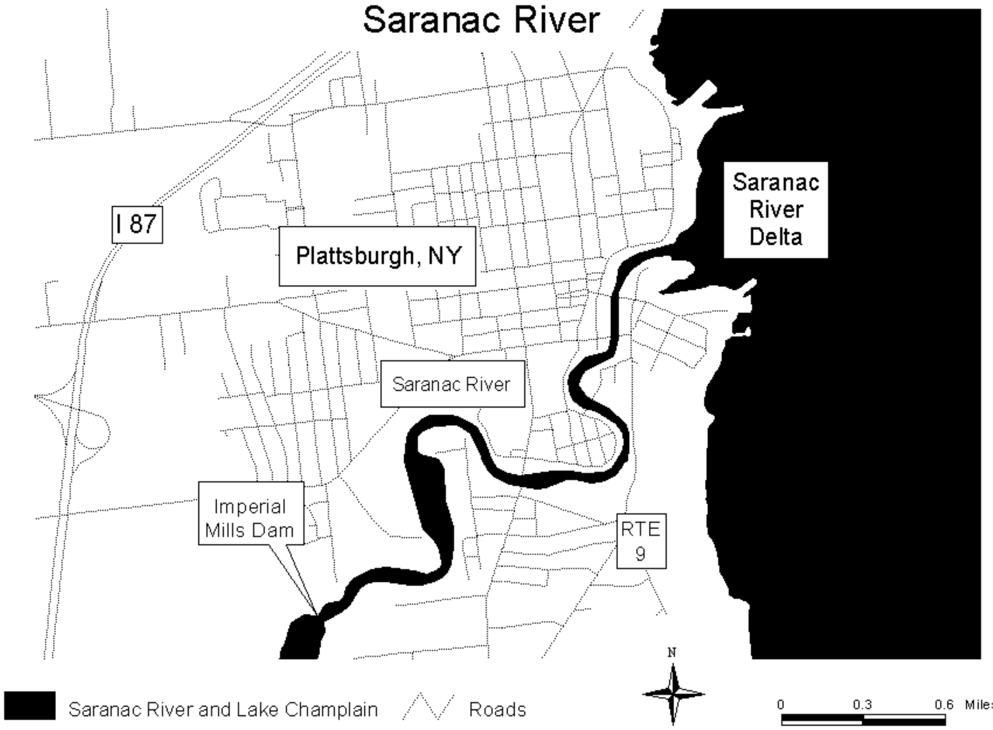


Table VIII-3. Saranac River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1992	3.3	391	3

Table VIII-4. Saranac River Delta Bayluscide treatment history.

Year of Treatment	Acres of Delta Treated with Bayluscide	Estimated Sea Lamprey Mortality
1991	154	240,317
1995	137	no estimate

Screening process

Estimated sea lamprey transformation

Post-treatment sea lamprey mortality assessments following the TFM treatment of the Saranac River found only three transformers among the samples collected. Even with the recognition that this represented a minimal estimate of transformer production, it was concluded that Saranac River transformer production was low. No transformer production estimates were made for the Saranac River Delta but it is recognized that the delta has the potential to produce considerable numbers of transformers if the river and/or delta sea lamprey populations are left uncontrolled over an extended period of years.

TFM

- Technical considerations: The lampricide TFM may be used to provide the level of sea lamprey control necessary for the Saranac River. TFM application would occur below the Imperial Mill Dam. Troublesome fluctuating flows from numerous hydroelectric facilities upstream would necessitate close scrutiny and appropriate adjustments of TFM application rates should such events occur during treatment. The Saranac River is relatively easy to treat, but the large volume of TFM required is costly. Secondary treatment of backwater areas may occur to treat sea lamprey refugia that would not receive lethal TFM doses.

- Nontarget concerns: Nontarget mortality encountered during the 1992 experimental TFM treatment are listed by the Fisheries Technical Committee (1999) and can be found in Appendix E. Based on this first treatment, stonecat, a TFM-sensitive species would likely suffer mortality should future TFM treatments be conducted on the Saranac River. No threatened or endangered species are known to exist within the proposed treatment area of the Saranac River. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: A unique and expensive impact involves providing the Georgia-Pacific Corporation paper mill with an alternate water source during advisories. The mill normally draws water from the lake, but during water-use advisories its water supply can be switched to the City of Plattsburgh water system until advisories are lifted.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of the Saranac River is expensive (estimated at $101,553 per treatment or $25,388 per year based on a four-year treatment cycle) due to the large amount of TFM (valued at approximately $50,000) required. The estimate includes the cost of water provided to Georgia-Pacific Corporation projected at $25,000 per treatment.

TFM/Niclosamide

- Technical considerations: The use of TFM/niclosamide combination is likely appropriate as a replacement for TFM alone should the entire 3.3 mile segment of sea lamprey accessible river be treated with lampricide. High river flows compared to other streams suggests that a TFM/niclosamide combination treatment offers monetary cost advantages and would reduce overall volume of chemical used compared to a TFM treatment. The simultaneous use of the two chemicals represents a conservation measure as less lampricide is necessary compared to TFM use alone. This treatment requires no boosts. Therefore, the increased staff required to treat simultaneously with TFM/niclosamide is acceptable and technically feasible (see Section IV.A.2.). Secondary treatment of backwater areas with TFM may occur to treat sea lamprey refugia that would not otherwise receive lethal TFM/niclosamide doses.

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: Human impacts would be similar to those listed for TFM except that the duration of water-use advisories may be shorter than with TFM, due to the overall reduction in chemical used.

- Habitat impacts: No unique impacts.

- Cost: Costs associated with TFM/niclosamide treatment of the Saranac River are estimated at $47,455 per treatment or $11,864 per year based on a four-year treatment cycle. This estimate includes the cost of water provided to Georgia-Pacific Corporation projected at $15,000 per treatment. This projected water supply cost assumes less total chemical used and shorter resulting advisory times.

Bayluscide 3.2% Granules

- Technical considerations: Sea lamprey control experience, changes in Bayluscide formulation, and the investigation of survey technology has resulted in several proposed sea lamprey survey and control changes for the Saranac River and Delta. Because sea lamprey in the Saranac River are concentrated near the mouth, there may be an opportunity to target sea lamprey in those limited areas of distribution by spot-treating infestations with Bayluscide 3.2% granules. Riverine sea lamprey infestations could be mapped using deepwater electrofishing gear and conventional electrofishers. Those areas can then be targeted with Bayluscide using portable applicators from the river bank and/or from boats. This method could replace whole, 3.3 mile river TFM or

TFM/Bayluscide combination treatments, maintain low sea lamprey levels on the river and limit recolonization of sea lamprey infestations on the delta. Proposed delta Bayluscide treatments would be limited to that area treated during the experimental program in 1991 and 1995 and eventually, may be limited to areas of sea lamprey infestation as indicated by infestation maps to be generated through use of deepwater electrofishing technology. Bayluscide application on the delta would be conducted boat.

- Nontarget concerns: Nontarget mortality encountered during the 1991 and 1995 Saranac Delta Bayluscide 5% granule treatments are listed by the Fisheries Technical Committee (1999). There were a few nontarget mortalities observed among 15 common fish species. Noted nontarget mortality was low during experimental control, and similar results can be expected during future treatments. No threatened or endangered species are known to exist within proposed Bayluscide treatment areas of the Saranac River and delta. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: A unique and expensive impact involves providing the Georgia-Pacific Corporation paper mill with an alternate water source during advisories. The mill normally draws water from the lake, but during water-use advisory periods its water supply can be switched to the City of Plattsburgh water system until advisories are lifted.

- Habitat impacts: No unique impacts.

- Cost: Treatment using Bayluscide 3.2% granules for river and delta treatment is estimated at $312,245 per full treatment, or $78,061 per year based on a four-year treatment cycle. Cost reductions would be commensurate with any treatment area reductions. This estimate includes the cost of water provided to Georgia-Pacific Corporation projected at $35,000 per treatment. Fixed water-use advisory times have been longer for Bayluscide treatments than for monitored advisory durations of TFM treatments, thus water cost for Georgia-Pacific are higher during Bayluscide treatment.

Barriers

- Technical considerations: A barrier already exists on the Saranac River in the form of the Imperial Mill Dam 3.3 miles upstream from Lake Champlain. A fishway is proposed for that dam to provide salmonids access to spawning habitats upstream. Provision to maintain the structure as a sea lamprey barrier will be incorporated into the fishway design. The barrier at the fishway will incorporate an adjustable weir designed to accommodate varying water levels. Based on current technology there are no other plans to establish sea lamprey barriers on the Saranac River closer to Lake Champlain. This lower portion of the River is a highly developed urban area poorly suited for further barrier development.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The cost of maintaining Imperial Mill Dam as a sea lamprey barrier will be associated with the design and construction of the movable weir within the salmonid passage structure. The project has been funded by the New York State Bond Act.

Trapping

- Technical considerations: The proposed fishway design may allow future, temporary trap installation for capture of spawning-phase sea lamprey during upstream migrations. No further upstream trapping is proposed for the Saranac River. Trapping in the Saranac River must be considered an additive control measure designed to prevent the redistribution of captured spawning-phase adults to other streams, and would probably not result in meaningful sea lamprey control in the absence of other control measures.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The proposed adult sea lamprey trapping operations would use temporary hardware or portable traps within or near the entrance to the fishway structure. Initial investments would involve expenditures for hardware. Long-term costs would be associated with the staff necessary for the operation and maintenance of traps during trapping operations estimated at $5,308 per year.

Saranac River System Control Strategy

Technically feasible control methods for the Saranac River system include TFM, TFM/niclosamide and Bayluscide 3.2% granule application, maintenance of the existing barrier and trapping at the barrier. The currently limited distribution of sea lamprey densities to the lower Saranac River and its delta suggests that Bayluscide 3.2% granule application be considered to those areas in lieu of a TFM or TFM/niclosamide application at the Imperial Mills Dam. A full-river lampricide treatment may expose areas of low sea lamprey abundance to lampricides while increasing potential for impacts. However, if sea lamprey infested habitat expands or Bayluscide 3.2% granule treatments is ineffective, full-river treatment from the Imperial Mills Dam will be undertaken. The Imperial Mill Dam would be maintained as a sea lamprey barrier and trapping of spawning-phase sea lamprey is recommended at the dam. As other control methods become feasible for use on the Saranac River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Maintain the Imperial Mill Dam as a sea lamprey barrier at river mile 3.3.

2. Apply Bayluscide 3.2% granules to localized infestations in the lower river and delta at four-year intervals. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

3. Apply TFM or TFM/niclosamide combination at river mile 3.3 (Imperial Mill Dam), only if Bayluscide treatment in the lower river should prove ineffective or infeasible.

4. Trap spawning-phase sea lamprey at the Imperial Mill Dam.

3. Salmon River and Delta

Sea lamprey habitat

Sea lamprey have access to the Salmon River from the river mouth to a natural bedrock barrier 4 miles upstream (Figure VIII-3), where TFM application has occurred during past treatments. Approximately 100 acres of delta contain habitat used by sea lamprey.

Treatment history/results

The Salmon River TFM and Delta Bayluscide treatment history is summarized in Tables VIII-5 and VIII-6 (Steinbach and Davis 1990a; NYSDEC, Ray Brook, New York, unpublished data; Neuderfer 1998a; Fisheries Technical Committee 1999). TFM treatment required an additional TFM application positioned at an unnamed tributary to eliminate the tributary as a refuge and to maintain target lampricide concentrations in downstream areas. Some secondary TFM spot treatments were conducted by a team of two who treated potential backwater sea lamprey refugia with portable backpack pumps. The Salmon River Delta was treated with Bayluscide 5% granules using cropduster aircraft.

Figure VIII-3.

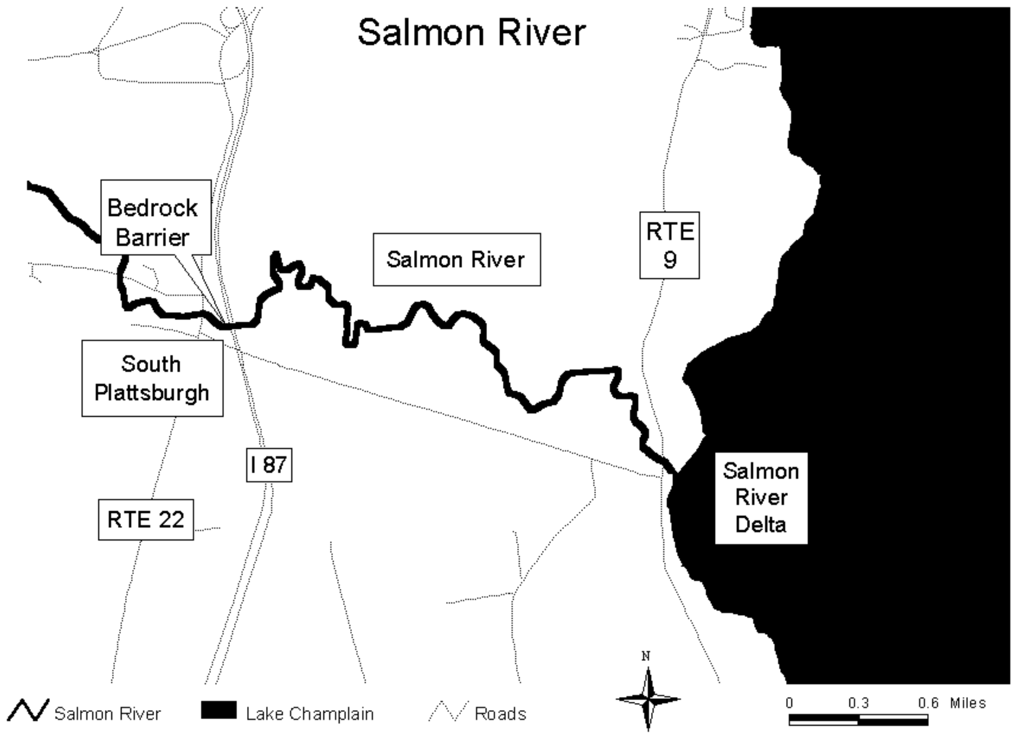


Table VIII-5. Salmon River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1990	4.0	51,852	12,976
1994	4.0	63,577	71
1998	4.0	18,733	18

Table VIII-6. Salmon River Delta Bayluscide treatment history.

Year of Treatment	Acres of Delta Treated with Bayluscide	Estimated Sea Lamprey Mortality
1991	54	1,550 (165 counted)
1995	54	50 counted

Screening Process

Estimated sea lamprey transformation

The Salmon River has the potential to produce a minimum of 13,000 transformers per year based upon transformer mortality estimates generated from the first round of experimental sea lamprey control. No sea lamprey transformer estimates were attempted for Salmon River Delta treatments.

TFM

- Technical considerations: TFM application is technically feasible on the Salmon River. Diurnal pH shifts are manageable and the positioning of an additional chemical feeder on a small unnamed tributary can be easily accommodated. Secondary treatment of backwater areas may occur to treat sea lamprey refugia that would not receive lethal TFM doses from the stream flow. If an effective sea lamprey barrier can be established near the mouth of the Salmon River, only one further TFM treatment would be necessary to rid the stream of sea lamprey infestations. Thereafter, TFM treatments would be avoided as long as the barrier remains effective. If such a barrier is not established on the Salmon River, sea lamprey control efforts would include TFM treatment on a four-year cycle unless more frequent TFM treatment intervals could eliminate or reduce the frequency of Salmon River Delta treatments.

- Nontarget concerns: Nontarget mortality encountered during the 1990 and 1994 TFM treatments are listed by the Fisheries Technical Committee (1999), and can be found in Appendix E. Low mortality was noted for seven common fish species, salamanders and crayfish. Future TFM treatments can be expected to produce similar nontarget mortalities. No threatened or endangered species are known to exist within the treatment areas of the Salmon River. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: A carbon filter was provided for the Valcour Lodge water supply. Valcour Lodge is a commercial lodging establishment located on the lake shore, south of the Salmon River, but within the advisory area.

- Habitat impacts: No unique impacts.

- Cost: Past treatments have indicated that TFM treatments of the Salmon River are highly effective in terms of sea lamprey killed relative to treatment cost. TFM treatment costs are estimated at $26,488 per treatment or $6,622 per year based on a four-year cycle of treatment.

TFM/Niclosamide

- Technical considerations: TFM/niclosamide combination treatment is not proposed for the Salmon River due to the complex application and analyses and additional personnel needs for treatment.

Bayluscide 3.2% Granules

- Technical considerations: Delta sea lamprey investigations will utilize deepwater electrofishing technology for periodic assessments. Bayluscide 3.2% granule application to sea lamprey-infested areas of the Salmon River Delta would be conducted by boat and applications would be considered every four years. Logistics of the experimental program Bayluscide 5% granule treatment of the Salmon River Delta were difficult due to the proximity of a marina and moorings located on parts of the delta. Many boats needed to be moved to accommodate aerial application, and a few that could not be moved needed to be cleaned after application. It is anticipated that boats will once again need to be moved to accommodate Bayluscide 3.2% granule application on the Salmon River Delta.

- Nontarget concerns: Nontarget mortality encountered during 1991 and 1995 Bayluscide treatments are listed by the Fisheries Technical Committee (1999). Banded killifish are a sensitive fish species likely to suffer considerable mortality during delta-wide treatments. Other observed mortalities included small numbers of fish of 11 common species. No threatened or endangered species are known to exist within the treatment area of the Salmon River Delta. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: During past delta treatments conducted with cropduster aircraft, a marina adjacent to the Salmon River Delta moved client's boats away from the treatment area where they were moored. Application of Bayluscide 3.2% granules by boat may require a similar effort in the future. The overlap of part of the Salmon River and Little Ausable River lake shore advisory zones for both TFM and Bayluscide treatments has potential to inconvenience some riparian owners in these areas with multiple advisories. Efforts to consolidate similar treatments of the Salmon and Little Ausable River systems within a short interval during the same year would minimize this impact.

- Habitat impacts: No unique impacts.

- Cost: The cost of Bayluscide 3.2% granule delta treatment may be reduced or avoided if treatment areas can be decreased in size or eliminated based on delta assessment surveys. A full delta treatment is estimated to cost $117,065 per treatment or $29,266 per year based on a four-year treatment cycle.

Barriers

- Technical considerations: The Salmon River provides an excellent setting for the development of a sea lamprey barrier near the stream mouth. If an effective barrier can be established, the entire stream above the barrier can be removed from TFM treatments. A definitive feasibility study must yet be undertaken to address cost and engineering issues.

- Nontarget concerns: Migration of some aquatic species may be affected by the barrier but no lake-run migrational fish species other than salmonids and sea lamprey are known to frequent the Salmon River, probably due to the steep initial gradient near the river mouth. Impacts of a barrier on salmonids could be mitigated by the construction of a series of jump pools to facilitate upstream passage of these fish. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: There would be an aesthetic visual impact associated with the concrete barrier especially in view of nearby stone structures. This visual impact could be mitigated with a more natural rock facing. The barrier would be constructed in a manner that would accommodate any flood events without increasing the hazard to any nearby structures.

- Habitat impacts: If a barrier is established near the mouth of the Salmon River, a small impoundment would be formed and a small portion of stream bed would be covered with a concrete structure tied to the banks with wing walls and rip-rap.

- Cost: Costs estimated at $299,116, associated with the construction of a barrier for the Salmon River could be considered one-time costs with a life expectancy of 50 years. Costs per year are estimated at $5,982. Savings would be large compared to repeated stream TFM and delta Bayluscide treatments otherwise necessary to achieve sea lamprey control on the Salmon River. Establishment of such a barrier is viewed as highly cost effective.

Trapping

- Technical considerations: A barrier on the Salmon River would incorporate a structure to accommodate a spawning-phase sea lamprey trapping operation, as a supplement to sea lamprey control afforded by the barrier. Trapping would prevent the redistribution of captured spawning-phase adults to other streams.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- <u>Habitat impacts</u>: No unique impacts.

- <u>Cost</u>: Spawning-phase sea lamprey trapping at the proposed barrier would be cost effective. Once the initial expenditure of trap construction is completed, the only costs are associated with the staffing, and vehicle use necessary for maintenance and operation of the trap (estimated at $4,758 per year). Portable traps would be more labor intensive and probably less effective at intercepting adult sea lamprey.

Salmon River System Control Strategy

Technically feasible control strategies for the Salmon River include TFM application, establishing a low-head barrier and trapping at the barrier. Of these strategies, a low-head barrier was determined to be the most cost effective means of control with few associated negative impacts. Trapping spawning-phase sea lamprey at the barrier would be conducted as an additional control method. The estimated annual cost of establishing a barrier is similar to the annual cost of TFM treatments and substantially less than a Bayluscide delta treatment. As other control methods become feasible for use on the Salmon River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Establish a barrier dam at river mile 0.1 if definitive engineering studies continue to support its feasibility, construction funding can be obtained, and landowners consent.

2. Trap spawning-phase sea lamprey at the barrier during upstream migrations.

3. Until an effective barrier can be established, or if an effective barrier can not be established, apply TFM to the lowermost 4.0 river miles at approximately four-year intervals. The time interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis, or if shorter intervals would eliminate the need to treat the delta with granular Bayluscide.

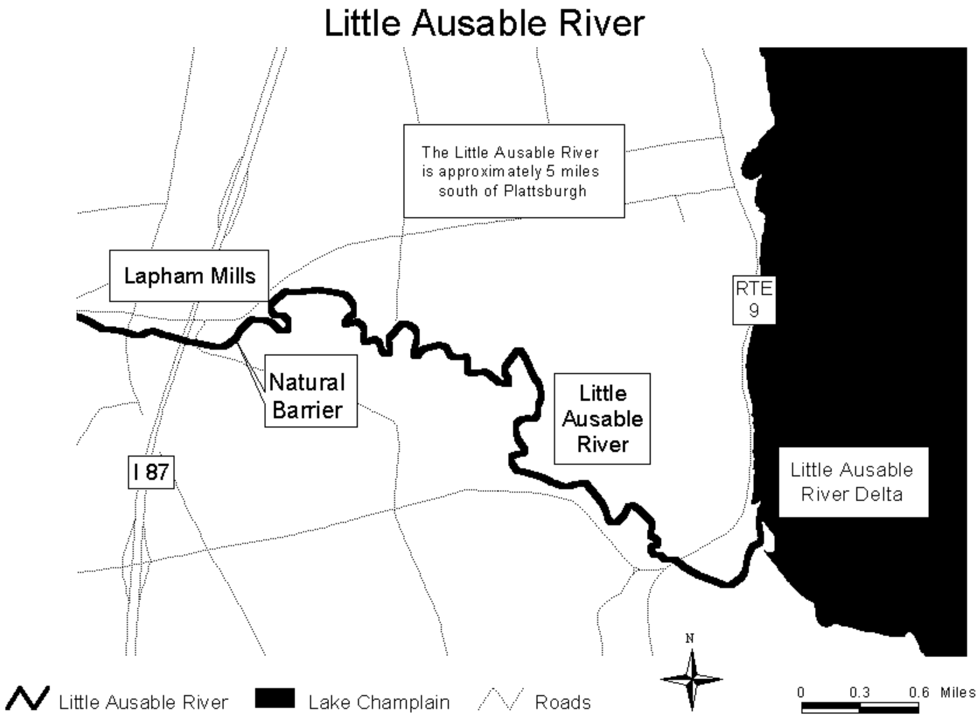
4. Apply Bayluscide 3.2% granules to localized infestations on the delta approximately every four years. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

4. Little Ausable River and Delta

<u>Sea lamprey habitat</u>

Sea lamprey have access to nearly 6.1 miles of the Little Ausable River (Figure VIII-4) and have infested up to 75 acres of its associated delta.

Figure VIII-4



<u>Treatment history/results</u>

The Little Ausable River TFM and Delta Bayluscide treatment history is summarized in Tables VIII-7 and VIII-8 (Steinbach and Davis 1990b; NYSDEC, RayBrook, New York, unpublished data; Neuderfer 1998b; Fisheries Technical Committee 1999). The overall length of the Little Ausable River treatment necessitated TFM boosting at a downstream location. Diurnal pH swings were of concern near wetlands but were accommodated through TFM application adjustments at the boost site. Delta Bayluscide 5% granule treatments were scheduled for 1991 and 1995 but only the 1991 treatment took place. Surveys indicated that sea lamprey recolonization on the Little Ausable Delta was insufficient to warrant Bayluscide 5% granule treatment in 1995. Bayluscide 5% granules were applied to the Little Ausable Delta using cropduster aircraft.

Table VIII-7. Little Ausable River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1990	6.1	91,045	31,411
1994	6.1	37,643	631
1998	6.1	12,189	30

Table VIII-8. Little Ausable River Delta Bayluscide treatment history.

Year of Treatment	Acres of Delta Treated with Bayluscide	Estimated Sea Lamprey Mortality
1991	54	8,548

Screening process

Estimated sea lamprey transformation

The Little Ausable River has the potential to produce over 31,000 sea lamprey transformers per year as determined from estimates generated from target mortality assessment during the experimental control program.

TFM

- Technical considerations: TFM application is technically feasible on the Little Ausable River. Access to primary and boost application points has been excellent thanks to the support and access provided by local landowners. Diurnal pH shifts do occur in the river and need to be considered in TFM application rates to accommodate toxicity changes. Secondary treatment of backwater areas may occur to treat sea lamprey refugia that would not receive lethal TFM doses from the stream flow. If TFM treatment remains a necessary sea lamprey control technique on the Little Ausable River, investigation into more frequent treatment intervals should be explored to determine if such measures could eliminate the need to treat the Little Ausable Delta with Bayluscide.

- Nontarget concerns: Nontarget mortality encountered during the 1990 and 1994 TFM treatments is listed by the Fisheries Technical Committee (1999), and can be found in Appendix E. A few mortalities of 19 common fish species, crayfish, salamanders, frogs and frog tadpoles and a mollusc were noted following treatments. The 1998 TFM treatment resulted in observed mortalities of only four fish of three common species and two dusky salamanders. Future TFM treatments could be expected to produce similar nontarget mortality. No threatened or endangered species are known to exist within the treatment area of the Little Ausable River. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment on the Little Ausable River is estimated to cost $26,767 per treatment or $6,692 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: The flows of the Little Ausable River are too low to warrant treatment with TFM/niclosamide in combination. Personnel requirements and the complexity of such a treatment would counter the benefits to be gained in terms of chemical savings.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is inappropriate for the riverine environment of the Little Ausable, but is proposed for use on the delta. Delta sea lamprey infestations will be surveyed and resulting information will be used to create infestation distribution maps. Bayluscide 3.2% granules would be applied to sea lamprey infestations by boat. If surveys demonstrate that delta sea lamprey populations are too low, periodic treatments may be avoided entirely. Bayluscide 3.2% granule treatments of the Little Ausable River Delta will be conducted approximately every four years if necessary.

- Nontarget concerns: Nontarget mortality encountered during the 1991 Bayluscide 5% granule treatment is listed by the Fisheries Technical Committee (1999). Banded killifish were strongly represented among species that suffered mortality. A few other common fish species were also affected. Invertebrate researchers (Gruendling and Bogucki 1993b) reported significant declines in five orders of invertebrates, but follow-up studies (Lyttle 1996) showed recovery of those invertebrates before the next scheduled Bayluscide granule treatment. Assessment teams reported a few additional mortalities of crayfish, tadpoles and an adult frog. Widespread Bayluscide 3.2% granule application on the Little Ausable River Delta is likely to result in similar nontarget mortality. Treatment of localized infestations by boat could reduce associated nontarget mortalities. No threatened or endangered species are known to exist within Bayluscide granule treatment areas of the Little Ausable River Delta. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: The overlap of part of the Little Ausable River, Salmon River and the Ausable River lake shore advisory zones for both TFM and Bayluscide treatments has the potential to inconvenience some riparian owners in these areas with multiple advisories. Efforts to consolidate similar treatments of the Little Ausable, Salmon and Ausable River systems within a short interval during the same year would minimize this impact.

- Habitat impacts: No unique impacts.

- Cost: Full Little Ausable Delta Bayluscide 3.2% granule treatment can be costly, estimated at $172,088 per treatment. With a four-year cycle of treatment, an estimated cost of $43,022 per year is projected. Costs could be reduced by treating only infested sections determined by delta assessment surveys. If it can be shown that recolonization of sea lamprey on the Little Ausable Delta is insufficient to warrant treatment at the scheduled time, treatment costs could be completely avoided. Surveys will provide the information necessary for treatment decision-making prior to scheduling Bayluscide delta treatment on the Little Ausable.

Barriers

- Technical considerations: Preliminary feasibility studies have shown that a potential site exists between 1.6 and 2.7 miles upstream of the river mouth within the zone of lake influence. Establishment of a sea lamprey barrier dam in this vicinity would eliminate access to nearly 100 percent of the sea lamprey spawning habitat that occurs in the river. Crest height of the dam was recommended to be set between 102.1 and 102.5 feet above mean sea level, (McAuley 1999, Ontario Ministry of Fisheries and Oceans, NYSDEC Memorandum), but may have to be constructed between 103.5 and 104.5 feet (Tollisen 1999, NYSDEC, Memorandum). McAuley projected sea lamprey barrier penetration to upstream areas once in 25 years for a dam with a crest height of 102.5 feet. Further engineering studies will be necessary.

- Nontarget concerns: Aquatic species migrations within the Little Ausable River including smallmouth bass, white sucker and emerald shiner, could be impacted. Jump pools would be provided for salmonid migration as a mitigation measure, but species unable to negotiate the jump pools may be restricted to the lower reaches of the river.

- Human impacts: There would be an aesthetic visual impact associated with the barrier. The prospective site is shielded from a nearby secondary road by vegetation, however. The barrier would be constructed in a manner that would accommodate substantial flood events. There are no nearby structures or development that would be impacted by elevated water levels. However, several landowners could experience permanent flooding of riverside property and landowner purchase/consent agreements would have to be negotiated.

- Habitat impacts: Establishment of a sea lamprey barrier dam with a crest height of 103.5 feet would inundate approximately 16.5 additional acres beyond the area now covered by the river. An additional 28 acres would be inundated at a crest height of 104.5 feet. The dam would occupy a section of sand and fine gravel stream bed and would be tied to the stream banks with wing walls. Likely construction materials would be steel sheet pile and concrete.

- Cost: The estimated construction cost ($305,501) of a barrier for the Little Ausable River could be considered a one-time cost with an assumed life expectancy of 50 years ($6,110 per year). New York State Bond Act funds totaling $226,500 have been secured, but may be redirected due to habitat and nontarget issues at this site. Additional costs would be incurred to purchase flooding rights from affected landowners.

Trapping

- Technical considerations: Provision for an adult sea lamprey trap would be incorporated into the design of the sea lamprey barrier. Establishing the Little Ausable as a sea lamprey adult trapping site will provide assessment information and prevent redistribution of captured spawning-phase adults to other streams. Without barrier construction, no trapping is proposed.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The initial expenditure of trap provision is incorporated into the barrier construction costs. Estimated costs are associated with the staffing necessary for maintenance and operation of the trap ($4,758 per year). Portable traps would be more labor intensive and probably less effective at intercepting adult sea lamprey.

Little Ausable River System Control Strategy

Technically feasible control strategies for the Little Ausable River include TFM and Bayluscide 3.2% granule application, establishing a low-head barrier and trapping at the barrier. Of these strategies, lampricide treatments (TFM stream and Bayluscide 3.2% granule delta) were determined to be the most effective control measures with acceptable negative impacts. Successful TFM stream treatments preventing reinfestations of the associated delta may preclude the need for delta Bayluscide 3.2% granule treatments. A sea lamprey barrier with a trap will be considered if adverse impacts from the barrier can be addressed. As other control methods become feasible for use on the Little Ausable River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Apply TFM to the lowermost 6.1 miles of the Little Ausable River at approximately four-year intervals. The time interval could be adjusted should sea lamprey surveys indicate slow recolonization, early metamorphosis, or if shorter intervals would eliminate the need to treat the delta with Bayluscide 3.2% granules.

2. Apply Bayluscide 3.2% granules by boat to the delta every four years. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

3. If satisfactory mitigation of adverse impacts can be accomplished, consider establishing a barrier on the Little Ausable between river miles 1.6 and 2.7. An effective barrier may eliminate the need for lampricide treatment.

4. Incorporate a trap for adult sea lamprey into the barrier dam structure if constructed.

5. Ausable River and Delta

Sea lamprey habitat

Sea lamprey access is limited to the 7.0 miles of river (includes both north and south channels) below Rainbow Falls located at the upstream limit of the Ausable Chasm (Figure VIII-5). Larval sea lamprey occupy the lower 6 miles of this section. Habitat is unsuitable for larval sea lamprey in the section through the Ausable Chasm. Most sea lamprey larvae are concentrated in lower reaches of the river. Sea lamprey larvae also utilize up to 250 acres of associated delta.

Treatment history/results

The Ausable River TFM and Delta Bayluscide treatment history is summarized in Tables VIII-9 and VIII-10 (Steinbach and Davis 1990c; NYSDEC, Ray Brook, New York, unpublished data; Fisheries Technical Committee 1999; Neuderfer 1999a). The Ausable River TFM treatments required simultaneous treatment of 0.5 mile of Dry Mill Brook, a small tributary entering the river near the Route 9 bridge. Substantial diurnal pH shifts were noted during experimental treatments and were a consideration in the selection of TFM application rates and timing. Infiltration of TFM into the 1.5 miles of sea lamprey infested Lower Mouth of the Ausable River was insufficient to provide lethal concentrations in 1990 and 1994. This resulted in near zero sea lamprey mortality during both the 1990 and 1994 TFM treatments for the Lower Mouth. In 1999, the channel was completely isolated from the mainstem and a portion of this isolated section was treated with TFM using backpack sprayers. Delta Bayluscide 5% granular applications were conducted using cropduster aircraft in 1991 and 1995.

Figure VIII-5.

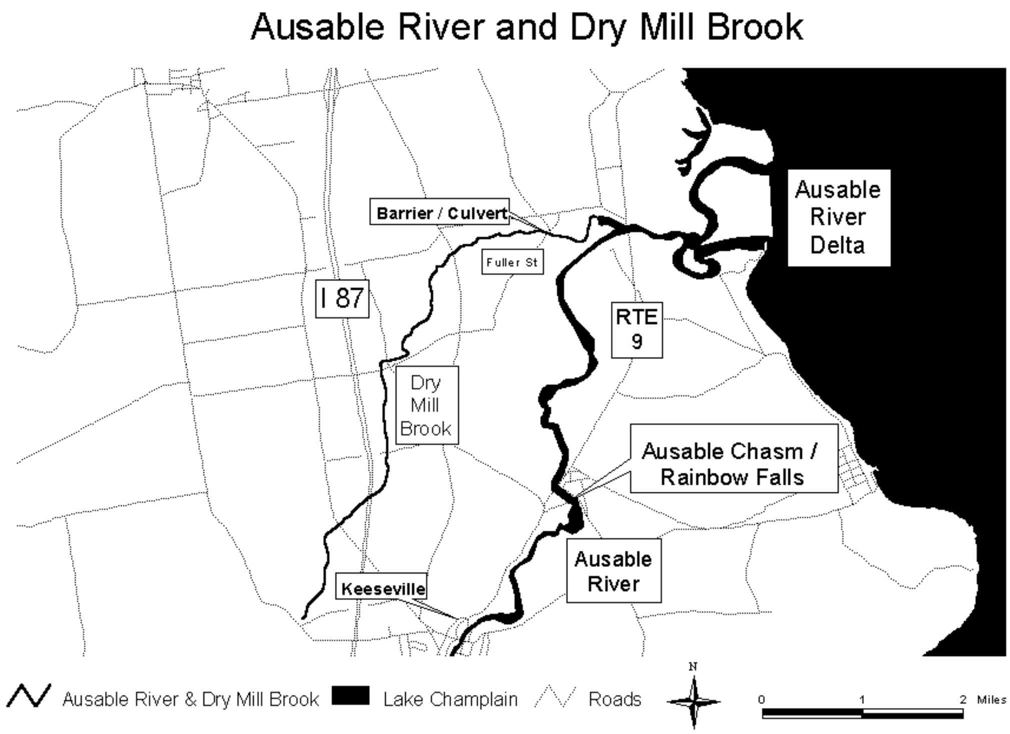


Table VIII-9. Ausable River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1990	7.0	22,196	2,310
1994	7.0	68,162	1,081
1999	7.0	25,276	1,315

Table VIII-10. Ausable River Delta Bayluscide treatment history.

Year of Treatment	Acres of Delta Treated with Bayluscide	Estimated Sea Lamprey Mortality
1991	165	20,697 (102 counted)
1995	182	1,905 counted

Screening Process

Estimated sea lamprey transformation

The Ausable River has the potential to produce a minimum of 2,000 sea lamprey transformers per year as determined from mortality data collected during the first Ausable River TFM treatment.

TFM

- Technical considerations: TFM treatment of the Ausable River is technically feasible using standard methodologies with the exception of the Lower Mouth. Treatment history has shown lampricide infiltration to the Lower Mouth to be insufficient to cause sea lamprey mortality necessary for effective control. Expectations are that TFM treatment can provide sea lamprey control for the main stem and north channels of the Ausable River. Diurnal pH shifts were noted during experimental control and would be accommodated with TFM application adjustments during any future treatments. Future treatments (spring or fall) would require simultaneous treatment of 0.5 mile of Dry Mill Brook. No other boosts are proposed for Ausable River treatments. Secondary treatment of backwater areas may occur to treat sea lamprey refugia that would not receive lethal TFM doses from the stream flow. If it can be shown that more frequent treatment intervals with TFM could eliminate the need to treat the delta with granular Bayluscide, then more frequent TFM treatments will be considered.

- Nontarget concerns: Nontarget mortality encountered during the 1990 and 1994 TFM treatments are listed in Fisheries Technical Committee (1999), and can be found in Appendix E. Treatments have resulted in considerable mortality of American brook lamprey. Mudpuppies also were found dead after each treatment. A few mortalities were also noted for 9 common fish species, crayfish, salamanders, frog tadpoles, mussels and snails after each of the first two treatments. Assessments (routine and special studies) following the 1999 TFM treatment recorded mortalities among American brook lamprey, 17 other common fish species, a few invertebrates, frog tadpoles, mudpuppies and two-lined salamanders. Future TFM treatments of the Ausable River can be expected to result in similar nontarget mortalities. Spring treatment may mitigate nontarget mortality as pH swings would probably be less pronounced. No threatened or endangered species are known to exist within the treatment area of the Ausable River. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: Temporary suspension of rafting and tube rides associated with the Ausable Chasm tourist attraction may be necessary during TFM treatments.

- Habitat impacts: No unique impacts.

- Cost: Periodic TFM treatments would be a cost effective sea lamprey control measure for the Ausable River ($57,443 per treatment or $14,361 per year based on a four-year cycle treatment cycle), but not necessarily the best option. Simultaneous treatment with TFM/niclosamide has advantages over TFM application alone and may provide a better treatment option.

TFM/Niclosamide

- Technical considerations: The high river flows of the Ausable River suggest that simultaneous treatment using a TFM/niclosamide combination would achieve comparable sea lamprey control results with less total lampricide used. Such a treatment would reduce the overall lampricide volume to the river and lake, and provide a considerable cost savings. TFM/niclosamide treatment is more staff intensive but acceptable in view of the potential to realize considerable benefits over TFM treatment alone (see Section IV.A.2.).

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: Human impacts would be similar to those listed for TFM treatment except that chemical exposure would be lower and duration of advisories could be comparably shorter due to the lesser amounts of chemical used for combination treatment.

- Habitat impacts: No unique impacts.

- Cost: TFM/niclosamide combination treatment is projected to cost $43,049 per treatment or $10,762 per year based on a four-year treatment cycle.

Bayluscide 3.2% Granules

- Technical considerations: There are two proposed uses of Bayluscide 3.2% granules: the Ausable Delta and the 1.5 mile Lower Mouth Ausable River that has never been effectively treated with TFM. Sea lamprey control experience, changes in the Bayluscide formulation and investigative survey technology have resulted in some positive changes for proposed lampricide treatment of the Ausable Delta and the Lower Mouth. Delta and Lower Mouth sea lamprey infestations will be surveyed using deepwater electrofishing techniques and resulting information will be used to create infestation distribution maps. Bayluscide 3.2% granule application would be conducted by boat. If surveys demonstrate sea lamprey populations below levels warranting chemical treatment, periodic treatments may be avoided entirely. Granular Bayluscide treatments of the Lower Mouth of the Ausable River and Ausable Delta will be considered every four years.

- Nontarget concerns: Nontarget mortality encountered during the 1991 and 1995 Bayluscide treatments is listed by the Fisheries Technical Committee (1999). Species likely to suffer mortality are banded killifish, mimic shiners, spottail shiners, American brook lamprey and molluscs. Mollusc recolonization studies conducted during experimental sea lamprey control indicated that populations returned to levels at or above pre-treatment levels within four years after treatment (Lyttle 1996). Future nontarget mortality could be minimized with spot/area treatments of known sea lamprey infestations to be mapped with deepwater electrofishing gear. Extensive use of Bayluscide 3.2 % granules in the Lower Mouth, however, will likely cause substantial mortalities of those species noted above that might be present as well as those killed there during the 1999 TFM treatment, especially bluntnose minnow, tesselated darter and frog tadpoles (Neuderfer 1999a). No threatened or endangered species are known to exist within the Bayluscide 3.2% granule treatment area of the Ausable River or delta. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: Due to the possibility of segmented treatments (Ausable mainstem, Ausable Delta and Ausable Lower Mouth) and the overlap of part of the Little Ausable lake shore advisory zones for both TFM treatment and Bayluscide delta work, there may be a burden of multiple advisories to some riparian water users lying within the advisory boundaries of all four treatments. Also, the advisory period within the Lower Mouth and associated lake shore area may be extended substantially if low flows slow dissipation of lampricide. Efforts to consolidate similar treatments of the Ausable and Little Ausable River systems within a short interval during the same year would minimize the impact.

- Habitat impacts: No unique impacts.

- Cost: Bayluscide 3.2% granule application of the entire Ausable Delta would be costly (projected at $348,602 per treatment based on a four-year treatment cycle or $87,151 per year). Bayluscide 3.2% granule application to the Lower Mouth is projected at $65,883 per treatment with a 40 acre application, or $16,471 per year based on a four-year treatment cycle. If sea lamprey delta infestations are surveyed and mapped, there may be opportunity to avoid full area treatments, thus lowering costs and minimizing environmental effects. Should surveys demonstrate sea lamprey infestations below levels warranting Bayluscide treatments, then entire treatments might be avoided.

Barriers

- Technical considerations: The majority of this lower river area is composed of lake backwater river channel and low lying topography. There are no suitable sites for the development of a sea lamprey barrier on the Ausable River.

Trapping

- Technical considerations: The Ausable River is poorly suited for sea lamprey trapping operations and trapping is not proposed.

Ausable River System Control Strategy

Technically feasible control strategies for the Ausable River include TFM and TFM/niclosamide stream treatments and Bayluscide 3.2% granule delta treatments. A TFM/niclosamide stream treatment was determined to be the more cost effective and may result in fewer negative impacts than TFM treatment alone. Effective TFM or TFM/niclosamide stream treatments at regular intervals may prevent future delta infestations, possibly precluding the need for scheduled delta Bayluscide 3.2% granule treatments. As other control methods become feasible for use on the Ausable River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Treat the Ausable River at river mile 6.5 (Rainbow Falls) with TFM or TFM/niclosamide every four years. The time interval could be adjusted should sea lamprey surveys indicate slow recolonization, early metamorphosis, or if shorter intervals would eliminate the need to treat the delta with granular Bayluscide. Springtime treatment may be required to afford effective treatment conditions in the Ausable River Lower Mouth.

2. Apply Bayluscide 3.2% granules or TFM by boat to sea lamprey infestations in the Lower Mouth of the Ausable River (in lieu of springtime TFM or TFM/niclosamide combination treatments) if necessary, and apply Bayluscide 3.2% granules to the delta every four years. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

5a. Dry Mill Brook

Sea lamprey habitat

Sea lamprey distributions are believed to be limited to the lower 0.5 miles of Dry Mill Brook (see Ausable River site map; Figure VIII-5). The upstream limit of sea lamprey access to the brook terminates at the first road crossing above the confluence with the Ausable River where a raised culvert and a natural waterfall present a barrier to adult sea lamprey.

Treatment history/results

The Dry Mill Brook TFM treatment history is summarized in Table VIII-11 (Steinbach and Davis 1990c; Fisheries Technical Committee 1999; Neuderfer 1999a; NYSDEC, Ray Brook, New York, unpublished data). Substantial sea lamprey mortality was noted after each TFM treatment with minimal nontarget mortality noted. Except in 1990, Dry Mill Brook target/nontarget surveys included a portion of the Ausable River above and below the confluence so counts could not be isolated by stream. Future surveys may isolate Dry Mill Brook for individual assessment.

Table VIII-11. Dry Mill Brook TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1990	0.5	540	67
1994	0.5	no estimate	no estimate
1999	0.5	no estimate	no estimate

Screening Process

Estimated sea lamprey transformation

Dry Mill Brook is capable of producing a minimum of 67 sea lamprey transformers per year as indicated by mortality assessments conducted after the first treatment.

TFM

- Technical considerations: TFM treatment of Dry Mill Brook is straightforward. Application at Fuller Street (river mile 0.5), the first road-crossing above the confluence with the Ausable River, must be timed to converge with the progress of the TFM bank from the treatment of the Ausable River. Dry Mill Brook would be treated with TFM only as part of the Ausable River treatment and may require secondary treatment of backwater sea lamprey refugia.

- Nontarget concerns: Nontarget mortality recorded for Dry Mill Brook and nearby areas of the Ausable River (Neuderfer 1999a) was low for all TFM treatments and consisted of a few American brook lamprey, eight other common fish species, frogs, mudpuppies and two-lined salamanders and a single crayfish. Similar nontarget mortality can be expected with future TFM treatments. No threatened and endangered species are known to exist within the treatment area of Dry Mill Brook. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts

- Cost: The cost of Dry Mill Brook TFM treatment are included in the costs associated with Ausable River TFM treatment. Dry Mill Brook would not be treated independently of the Ausable River.

TFM/Niclosamide

- Technical considerations: If the Ausable River is treated with a TFM/niclosamide combination, Dry Mill Brook would be treated with TFM only, due to the small size of the tributary and the complicated nature of Bayluscide application and analysis. TFM treatment would be timed to coincide with a treatment on the Ausable River.

Bayluscide 3.2% Granules

- Technical considerations: No use of granular Bayluscide is planned for Dry Mill Brook. Granular Bayluscide is inappropriate for use in such riverine environments.

Barriers

- Technical considerations: Lampricide application would occur at the Fuller Street barrier and no barrier dam development is proposed for a location closer to the confluence with the Ausable River.

Trapping

- Technical considerations: Since the Ausable River will require lampricide treatment for sea lamprey control, Dry Mill Brook will be treated to eliminate the tributary as refugia and counter its dilution effect to that treatment. Trapping using PATs is possible at the Fuller Road site, but would not result in any additional benefit to sea lamprey control efforts.

Dry Mill Brook Control Strategy

TFM application is the only technically feasible control method for Dry Mill Brook. Treatment of Dry Mill Brook would be conducted only in association with concurrent treatment of the Ausable River. TFM treatment is necessary to prevent its use as a sea lamprey refuge during lampricide treatment of the Ausable River, and to prevent attenuation of the chemical block in the Ausable River below the confluence of the two streams. The necessity of this treatment precludes other efforts of control such as barriers or trapping. As other control methods become feasible for use on the Ausable River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

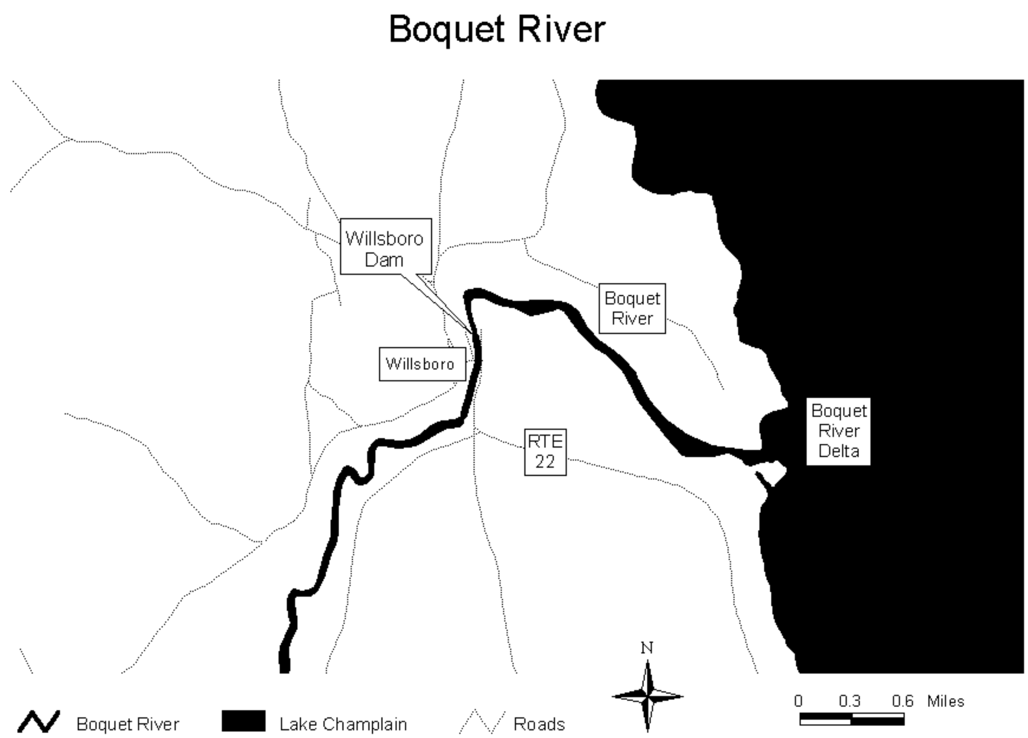
1. Treat with TFM at the Fuller Street culvert (river mile 0.5) only in conjunction with Ausable River TFM or TFM/niclosamide treatments.

6. Boquet River and Delta

Sea lamprey habitat

Sea lamprey have access to 2.6 miles of river extending upstream from the mouth to the dam in Willsboro (Figure VIII-6) and use up to 250 acres of delta at the river mouth. The Willsboro dam is a barrier to sea lamprey and is equipped with a fishway for salmonid passage that contains a weir with a projecting steel lip in the interior jump pool to maintain the structure as a barrier to sea lamprey.

Figure VIII-6.



Treatment history/results

The Boquet River TFM and Delta Bayluscide treatment history is summarized in Tables VIII-12 and VIII-13 (Steinbach and Davis 1990d; Fisheries Technical Committee 1999; Neuderfer 1999b; NYSDEC, Ray Brook, New York, unpublished data). Diurnal pH shifts presented no problem for Boquet River TFM treatments and no boosts were required to conduct treatments.

Secondary treatment of backwater sea lamprey refugia was conducted by boat and by foot. The Boquet Delta was treated with Bayluscide 5% granules using cropduster aircraft.

Table VIII-12. Boquet River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1990	2.6	5,128	1,197
1994	2.6	6,492	72
1999	2.6	1,904	67

Table VIII-13. Boquet River Delta Bayluscide treatment history.

Year of Treatment	Acres of Delta Treated with Bayluscide	Estimated Sea Lamprey Mortality
1991	210	35,879
1995	210	no estimate

Screening process

Estimated sea lamprey transformation

The Boquet River has the potential to produce over 1,000 sea lamprey transformers per year as determined from mortality data collected during the first Boquet River TFM treatment of experimental sea lamprey control.

TFM

- Technical considerations: The setting of the Boquet River allows for a straightforward TFM treatment. Diurnal pH shifts are small and easily accommodated, the entire 2.6 mile river segment can be treated from one primary application site, (no boosts are necessary for maintenance of target lampricide concentrations) and the river is easily accessed for secondary treatment of backwater sea lamprey refugia. If it can be shown that TFM treatment intervals shorter than four years could eliminate the need to treat the delta with Bayluscide 3.2% granules, then more frequent TFM treatments will be considered.

- Nontarget concerns: Nontarget mortality that resulted from TFM treatments in 1990, 1994 (Fisheries Technical Committee 1999) and during an independent New York treatment in 1999 was low (see Appendix E). During the 1990 treatment only a few mortalities of five common fish species were counted. During the 1994 treatment, few mortalities of eight common fish species, frog tadpoles and adults, and one crayfish mortality were counted during routine nontarget assessments. The 1999 treatment resulted in mortalities of ten common fish species, silver lamprey, frog tadpoles and four individual mussels. Future TFM treatments would be expected to produce similar nontarget mortalities. No threatened and endangered species are known to exist within the treatment area of the Boquet River. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of the Boquet River is effective in terms of sea lamprey eliminated, and costs are acceptable ($44,705 per treatment or $11,176 per year based on a four-year treatment cycle). Costs and chemical exposure to the environment could be reduced further however, by conducting a TFM/niclosamide combination treatment instead of TFM treatment.

TFM/Niclosamide

- Technical considerations: Treatment with a TFM/niclosamide combination is technically well suited for the Boquet River. The relatively high flows of the Boquet offer an opportunity to reduce costs and reduce the overall volume of lampricide applied through combination treatment. The Boquet represents a fairly simple treatment scenario with a single application point (no boosts, no tributaries). Secondary treatment of backwater areas would be conducted with TFM only.

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: Treatment of the Boquet River with a TFM/niclosamide combination is estimated to cost $30,806 per treatment or $7,702 per year based on a four-year treatment cycle.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide 3.2% granule application is proposed for the Boquet Delta. Delta sea lamprey investigations will utilize deepwater electrofishing technology for periodic assessments culminating in the production of delta sea lamprey density maps. Treatment by boat of infested areas of the Boquet River Delta will be considered every four years.

- Nontarget concerns: Nontarget mortality encountered during the 1991 and 1995 experimental Bayluscide treatments is listed by the Fisheries Technical Committee (1999). Assessments following the 1995 evening delta treatment were truncated due to darkness. Species likely to suffer considerable mortality are banded killifish and molluscs. Future Bayluscide delta treatments may result in less nontarget mortality provided sea lamprey densities targeted for treatment are localized, which should allow portions of the delta to go untreated. No threatened and endangered species are known to exist within the treatment area of the Boquet River and Delta. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: Treatment of the entire 250 acre delta area with Bayluscide 3.2% granules is estimated to cost $399,458 per treatment or, $99,865 per year if a four-year treatment cycle is implemented. If the size of treatment area can be reduced, significant savings would result in monetary costs and environmental impacts would be minimized. Delta assessment surveys will be used to create sea lamprey distribution maps in an attempt to isolate and target only sea lamprey infested areas with Bayluscide 3.2% granules. The delta treatment area could be much reduced or even eliminated for a given treatment cycle using these techniques.

Barriers

- Technical considerations: A sea lamprey barrier is already present on the lower Boquet River at the Willsboro Dam (river mile 2.6). A fishway provides salmonid passage upstream at the dam and has a sea lamprey barrier incorporated into the fishway design. Observations have indicated that sea lamprey are unable to reach this barrier due to the steep river gradient immediately below, but as added insurance, the fishway barrier will be maintained. No other feasible barrier sites exist closer to Lake Champlain.

Trapping

- Technical considerations: The Boquet River setting is poorly suited for adult sea lamprey trapping because sea lamprey are unable to navigate the cascades immediately downstream of the Willsboro Dam. No trapping is currently proposed.

Boquet River System Control Strategy

Technically feasible control methods for the Boquet River include TFM, TFM/niclosamide and Bayluscide 3.2% granule application, and barrier maintenance at the Willsboro Dam. A TFM/niclosamide stream treatment was determined to be most cost effective and would result in fewer impacts than a TFM treatment alone. Effective TFM or TFM/niclosamide treatments at regular intervals may prevent future delta infestations, possibly precluding the need for delta Bayluscide 3.2% granule treatments. The Willsboro Dam barrier will be maintained. As other control methods become feasible for use on the Boquet River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Maintain the Willsboro Dam as a sea lamprey barrier at river mile 2.6.

2. Treat the Boquet River with TFM or TFM/niclosamide every four years at the Willsboro Dam. The time interval could be adjusted should sea lamprey surveys indicate slow recolonization, early metamorphosis, or if shorter intervals would eliminate the need to treat the delta with Bayluscide 3.2% granules.

3. Treat the Boquet Delta with Bayluscide 3.2% granules by boat. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

7. Beaver Brook

Sea lamprey habitat

The 2.5 miles of Beaver Brook closest to Lake Champlain represents the habitat available for larval sea lamprey colonization (Figure VIII-7).

Treatment history/results

The Beaver Brook TFM treatment history is summarized in Table VIII-14 (Steinbach1990; Neuderfer 1998c; Fisheries Technical Committee 1999). Low water conditions led to the TFM application point being moved downstream in 1990 where only the last mile of brook was treated. The scheduled 1994 treatment was avoided due to low sea lamprey recolonization indicated by pre-treatment sea lamprey surveys.

Figure VIII-7

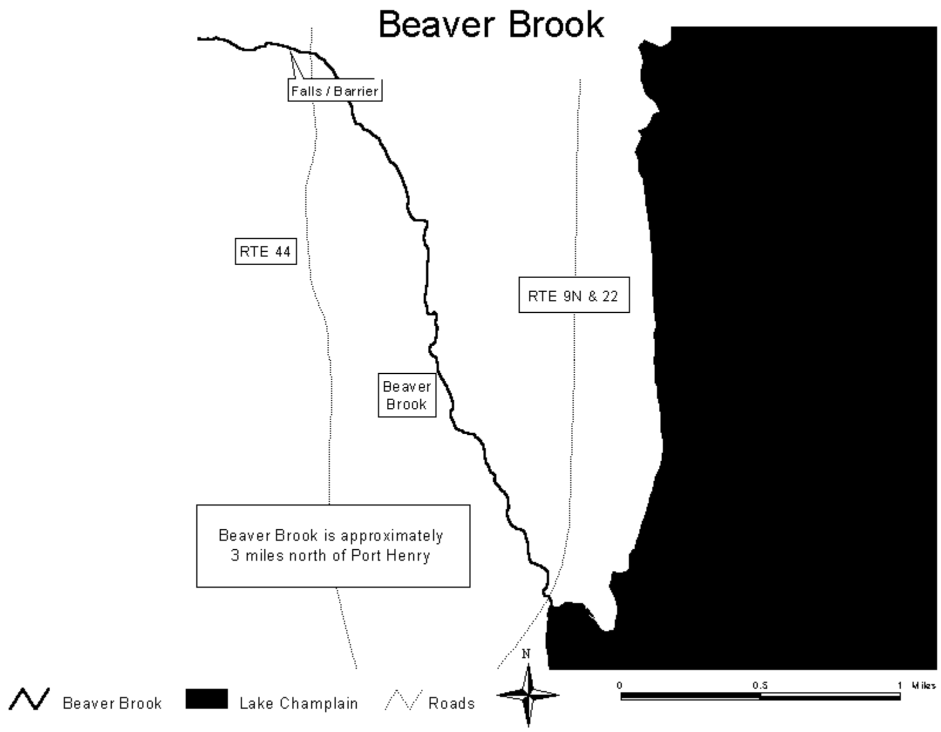


Table VIII-14. Beaver Brook TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1990	1.0	874	131
1998	2.5	667	287

Screening Process

Estimated sea lamprey transformation

Beaver Brook has the potential to produce a minimum of 131 sea lamprey transformers per year as determined from target mortality estimates collected after the first TFM treatment of Beaver Brook during the experimental sea lamprey control program.

TFM

- Technical considerations: Beaver Brook has substantial beaver impoundment activity that interferes with TFM distribution and progression downstream. Many beaver dams had been breached prior to past TFM treatments, but many also remained. Low stream flows slow the progression of the chemical bank downstream and allow attenuation of the chemical concentration over time. Substantial backpack spraying of remaining beaver impoundments and backwater areas may be necessary for effective TFM treatment. Diurnal pH shifts are not problematic on Beaver Brook. A possible means to deal more efficiently with the chemical attenuation problem, would be to establish two simultaneous TFM feeds, one at the primary application point (AP) and another approximately midway from the AP to the mouth.

- Nontarget concerns: Nontarget mortality encountered during the 1990 TFM experimental treatment can be found in Appendix E, and is listed by the Fisheries Technical Committee (1999) and include silver lamprey, a few individuals of three common fish species and two salamanders. The 1998 TFM treatment resulted in higher mortalities for eleven common fish species, frog tadpoles and salamanders. No threatened or endangered species are known to exist within the TFM treatment zone of Beaver Brook. Simultaneous TFM feeds from two AP's would expose the lower stream section to two separate banks of TFM. Elevated nontarget mortality could occur due to longer exposure times resulting from two simultaneous TFM feeds. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment is estimated to cost $18,611 per treatment or $4,653 per year based on a four-year treatment cycle.

TFM/niclosamide

- Technical considerations: The low flows of Beaver Brook preclude a combined TFM/niclosamide treatment due to the added complexity of combined treatment and the additional personnel required.

Bayluscide 3.2% Granules

- Technical considerations: The riverine setting of Beaver Brook is unsuited for use of Bayluscide granules and it is not proposed for use there.

Barriers

- Technical considerations: Beaver Brook is a small stream that could potentially be removed from lampricide exposure by the installation of a sea lamprey barrier or barriers on the mainstem and tributaries. However, the landowners with the most promising sites for a structure that would block 100 percent of sea lamprey spawning habitat are presently unwilling to consider the sale of the necessary parcels. It is likely that some of these sites are in the zone of lake level influence making barrier development at these sites problematic. Other sites further upstream are currently being investigated.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: Establishing a barrier on Beaver Brook is estimated to cost $75,000 with an expected durable life of 50 years. This equates to $1,500 per year. Additional costs may be incurred securing landowner consent and securing property necessary for development.

Trapping

- Technical considerations: Difficult access, high water in spring and problematic instream debris make spawning-phase sea lamprey adult trapping operations unlikely on Beaver Brook and such operations are not proposed. If a barrier is established and a permanent trap could be incorporated into the structure then trapping efforts may be reconsidered.

Beaver Brook Control Strategy

Technically feasible control methods for Beaver Brook include TFM application and a potential sea lamprey barrier. Prior TFM stream treatments have been challenging but effective. A barrier was determined to have few negative impacts and the annual costs are more favorable than TFM application. Landowner consent must be secured, however, before a barrier can be employed. As other control methods become feasible for use on Beaver Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Establish a sea lamprey barrier (or barriers) on Beaver Brook and accessible sea lamprey tributaries if feasible and landowners consent. Investigate the applicability of spawning-phase sea lamprey trapping at the barrier if established.

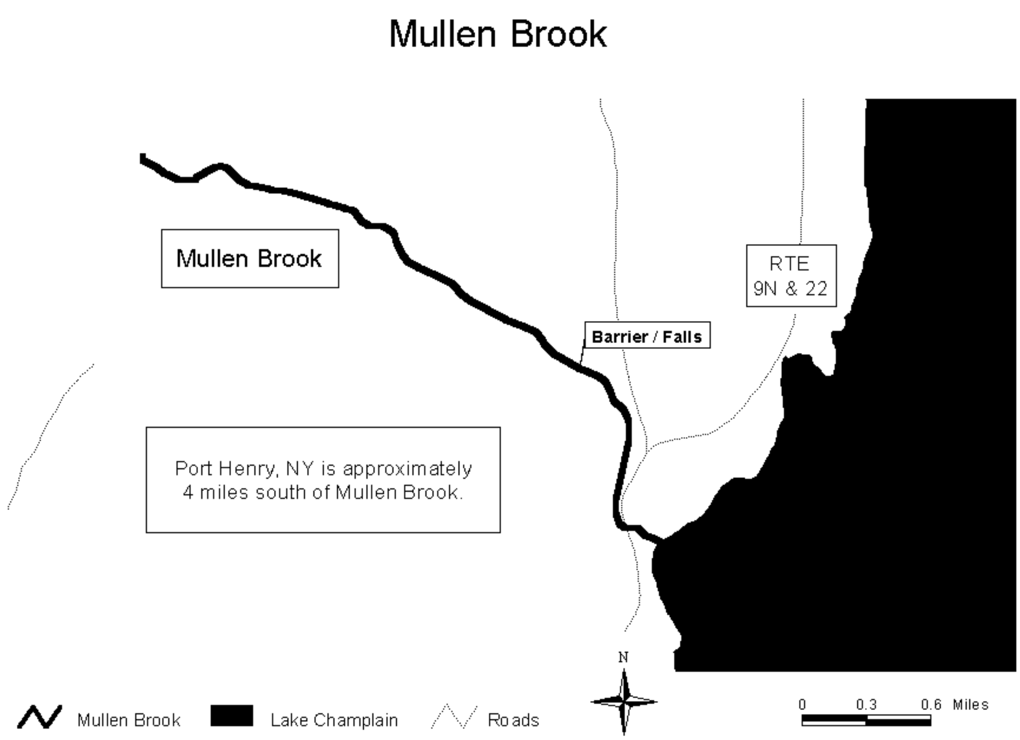
2. Until an effective barrier system can be established or if an effective barrier system is not established, apply TFM to the lowermost 2.5 stream miles at approximately four-year intervals. The time interval could be adjusted should sea lamprey surveys indicate either slow *recolonization or early metamorphosis.*

8. Mullen Brook

Sea lamprey habitat

Sea lamprey larvae have recently been observed in Mullen Brook. Sea lamprey access is limited to the lowermost 1.0 miles of stream below a natural barrier (Figure VIII-8).

Figure VIII-8.



Treatment history/results

Mullen Brook was not included as a control location during the experimental program because observations indicated sea lamprey were not present prior to the program.

Screening Process

Estimated sea lamprey transformation

No current estimates of sea lamprey transformer production exist for Mullen Brook but preliminary surveys in 2000 indicate sea lamprey abundance is probably low. A preliminary habitat evaluation in 2000 (David Nettles, USFWS, personal communication) indicates that sea lamprey larval habitat is concentrated in the lowermost 0.3 miles of stream. Surveys will be scheduled to get initial estimates of larval sea lamprey densities and some determination of the potential for sea lamprey transformer production prior to implementing sea lamprey control activities.

TFM

- Technical considerations: Technically, the Mullen Brook setting presents no unique difficulties that would complicate TFM treatments. It is a relatively small stream with a rural agricultural setting and sparse human development.

- Nontarget concerns: American brook lamprey are present and sensitive to TFM. Considerable American brook lamprey mortality can be expected if standard TFM application practices are followed. The extent of the American brook lamprey population should be investigated to determine if there would be unimpacted populations outside of any proposed TFM application areas. Mullen Brook was designated as a potential donor water for transfer of American brook lamprey to the Ausable River should lampricide treatment be terminated there and the American brook lamprey population be determined to be non-viable as a result of those treatments (Nashett and Durfey 1990). No threatened or endangered species are known to exist within the treatment zone of Mullen Brook. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: Currently unknown. No unique impacts are expected.

- Habitat impacts: No unique impacts.

- Cost: TFM lampricide treatment costs are estimated at $17,868 per treatment or $4,467 per year based on a four-year cycle of treatment.

TFM/Niclosamide

- Technical considerations: TFM/niclosamide combination treatment is not planned for Mullen Brook due to its small discharge, the complexity of treatment and analyses, and additional personnel necessary.

Bayluscide 3.2% Granules

- Technical considerations: No use of granular Bayluscide is currently planned for Mullen Brook Delta because deepwater habitats are thought unlikely to contain a sea lamprey population warranting control at this location. If future surveys indicate differently then Bayluscide application will be reevaluated.

Barriers

- Technical considerations: Mullen Brook has not been scrutinized for barrier application because it was not targeted for treatment under the experimental control program. Investigation of the application of barrier technology for Mullen Brook is needed. Other screening discussion for barriers will be deferred until more information is known.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: Establishing a barrier on Mullen Brook is projected to cost approximately $75,000. Assuming a 50 year structure durability the annual cost is estimated at $1,500.

Trapping

- Technical Considerations: Mullen Brook may be a candidate for spawning-phase sea lamprey trapping operations if the population is determined to be high enough to warrant control activities. High spring flows present a major difficulty to surmount if such activities are planned. If a barrier is established and a permanent trap could also be established then trapping efforts would become more realistic.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: Trapping using PATs is likely to cost $4,758 per year. If a barrier is established a permanent trap may be incorporated into that structure. The cost of establishing a permanent trap would be included in the construction costs of a barrier.

Mullen Brook Control Strategy

Technically feasible control methods for Mullen Brook may include TFM application, establishing a low-head barrier and trapping at the barrier. Present transformer production estimates are not available and recent preliminary surveys indicate low sea lamprey abundance. If future sea lamprey assessments find sea lamprey populations warranting control, the above methods will be considered for implementation. As other control methods become feasible for use on Mullen Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Investigate the applicability of spawning-phase sea lamprey trapping

2. Investigate the applicability of establishing a permanent barrier if feasible and landowners consent. If a barrier can be established, incorporate a permanent sea lamprey trap into the barrier structure.

3. Apply TFM at approximately four-year intervals at a location below the natural barrier. That location will be determined by surveys. TFM application would occur only if sea lamprey densities indicate that control is necessary, trapping proves unsuccessful and an effective barrier cannot be developed. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

9. Putnam Creek

<u>Sea lamprey habitat</u>

Sea lamprey have access to 4.8 miles of Putnam Creek from its mouth to a natural barrier at Crown Point Center, New York (Figure VIII-9). No tributary feeder streams are believed to contain larval sea lamprey at this time.

<u>Treatment history/results</u>

The Putnam Creek TFM treatment history is summarized in Table VIII-15 (Steinbach and Davis 1990e; Neuderfer 1998d; Fisheries Technical Committee 1999; NYSDEC, Ray Brook, New York, unpublished data). Diurnal pH shifts increased the complexity of TFM treatments at this site. Coupled with freshwater intrusions from numerous streambed springs, excessive chemical attenuation occurred on lower reaches of the creek. Putnam Creek represents one of the most technically difficult treatments and consists of several application points and boosts in efforts to address the chemical attenuation problems. In both the 1990 and 1994 treatments, minimum lethal chemical concentrations were not carried in the lower reaches of the creek. In all three previous treatments, Brevoort Brook, Ranney Brook, Hatchery Outlet, an unnamed tributary and two downstream mainstem locations (Rt 2 and Rt 9 boosts) were all treated with TFM in efforts to neutralize, to the degree possible, the dilution effects of added volumes of water into Putnam Creek and prevent sea lamprey escapement. Crews applied TFM to tributary streams at accessible locations as close to their confluence with Putnam Creek as possible.

Figure VIII-9

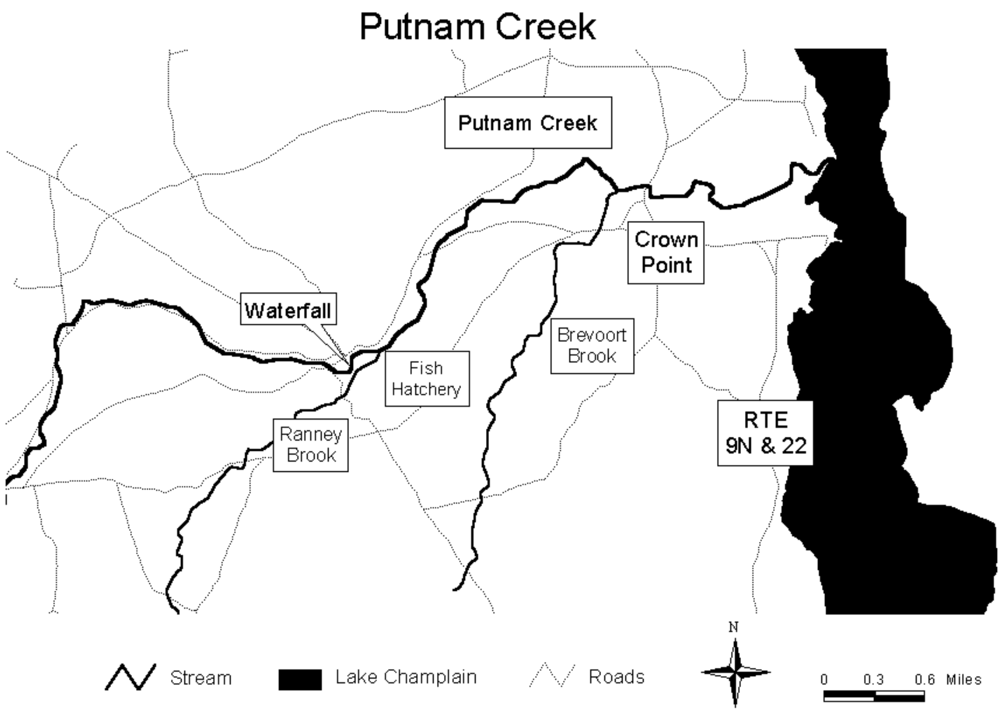


Table VIII-15. Putnam Creek TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1990	4.8	27,109	3,121
1994	4.8	19,545	1,114
1998	4.6	11,358	466

Screening process

Estimated sea lamprey transformation

Putnam Creek has the potential to produce over 3,000 sea lamprey transformers per year as determined from target mortality estimates evaluating the first Putnam Creek TFM treatment during the experimental control program.

TFM

- Technical considerations: Putnam Creek represents a technically feasible, though difficult stream to treat with TFM because of numerous freshwater inputs from feeder streams and streambed springs. There are also fairly wide pH shifts in the lower reaches of the creek. These factors affect lampricide toxicity. TFM concentration targets and applications require careful scrutiny to assure that lampricide toxicities remain lethal to sea lamprey but below permitted thresholds. TFM was applied previously within a very short distance of the mouth of Brevoort Brook, but access would be much easier 0.3 miles upstream and consideration should be given to applying the block there. The only practical location for the TFM application on Ranney Brook is 0.1 miles upstream from the confluence with Putnam Creek. Treatments have been effective in spite of the difficulties, and assessments have shown large reductions of larval sea lamprey populations. Experiences gained may offer new opportunities for improved effectiveness for future TFM treatments.

- Nontarget concerns: Nontarget mortality encountered during the 1990 and 1994 experimental TFM treatments is listed by the Fisheries Technical Committee (1999), and can be found in Appendix E. Sensitive species likely to suffer mortality are silver lamprey and mudpuppies. In 1998 nontarget assessment following TFM treatment indicated mortalities of 21 common fish species and some salamanders. Future TFM treatments would likely result in similar nontarget effects. No threatened or endangered species are known to exist within the treatment area of Putnam Creek. Therefore, no special mitigation is necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: A unique aspect is that this stream, entirely within New York, has a plume affecting the Vermont shoreline as well as the New York shoreline of Lake Champlain.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost is $40,335 per treatment or $10,084 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: Putnam Creek flows are too low to warrant the complex application and analyses and additional personnel needs for treatment using a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide 3.2% granule application is considered inappropriate for the riverine environment of Putnam Creek.

Barriers

- Technical considerations: A sea lamprey barrier is not currently proposed for Putnam Creek. The preliminary barrier feasibility study for Putnam Creek (Anderson, B. E. et al. 1985) indicated numerous difficulties with the establishment of a low-head barrier. The best proposed location of a barrier would only eliminate approximately 60 percent of the available sea lamprey larval habitat, and several questions remain to be addressed regarding stream flows, lake levels, lake wave action and necessary weir length and height to accommodate extreme conditions. Also, small numbers of sea lamprey nests have been observed below the proposed barrier site. Although potentially feasible with careful engineering of jump pools and levees, the outlook is currently poor for establishment of a low-head barrier that would eliminate the need for TFM treatments in the foreseeable future. Electronic barrier feasibility should be considered and investigated at a location below all sea lamprey activity. This may be a poor option due to the presence of a rainbow trout (steelhead) run however, and the improbability of implementing an effective trap and transfer operation necessary to move steelhead above the barrier.

- Nontarget concerns: A steelhead run is known to exist on Putnam Creek and though low-head barriers can be equipped with jump pools to allow migrations beyond such barriers, electronic barriers cannot incorporate jump pools without a fishway and sophisticated water pumping operations. Other means of passing steelhead, such as a fish trap and transfer operation, would be infeasible given expected staffing and funding availability. Therefore, barrier construction is not currently recommended.

Trapping

- Technical considerations: Provision for adult sea lamprey trapping should be incorporated into any future (though unlikely) barrier design. The outlook for portable adult trapping as a sole means of sea lamprey control on Putnam Creek is poor due to excessive spring flows, the technical difficulty of mitigating interference with steelhead migrations and the location of Putnam Creek far from the personnel required for such operations.

Putnam Creek Control Strategy

Technically feasible control methods for Putnam Creek include only TFM application. Preliminary studies relative to a sea lamprey barrier were not favorable but the feasibility of a barrier will continue to be explored. As other control methods become feasible for use on Putnam Creek the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Apply TFM at approximately four-year intervals to the lower 4.8 miles of Putnam Creek and a total of 0.4 miles of associated tributaries. Treating associated tributaries at accessible locations is necessary to neutralize the dilution effect of additional water to Putnam Creek and to prevent sea lamprey escapement. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

2. Pursue further sea lamprey barrier feasibility studies to determine whether an effective sea lamprey barrier including trapping facilities can be established on Putnam Creek.

10. Mt. Hope Brook

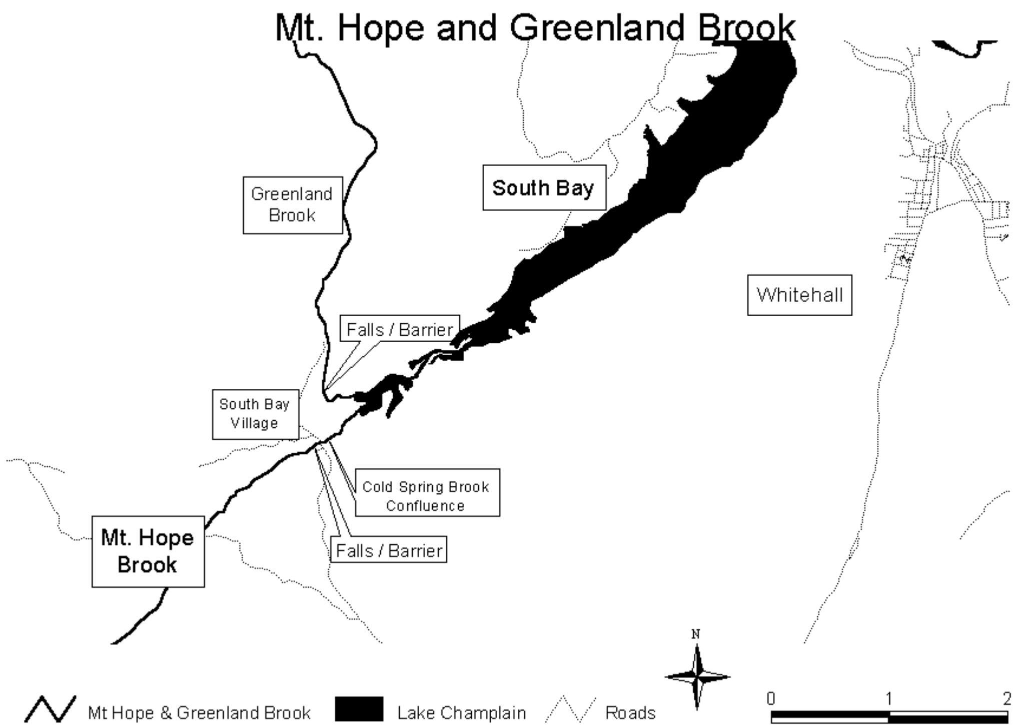
Sea lamprey habitat

The sea lamprey accessible habitat of Mt. Hope Brook extends from the mouth to an area 1.3 miles upstream in the hamlet of South Bay, New York (Figure VIII-9). An additional 0.6 miles accessible to sea lamprey occurs on Greenland Brook, a tributary to Mt. Hope Brook.

Treatment history/results

The Mt. Hope Brook TFM treatment history is summarized in Table VIII-16 (Steinbach 1991a; Fisheries Technical Committee 1999; Neuderfer 1999c; NYSDEC, Ray Brook, New York, unpublished data). The primary application occurred at the village of South Bay at the stream's crossing of County Route 16 in 1991. A boost site was located at the confluence of a tributary known locally as Cold Spring to address the dilution factor there. Because of very low water in 1995, the primary application point was moved to the confluence of Cold Spring, downstream of County Route 16. During both treatments an additional TFM application site was located on Greenland Brook near its confluence with Mt. Hope Brook to compensate for untreated water dilution and to remove the brook as a refuge to sea lamprey during treatment. The application point for the 1999 treatment was again at the County Route 16 crossing and a boost was operated at the confluence with Cold Spring and on Greenland Brook. Secondary backpack spray treatments occurred during all treatments to numerous backwater regions adjacent to the brook. These areas were hand-sprayed because TFM could not infiltrate into these areas from the main stream application. Left untreated, these backwaters provided sea lamprey refugia from lethal

Figure VIII-10.



chemical concentrations. Greenland Brook was treated by backpack sprayer above the boost site in 1999 in an effort to treat obvious sea lamprey habitats occurring in this area.

Table VIII-16. Mt Hope Brook TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1991	1.4	21,894	4,018
1995	1.3	9,629	1,367
1999	1.5	12,276	169

Screening Process

Estimated sea lamprey transformation

Mt. Hope Brook has the potential to produce over 4,000 transformers annually based upon mortality estimates generated during assessments of the first TFM treatment.

TFM

- Technical considerations: Mt. Hope Brook normally requires three application sites to facilitate TFM treatment of the stream: a primary application near the upstream sea lamprey habitat terminus, at Cold Spring Brook, and at Greenland Brook to counter dilution of the lampricide in the mainstream and to prevent use of these tributaries as sea lamprey refuge areas during treatment. Several problems make treatment logistics difficult. Numerous backwaters and beaver dams complicate stream flows and interfere with lampricide infiltration to many target areas of sea lamprey infestation. Beaver dams must be breached and kept breached long enough before treatment to decrease chances of sea lamprey survival in exposed mud banks and flats. Low flows complicate treatment through increased attenuation of lampricide and decreased infiltration of lampricide into backwater regions. Greenland Brook is also infested with sea lamprey, and approximately 0.6 miles should be included during future TFM applications. Diurnal pH swings were not problematic on Mt. Hope Brook.

- Nontarget concerns: Nontarget mortality encountered during the 1991 and 1995 experimental TFM treatments is listed by the Fisheries Technical Committee (1999), and can be found in Appendix E. Silver lamprey are a sensitive species likely to suffer mortality and a few were observed dead after each treatment. Overall nontarget mortality was low during experimental control. In 1999, TFM treatment resulted in moderate mortality among 9 common fish species, silver lamprey, red-spotted newts, and two-lined salamanders. A single crayfish mortality was also recorded. Similar nontarget mortality can be expected from future TFM treatments on Mt. Hope Brook. No threatened or endangered aquatic species are known to exist within the TFM treatment area of Mt. Hope Brook. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: Water-use advisories associated with TFM treatment have remained in effect for all of South Bay Lake Champlain for up to 12 days.

- Habitat impacts: No unique impacts.

- Cost: The cost of TFM treatment on Mt. Hope Brook is estimated at $20,760 per treatment or $5,190 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: Mt. Hope Brook flows are too low to warrant the complex application and analyses and additional personnel needs for treatment using a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide 3.2% granule application is considered inappropriate for use in the riverine environment of Mt. Hope Brook.

Barriers

- Technical considerations: The sea lamprey infested area of Mt. Hope Brook is not conducive to the establishment of a low-head sea lamprey barrier nor does current technology offer other barrier options suitable for this tributary. Barrier development for Mt. Hope Brook is not currently proposed.

Trapping

- Technical considerations: Mt. Hope Brook has difficult access to the lower reach of stream where trapping operations might occur. High spring flows, numerous backwaters and a broad flood plain add to trapping difficulties. These problems currently preclude spawning-phase trapping operations as a component of long-term sea lamprey control.

Mt. Hope Brook Control Strategy

Technically feasible control methods for Mt. Hope Brook include only TFM application. Other control options explored are either inappropriate or not feasible at this time. As other control methods become feasible for use on Mt. Hope Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Apply TFM to Mt. Hope Brook at or below river mile 1.3 approximately every four years. The time interval could be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

10a. Greenland Brook

Sea lamprey habitat

The sea lamprey accessible habitat of Greenland Brook extends from a natural barrier (waterfall) 0.6 miles to the brook's confluence with Mt. Hope Brook (see Mt. Hope Brook site map, Figure

VIII-10).

Treatment history/results

The Greenland Brook TFM treatment history is summarized in Table VIII-17 (Steinbach 1991a; Neuderfer 1995a, 1999c; Fisheries Technical Committee 1999). Greenland Brook has not been adequately treated for sea lamprey control. There were TFM applications near the confluence with Mt. Hope Brook to prevent its use as a refuge and counter the dilution effect that would otherwise take place during the 1991 and 1995 Mt. Hope Brook TFM treatments. In 1999, NYSDEC conducted a TFM treatment that included the lower half of the 0.6 miles of sea lamprey-infested Greenland Brook. The treatment was accomplished using a TFM application near the confluence and applying TFM using backpack sprayers to sections of stream extending approximately half way to the upstream barrier.

Table VIII-17. Greenland Brook TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transfomer Mortality
1991	0.1	824	234
1995	0.1	246	66
1999	0.3	670	0

Screening Process

Estimated sea lamprey transformation

Greenland Brook is capable of producing over 200 sea lamprey transformers annually based on mortality assessments following the first TFM treatment.

TFM

- Technical considerations: Greenland Brook is periodically inundated with beaver dams over much of the sea lamprey infested area. TFM treatment at the barrier would require the breaching of all beaver dams to the confluence with Mt. Hope Brook to enable TFM to progress unimpeded to the confluence.

- Nontarget concerns: Nontarget mortality assessments did not separate Greenland Brook nontarget counts from the corresponding Mt. Hope Brook section at the confluence of the two brooks so a separate estimate is not available. The 1999 nontarget assessment crew leader (Vance Gilligan, NYSDEC, personal communication), indicated that very little nontarget mortality was observed on Greenland Brook. No threatened or endangered species are known to exist within the treatment area of Greenland Brook. Therefore, no special mitigation measures are necessary and typical treatment protocol will be followed. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: Costs are part of the Mt. Hope Brook TFM treatment and are included within the overall cost estimates for that TFM treatment. Greenland Brook would not be treated with TFM independently from Mt. Hope Brook.

TFM/Niclosamide

- Technical considerations: The Mt. Hope/Greenland Brook combined stream system flows are too low to warrant the complex application, analysis and additional personnel needs for treatment using a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide 3.2% granule application is inappropriate for use in the low-discharge riverine waters of Greenland Brook.

Barriers

- Technical considerations: The physical setting, remote location and a probable walleye spawning run preclude the establishment of a barrier on Greenland Brook.

Trapping

- Technical considerations: The presence of beaver activity, expected high spring flows, Lake Champlain backwater effects, remote location and poor site suitability make trapping prospects very poor. No trapping operations are planned for Greenland Brook.

Greenland Brook Control Strategy

TFM application is the only technically feasible control method for Greenland Brook. A simultaneous lampricide treatment of Greenland Brook with a treatment of Mt. Hope Brook is necessary to prevent is use as a sea lamprey refuge, and to prevent attenuation of the chemical block in Mt. Hope Brook downstream of its confluence with Greenland Brook. As other control methods become feasible for use on Greenland Brook, the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

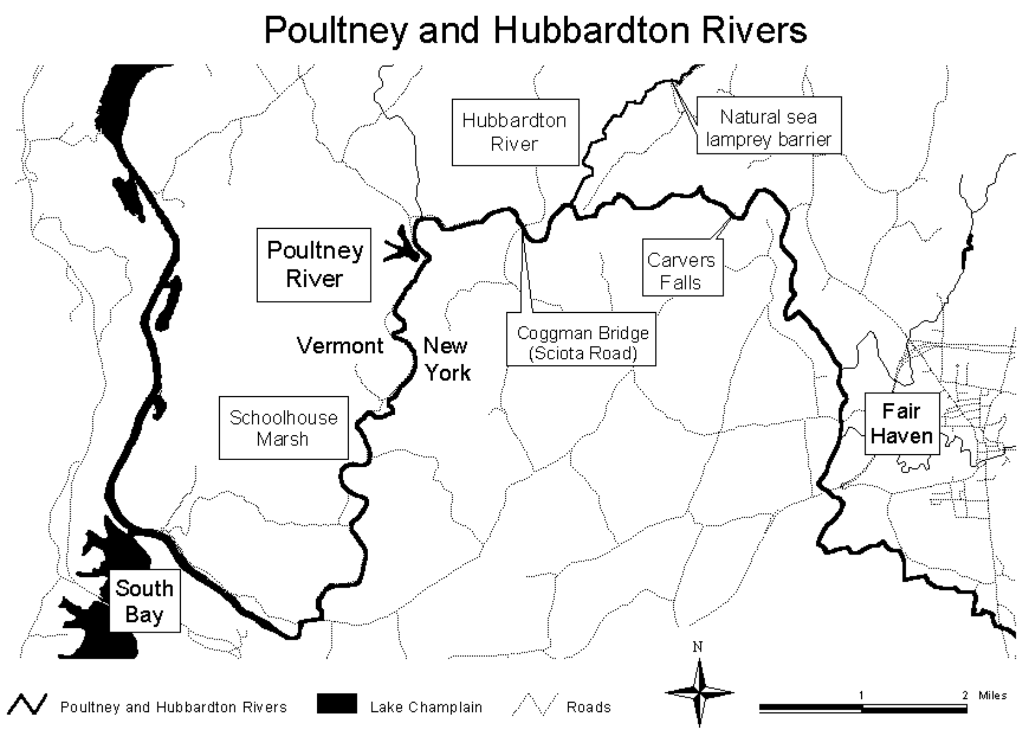
1. Apply TFM in Greenland Brook only in conjunction with a TFM treatment of Mt. Hope Brook at or near the natural barrier approximately 0.6 miles above the confluence with Mt. Hope Brook.

11. Poultney River

<u>Sea lamprey habitat</u>

Sea lamprey have access to approximately 10.5 miles of the lower Poultney River which extends from the mouth to a natural barrier at Carvers Falls in the Towns of Whitehall, New York and Fair Haven, Vermont (Figure VIII-11).

Figure VIII-11.



Treatment history/results

The Poultney River treatment history is summarized in Table VIII-18 (Steinbach 1992b; Neuderfer 1997b; Fisheries Technical Committee 1999). Both experimental program TFM treatments were conducted at concentrations below the typical treatment level of 1.5 times MLC. In 1992, restrictive permit conditions required TFM to be applied at a concentration equivalent to 0.8 times MLC, and did not allow simultaneous TFM application in the Hubbardton River to maintain the permitted concentration downstream of its confluence with the Poultney (Steinbach 1992b). This approach resulted in an ineffective treatment. In 1996, modified permit conditions allowed a TFM concentration of 1.0 times MLC to be applied, along with a simultaneous application to the Hubbardton River, which resulted in an effective treatment (Fisheries Technical Committee 1999).

The 1996 treatment, with a minimally effective TFM concentration, was successful due to (1) overcast and rainy weather and consequent stabilization of pH combined with a slow and steady decrease in alkalinity at the time of treatment, which maintained, or slightly increased toxicity; and (2) the simultaneous treatment of the Hubbardton River which prevented excessive downstream dilution of the TFM block (Neuderfer 1997b). Stabilization of flows at the Carvers Falls hydroelectric station may also have been a factor.

Table VIII-18. Poultney River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transformer Mortality
1992	10.5	197	0
1996	10.5	5,770	989

Screening Process

The Poultney River was designated an “Outstanding Resource Water” in 1991 by the Vermont Water Resources Board, in response to a public petition pursuant to 10 V.S.A. Section 1424a. This designation reflects the State of Vermont’s acknowledgment of the Poultney River’s biodiversity and social values. The river contains diverse native freshwater mussel and fish communities, including an important walleye spawning area, and high quality riparian wildlife habitat.

An Outstanding Resource Waters designation requires the State of Vermont to hold aquatic nuisance control permit applications to a higher standard than it would for similar proposals on other rivers. The VTDEC has stated that “Increased scrutiny and caution in the issuance of an aquatic nuisance control permit for an outstanding resource water should be expected” (VTDEC 1996b). The screening process therefore reflects the Cooperative’s full recognition of, and consideration for the Poultney River’s biological and social values, and the regulatory implications of its designation as an Outstanding Resource Water.

Estimated Sea Lamprey Transformation

Mortality counts following the 1996 Poultney River TFM treatment resulted in an estimate of nearly 1,000 transformers killed (Fisheries Technical Committee 1999). No transformer mortality was observed following the unsuccessful 1992 TFM treatment (Fisheries Technical Committee 1999). A preliminary estimate of 1,034 sea lamprey transformers was made in 2000, utilizing quantitative assessment sampling survey techniques described by Klar and Schleen (1999) (USFWS, Essex Junction, Vermont, unpublished data).

TFM

- Technical considerations: A TFM treatment of the Poultney River is technically feasible. The experimental program TFM treatments demonstrated that water flows can be augmented by the release of water from Lake Bomoseen which flows into the Poultney River approximately 3.3 river miles above Carvers Falls via the Castleton River (provided that the Lake Bomoseen water level is above that prescribed by the Vermont Water Resources Board). River flows can also be stabilized at the Carvers Falls Hydroelectric Plant. Applying TFM through the Carvers Falls Hydroelectric Plant penstock allows for rapid and thorough mixing of TFM. Attainment of an effective treatment also requires simultaneous application of TFM to the Hubbardton River to prevent dilution of the TFM block downstream of its confluence with the Poultney River.

- Nontarget concerns: The channel darter, (endangered in Vermont) and the eastern sand darter (threatened in Vermont and New York) along with six Vermont state-listed endangered mussel species (black sandshell, fluted shell, fragile papershell, pink heelsplitter, cylindrical papershell and pocketbook) and one Vermont threatened mussel (giant floater) are found in the Poultney River. There were no observed mortalities of any of these listed species in the two experimental program TFM treatments (Fisheries Technical Committee 1999; Appendix E). Silver lamprey were the most affected nontarget fish species during the previous treatments, with estimated mortalities of 101 individuals in 1992 and 2,549 in 1996. Excluding silver lamprey, only four nontarget fish mortalities representing four species were observed after the 1992 treatment; in 1996, 21 mortalities were observed representing eight fish species (Fisheries Technical Committee 1999). Amphibian mortalities were limited to two salamanders from the 1996 treatment; no amphibian mortalities were observed during the 1992 treatment (Fisheries Technical Committee 1999). This level of nontarget impact would likely be similar in future TFM treatments.

  A TFM treatment of the Poultney River is expected to have the lowest risk of significant nontarget impacts relative to other current technically feasible control methods. Impacts would be mitigated by applying TFM at a target concentration of less than or equal to the lowest no observed effect concentration, determined by toxicity testing, for the resident threatened and endangered species discussed in the preceding paragraph. Lampricide toxicity data are currently available for all of these species except for the fluted shell, fragile papershell, giant floater and cylindrical papershell; toxicity testing of these species is currently underway or planned, and the results will be made available prior to obtaining permits for future treatment of the Poultney River. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: A TFM treatment of the Poultney River will create noticeable but manageable human impacts. The 1992 and 1996 treatments resulted in a 10.5-mile-long river water-use advisory area which began at the TFM application point and extended to the river's mouth; as well as a 20-mile-long lake shore advisory area from the river mouth near Whitehall, New York, north to Ticonderoga, New York. In 1992 this advisory area was divided into four zones (upper river, lower river, south lake, north lake). The 1992 treatment resulted in water-use advisories which ranged from 2 days for the upper river (from Carvers Falls to the confluence of the Hubbardton River), to 15 days for the north lake zone. The 1996 treatment resulted in similar water-use advisory durations. Water releases from Lake Bomoseen have been used to enhance flows of the Poultney River during past TFM treatments. Impacts to human use of Lake Bomoseen from such releases during a treatment are negligible since the water available is restricted to within 3 inches above or below the lake level mandated by the Vermont Water Resources Board. The duration of water-use advisories may be shortened in instances when Lake Bomoseen water is released to dilute the lampricide following treatment.

  A lampricide treatment of the Poultney River may produce other human impacts. The successful efforts to designate the Poultney River as an outstanding resource water by local citizens demonstrates their strong commitment to the protection of this river system. Some are concerned with the use of lampricides in the Poultney and find it to be an unacceptable control option. The Cooperative recognizes these concerns and will continue to investigate appropriate non-chemical control alternatives.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of the Poultney River is estimated to cost $70,700 per treatment or $17,700 per year based on a four-year treatment cycle. This estimate includes the cost of a simultaneous TFM application in the Hubbardton River.

TFM/Niclosamide

- Technical considerations: If the Poultney River is treated at flows of greater than 100 cfs it may be advantageous to treat it with a TFM/niclosamide combination as compared to TFM, since it would significantly reduce the total amount of lampricide required.

Treatment would be similar to that of a TFM application with an increase in effort associated with the additional application of Bayluscide 70% Wettable Powder (or a liquid Bayluscide formulation, pending completed EPA registration) to the treatment. Application and analysis efforts would require additional personnel and equipment to accommodate such a treatment (See Section IV.A.2.).

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: Human impacts would be similar to those indicated with TFM treatments except that the duration of water-use advisories may be shorter than with treatments using TFM alone, due to the overall reduction in the amount of lampricide used.

- Habitat impacts: No unique impacts.

- Cost: TFM/niclosamide treatment of the Poultney River is estimated to cost $51,200 per treatment or $12,800 per year based on a four-year treatment cycle. This estimate includes the cost of a simultaneous TFM application in the Hubbardton River.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is not proposed. This formulation is inappropriate for use in the sea lamprey-infested riverine environment of the Poultney River.

Barriers

- Technical considerations: The construction of a low-head or adjustable crest barrier on the Poultney River is not being proposed at this time. Feasibility studies have shown that the construction of a barrier dam on the Poultney River at approximately 1.0 miles below Carvers Falls (the most suitable site) would be technically difficult due to the erosional nature of the soils (Walrath and Swiney 2001). Furthermore, a low-head or adjustable crest barrier would not necessarily eliminate the need for other lamprey control measures (i.e. lampricide application) as sea lamprey spawning and larval habitat exists below this site and in downstream tributaries including the Hubbardton River (NYSDEC et al. 1990; Walrath and Swiney 2001). The construction of an electrical barrier may be technically feasible at Coggman Bridge (Walrath and Swiney 2001). Utility poles are present at the site and power is only 0.25 miles away. Since this site is below the Poultney/Hubbardton River confluence, a successful electrical barrier here may also eliminate the need for additional sea lamprey control in the Hubbardton River.

- Nontarget concerns: Any barrier located on the Poultney River could have significant impacts on important migratory fish populations by blocking spawning migrations of several species including walleye, rainbow smelt, smallmouth bass, white suckers and various cyprinid species. It may not be feasible to develop an effective fish passage facility for the Poultney River. Several fish species' spawning migrations coincide with sea lamprey movements and typically occur under highly variable spring stream flows and Lake Champlain backwater levels, when the operation of effective fish passage would be compromised. A barrier may prevent some migratory host fish/mussel glochidia interactions which could potentially affect mussel recruitment upstream of the barrier. In order to minimize potential adverse impacts to the endangered and threatened fish and mussel communities within the Hubbardton and lower Poultney Rivers, a fish passage facility would have to be highly effective in the capture and passage of migratory fish species. Therefore, no low-head, adjustable crest, or electrical barrier is proposed at this time. The feasibility of a barrier on the Poultney River will be periodically revisited as the technology of sea lamprey barrier design and fish passage advances.

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey using portable assessment traps is not proposed as a means of sea lamprey control in the Poultney River at this time. Suitable trapping sites where sufficient numbers of spawning-phase sea lamprey could be removed to effectively limit reproduction do not currently exist. Only a few spawning-phase sea lamprey of each sex avoiding traps may repopulate the entire river due to their very high fecundity. Attempts have been made with portable assessment traps to capture sea lamprey spawners at Carvers Falls and near Coggman Bridge, but these efforts yielded very few sea lamprey, and thus were deemed ineffective.

Poultney River Control Strategy

At present, no non-chemical control alternatives have been determined to be both technically feasible, and to pose lower risks to the non-target environment of the Poultney River than do controlled lampricide applications. The presence of nine endangered and threatened species documented in the Poultney River requires appropriate mitigation to protect them from nontarget impacts due to lampricide treatment. Non-chemical control alternatives, including techniques currently under development, will continue to be investigated. The Poultney River, with its Outstanding Resource Water designation, would receive priority for implementation of such alternatives should any be determined to be feasible. The following sea lamprey control strategy is recommended:

1. Defer lampricide treatment of the Poultney River for five years after the initiation of the Proposed Action to fully assess potential alternatives to lampricides and the effects of the proposed sea lamprey control program on wounding rates. If program wounding rate objectives are not attained and feasible alternative control methods are not available at the end of this five-

year period, or if program objectives are not maintained as verified by periodic assessments thereafter, in absence of effective control alternatives, then apply TFM or a TFM/niclosamide combination at river mile 10.5 (Carvers Falls), with a concurrent TFM treatment of the Hubbardton River (see following Hubbardton River discussion). TFM only will be applied in the first potential treatment; TFM or a TFM/niclosamide combination will be considered for potential subsequent treatments. Target treatment concentrations will be less than or equal to levels shown not to cause mortality to resident state-listed threatened and endangered aquatic species. The time interval between treatments, if conducted, would likely be four years. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis.

11a. Hubbardton River

Sea lamprey habitat

Sea lamprey have access to approximately 2.0 miles of the Hubbardton River above its confluence with the Poultney River to a region of stepped bedrock which acts as a natural sea lamprey barrier (see Figure VIII-11).

Treatment history/results

The Hubbardton River TFM treatment history is summarized in Table VIII-19 (Steinbach 1992c; Neuderfer 1997b; Fisheries Technical Committee 1999). In 1992, the entire 2.0 miles of larval habitat was treated (Steinbach 1992c), while in 1996, only the lowermost 0.5 mile of the Hubbardton was treated primarily to achieve precise timing of chemical convergence between the Hubbardton and Poultney Rivers (Neuderfer 1997b). Both treatments were conducted at a target concentration of 1.0 times MLC, to afford protection to nontarget species downstream in the Poultney River.

Table VIII-19. Hubbardton River TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transformer Mortality
1992	~2.0	174	8
1996	0.5	20	0

Screening process

Estimated sea lamprey transformation

Transformer production is low in the Hubbardton River based on mortality counts following the

1992 TFM treatment. Only the lower 0.5 mile of stream was treated in 1996. A preliminary estimate of 110 sea lamprey transformers was made in the summer of 2000 (USFWS, Essex Junction, Vermont, unpublished data), using quantitative assessment survey techniques as described by Klar and Schleen (1999). This level of transformer production does not warrant treatment of the Hubbardton River alone, but treatment near its mouth would be necessary in conjunction with a treatment of the Poultney River (see below).

TFM

- Technical considerations: A TFM treatment of the Hubbardton River is technically feasible as demonstrated by the 1992 and 1996 lampricide treatments. While the Hubbardton River could be treated alone, it would presently not be necessary to treat it unless included with a simultaneous treatment of the Poultney River. A simultaneous lampricide treatment of the Hubbardton River with a treatment of the Poultney River is necessary to prevent attenuation of the chemical block in the Poultney River downstream of its confluence with the Poultney River.

- Nontarget concerns: The giant floater mussel (threatened in Vermont) has been documented in the Hubbardton River. No mussel mortalities were observed after the 1992 or 1996 TFM treatments. The 1992 TFM treatment of the Hubbardton River resulted in a single mortality observed for each of the following species: tessellated darter, silvery minnow, pumpkinseed and an unidentified minnow (Fisheries Technical Committee 1999; Appendix E). The 1996 TFM treatment resulted in the observed mortality of a single tessellated darter. These same species may be similarly impacted in future TFM treatments. Although no amphibian mortalities were reported during the 1992 or 1996 TFM treatments, mudpuppies and frog tadpoles may inhabit the Hubbardton River, and may suffer limited mortality from TFM applications. Impacts will be mitigated by applying TFM at a target concentration of less than or equal to the lowest no observed effect concentration, determined by toxicity testing, for the resident threatened and endangered species discussed above. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of the Hubbardton River is incorporated into the cost of a TFM treatment of the Poultney River.

TFM/Niclosamide

- Technical considerations: Hubbardton River flows are too low to warrant the complex application and analysis and additional personnel needs for treatment using a

TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is not proposed for use in the Hubbardton River. This formulation is inappropriate for use in the riverine environment of the Hubbardton River.

Barriers

- Technical considerations: Although a site approximately 0.5 mile above the Poultney River confluence exists where a low-head barrier dam could be constructed on the Hubbardton River, the construction of a sea lamprey barrier on the Hubbardton River is not proposed due to the low transformer production noted. Construction of a barrier would not preclude the use of TFM during a Poultney River treatment (see TFM section above).

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey using portable assessment traps is not proposed for Hubbardton River because suitable sites do not exist where trapping with PATs alone could effectively remove sufficient numbers of spawning-phase lamprey.

Hubbardton River Control Strategy

Technically feasible control methods for the Hubbardton River include TFM application and low-head barrier establishment. Although estimated transformer numbers are low, a simultaneous lampricide treatment of the Hubbardton River coinciding with a treatment of the Poultney River is necessary to prevent attenuation of the chemical block in the Poultney River downstream of its confluence with the Hubbardton River. The application point may be established near the mouth to facilitate the lampricide convergence timing of the two treatments. The construction of a barrier would not eliminate this need. As other control methods become feasible for use on the Hubbardton River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

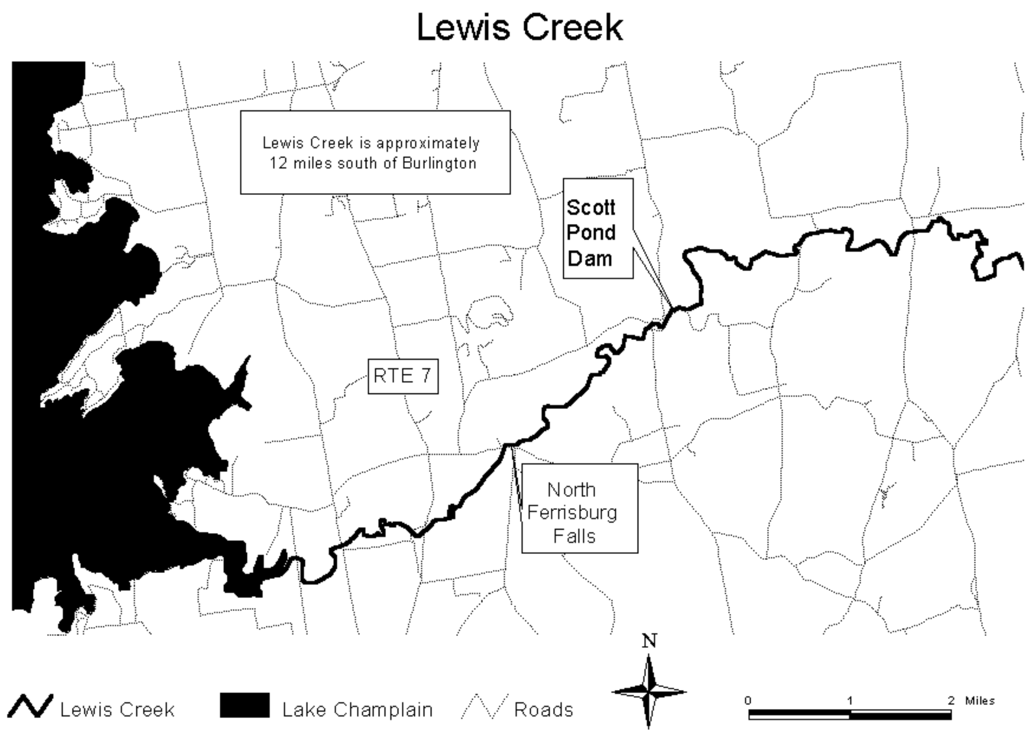
1. Apply TFM only in conjunction with a Poultney River lampricide treatment to maintain adequate treatment concentrations in the Poultney River. The application point will be dependent on sea lamprey densities and distribution within the Hubbardton River.

12. Lewis Creek

Sea lamprey habitat

Sea lamprey have access to approximately 9.5 miles of Lewis Creek to Scott Pond Dam in Charlotte, Vermont. The falls at river mile 5.2 in North Ferrisburg act as a sea lamprey barrier in some years, but during high flows sea lamprey are able to pass over the falls (Figure VIII-12).

Figure VIII-12.



Treatment history/results

The Lewis Creek TFM treatment history is summarized in Table VIII-20 (Steinbach and Davis 1990f; Neuderfer 1995b; Fisheries Technical Committee 1999). In 1990, TFM was applied at Scott Pond Dam and the treatment required a boost at the old U.S. Route 7 bridge (Steinbach and Davis 1990f). In 1994, the primary application point was moved downstream approximately 4 miles to the North Ferrisburg falls because assessment surveys indicated low sea lamprey abundance between Scott Pond Dam and the falls (Neuderfer 1995b).

Table VIII-20. Lewis Creek TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transformer Mortality
1990	9.5	21,645	4,297
1994	5.2	40,537	871

Screening process

Estimated sea lamprey transformation

Lewis Creek has the potential to produce a minimum of over 4,000 sea lamprey transformers annually based on mortality estimates following the 1990 treatment. A recent quantitative assessment survey (Klar and Schleen 1999) in Lewis Creek estimated 4,999 sea lamprey transforming in 2000 (USFWS, Essex Junction, Vermont, unpublished data).

TFM

- Technical considerations: A TFM treatment of Lewis Creek is technically feasible. Both the 1990 and 1994 experimental TFM treatments were effectively accomplished.

- Nontarget concerns: Nontarget mortality encountered during the 1990 and 1994 TFM treatments are listed in Fisheries Technical Committee (1999), and can be found in Appendix E. No threatened or endangered fish species have been found in Lewis Creek. Silver lamprey, which are sensitive to TFM, may be most impacted. Some common fish species will likely suffer limited mortalities. Four Vermont-listed endangered mussel species (pocketbook, pink heelsplitter, fragile papershell and fluted-shell) and one Vermont threatened mussel (giant floater) are found in Lewis Creek. One pink heelsplitter was observed to be dead immediately below the TFM boost site at the old Route 7 Bridge after the 1990 treatment, but no dead mussels were observed after the 1994 treatment. Small numbers of mudpuppies were reported killed during both experimental program TFM treatments. Limited mudpuppy mortality may occur during future treatments. Impacts will be mitigated by applying TFM at a target concentration of less than or equal to the lowest no observed effect concentration, determined by toxicity testing, for the resident threatened and endangered species discussed above. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of Lewis Creek is estimated to cost $51,403 per treatment or $12,851 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: Lewis Creek flows are too low to warrant the complex application and analysis and additional personnel needs for treatment using a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide is not proposed for use in Lewis Creek or it's delta. Application of this formulation is inappropriate for the riverine environment of Lewis Creek, and there is no evidence of a Lewis Creek delta population of sea lamprey.

Barriers

- Technical considerations: A sea lamprey barrier was maintained at Scott Pond (river mile 9.5) in 1994 by refurbishing an eroding low-head dam. Construction of a fixed-crest barrier dam on Lewis Creek at Greenbush Road bridge (river mile 2.5) is technically feasible, and would eliminate 99% of sea lamprey spawning habitat. (Anderson, B.E. et al 1985, Staats 1994). Specific studies into the feasibility of adjustable-crest or electrical barriers on Lewis Creek have not been conducted.

- Nontarget concerns: The addition of a sea lamprey barrier on Lewis Creek at Greenbush Road bridge will have significant negative impacts to migratory fish populations which use Lewis Creek, potentially blocking passage of silver lamprey, smallmouth bass, rainbow trout, white suckers and cyprinids (Staats 1994). A barrier would also restrict movements of stream-resident fishes and mudpuppies. These impacts would be common to a year-round fixed-crest barrier, as well as to adjustable-crest or electrical barriers during their seasonal use period. Barriers can be designed to pass jumping fish such as rainbow trout, but mitigation for passage for non-jumping species would be extremely difficult with existing technology. Implementation of a barrier on Lewis Creek is not currently feasible due to anticipated nontarget impacts, but it will be reevaluated when improved fish passage technology becomes operational.

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey is not proposed as a control option on Lewis Creek. Sea lamprey traps are most effective when used in conjunction with a barrier or where the stream is constricted and adult sea lamprey are concentrated. Sea lamprey trapping has been conducted at the falls in North Ferrisburg since 1981 to monitor spawning runs. While the falls on Lewis Creek act as a partial barrier to sea lamprey migration, it is not conducive to effective trapping. Removal of small numbers of sea lamprey caught in PATs has had no effect on the overall lamprey population. This is due, in part, to the location of this trapping site upstream of widespread sea lamprey spawning areas, which allows lamprey that are not captured to spawn below this point. Attempting to trap sea lamprey downstream of this site would present obstacles to other migrating species (see species in barrier discussion above) as a trap would need to employ net extensions to block the stream channel and guide sea lamprey to the trap.

Lewis Creek Control Strategy

Technically feasible control methods for Lewis Creek include TFM application and establishment of a low-head barrier. Of these methods, TFM application was determined to result in substantially lower negative impacts. The construction of a low-head barrier dam on Lewis Creek at the Greenbush Road bridge would have serious negative impacts to migratory fish populations. A sea lamprey barrier will be maintained at Scott Pond. As other control methods become feasible for use on Lewis Creek the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Maintain Scott Pond Dam at river mile 9.5 as a sea lamprey barrier.

2. Apply TFM at river mile 9.5 (or river mile 5.2 if substantial colonization is not found above the falls in North Ferrisburg) every four years. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis.

13. LaPlatte River

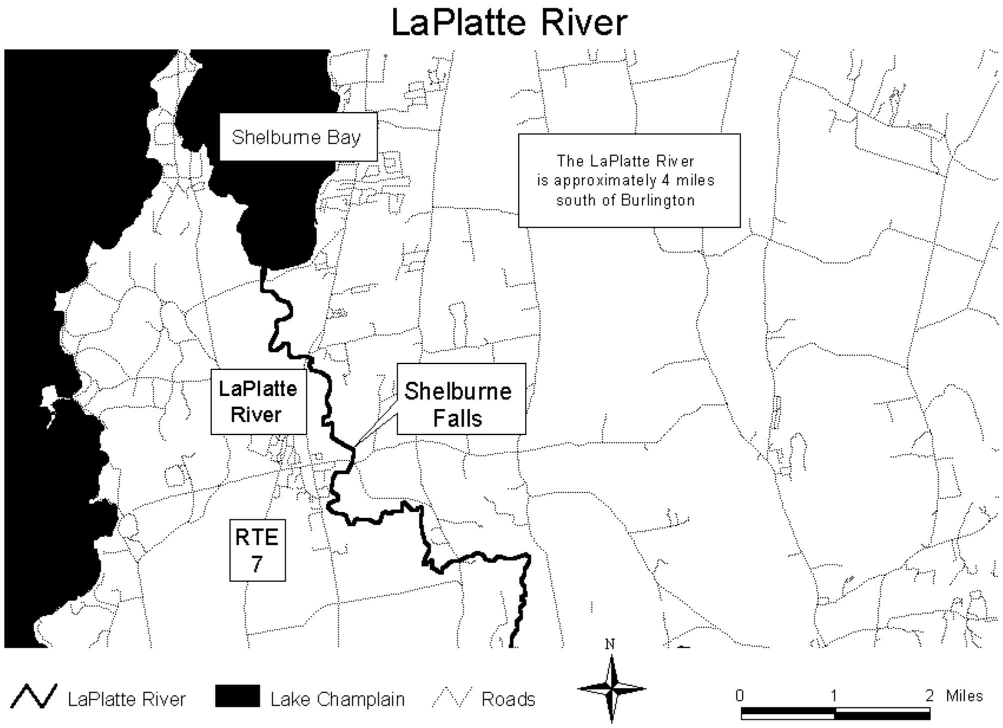
<u>Sea lamprey habitat</u>

Sea lamprey have access to approximately 3.3 miles of the LaPlatte River to the falls in Shelburne, Vermont. These falls are the upstream barrier to migration of adult sea lamprey (Figure VIII-13).

<u>Treatment history/results</u>

The LaPlatte River was not included in the experimental control program because no evidence of sea lamprey infestation had been found in the river prior to 1993 (USFWS, Essex Junction, Vermont, unpublished data).

Figure VIII-13.



Screening process

Estimated sea lamprey transformation

Sea lamprey surveys prior to 1993 were negative for lamprey larvae despite evidence of adult spawning. However, surveys conducted in 1993 and 1997 found evidence that a larval population may be building, perhaps due to improvements in water quality. Quantitative assessment of sea lamprey habitat and larval density will be conducted to determine if control is warranted.

TFM

- Technical considerations: TFM treatment of the LaPlatte River may be technically feasible. Water chemistry and dye plume and wetland studies will need to be conducted prior to conducting TFM treatments.

- Nontarget concerns: TFM application in the LaPlatte River may impact the Vermont-listed stonecat (endangered) and channel darter (endangered). Therefore, treatment may not be pursued unless potential impacts can be mitigated.

- Human impacts: No unique impacts are anticipated.

- Habitat impacts: No unique impacts are anticipated.

- Cost: No cost estimate has been generated.

TFM/Niclosamide

- Technical considerations: LaPlatte River flows are too low to warrant the complex application and analysis and additional personnel needs for treatment using a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is not proposed for use in the LaPlatte River or on its delta. This formulation is inappropriate for use in the riverine environment of the LaPlatte River and there is no evidence of a LaPlatte River delta population of sea lamprey at this time.

Barriers

- Technical considerations: The availability of suitable sea lamprey barrier sites is currently unknown. The technical feasibility of the use of a sea lamprey barrier (low-head, adjustable crest, electrical) will be investigated if future assessments indicate significant larval sea lamprey production.

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey in the LaPlatte River is not proposed as a control option at this time. The waterfall at river mile 3.3 in the village of Shelburne may offer a suitable trapping site. No adult sea lamprey trapping has been conducted, but if sea lamprey populations continue to expand, the feasibility of trapping spawning-phase sea lamprey alone or as part of a barrier, would be investigated.

LaPlatte River Control Strategy

Technically feasible control methods for the LaPlatte River may include TFM application, establishing a low-head barrier and/or trapping. Present transformer production estimates are not available and past surveys revealed a small larval population which may be building. If sea lamprey populations warrant control in the future, the above strategies will be considered further. Of these strategies, TFM would likely provide the most effective control (provided mitigation measures are developed to protect the resident endangered species), but the other listed options will be thoroughly studied for applicability prior to obtaining permits authorizing control. As other control methods become feasible for use on the LaPlatte River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. If the LaPlatte River sea lamprey population warrants control, investigate the feasibility of constructing a sea lamprey barrier and/or trapping facility.

2. If control methods investigated in Strategy 1 are found not to be feasible, and only if nontarget impacts to the resident stonecat can be acceptably mitigated, apply TFM below Shelburne Falls. The time interval between treatments would likely be four years or greater. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis.

14. Winooski River

Sea lamprey habitat

Sea lamprey have access to approximately 11.0 miles of the Winooski River which extends from the mouth upstream to the Winooski One Hydroelectric Facility dam in the city of Winooski, Vermont (Figure VIII-14).

Treatment history/results

The Winooski River was not included in the experimental control program because assessments indicated few sea lamprey larvae were present at that time.

Screening process

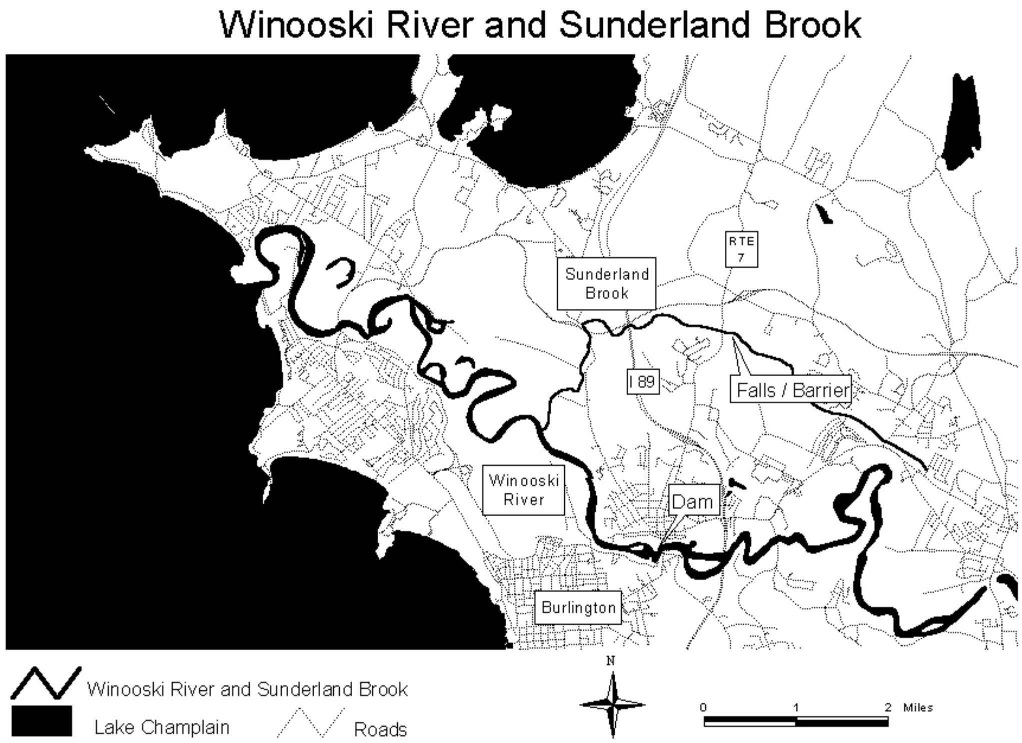
Estimated sea lamprey transformation

A preliminary estimate of 1,800 sea lamprey transformers was made in 2000 (USFWS, Essex Junction, Vermont, unpublished data) utilizing quantitative assessment survey techniques (Klar and Schleen 1999). The substantial increase in abundance of sea lamprey in the Winooski River since the late 1980s may be due to improvements in water quality.

TFM

- Technical considerations: A TFM treatment of the Winooski River may be technically feasible, but would be an expensive and demanding task. Fall river flows occasionally

Figure VIII-14.



exceed 1,000 cfs and flows may be variable. However, several hydroelectric facilities situated upstream of the sea lamprey infested areas may potentially be utilized to control river flow. Control of water flow may also be used to an advantage if flow can be increased following treatment to more rapidly flush the chemical out of the river once treatment is complete. Water chemistry, dye plume, and wetland studies need to be conducted to determine proper lampricide application procedures and to define water-use advisory zones.

- Nontarget concerns: Three Vermont-listed fish species have been found in the Winooski River. The endangered lake sturgeon utilizes the Winooski River for spawning in late April through June and juveniles may inhabit the river year-round. The endangered channel darter and threatened eastern sand darter are known to inhabit the river. Four Vermont-listed endangered mussel species (fluted-shell, pink heelsplitter, fragile papershell, and pocketbook) are found in the Winooski River as is one Vermont threatened mussel (giant floater). Mudpuppies are known to inhabit the Winooski River, and limited mortality may occur. Impacts will be mitigated by applying TFM in accordance with the Service's "TOP:011.1A Interim Protocol for Conducting Treatments of Streams with Populations of Young-of-Year Lake Sturgeon (*Acipenser fluvescens*)" as described in Klar and Schleen (1999). The interim protocol should protect the other resident threatened and endangered species discussed above. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: At least two large vegetable farms draw water from the Winooski River for irrigation. Provisions will be made to supply irrigation water from alternative sources during treatment, if necessary.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of the Winooski River is estimated to cost $195,683 per treatment or $48,921 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: The large size of the Winooski River makes it a candidate for a treatment using a TFM/niclosamide combination. The treatment would be similar to that of a TFM application but would require an increase in application and analysis effort associated with the addition of Bayluscide to the treatment (see Section IV.A.2.). Water chemistry, dye plume, and wetland studies would need to be conducted to determine treatment specifics as described in the TFM discussion.

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: Human impacts would be similar to those indicated with TFM treatments except that the duration of water-use advisories may be shorter than treatments using TFM alone, due to the overall reduction in chemical used.

- Habitat impacts: No unique impacts.

- Cost: A TFM/niclosamide treatment of the Winooski River is estimated to cost $132,880 per treatment or $33,220 per year based on four-year treatment cycle.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is most appropriate in slow-moving rivers, estuaries or lake regions (deltas). Bayluscide has been applied in defined areas within the St. Mary's River (the outlet of Lake Superior), which has a discharge of nearly ten times that of the Winooski River (Schleen and Klar 2000). If lamprey infestations within the river exist in specific areas within Lake Champlain backwater and they can be demarcated, it may be technically feasible to treat these specific areas with Bayluscide granules by boat. This method of control would reduce the amount of chemical used, avoid treatment of areas not inhabited by lamprey, and relieve some water-use impacts.

- Nontarget concerns: Mortalities to nontarget fish in Bayluscide-treated areas should be limited primarily to species which are strongly associated with the river bottom. Species of this nature found in the Winooski River include eastern sand darter, tesselated darter, channel darter, logperch, and possibly juvenile sturgeon. Lake sturgeon reproduction was documented with the observation of a juvenile in the summer of 2001 (VTDFW, Essex Junction, Vermont, unpublished data). Among invertebrates, mussels and snails are particularly sensitive to Bayluscide and sizeable mortalities are possible. See TFM section above for a list of mussel species found in the Winooski River. It may be extremely difficult to effectively treat sea lamprey-infested areas with Bayluscide 3.2% granules without negatively impacting Vermont threatened and endangered mussel species inhabiting the Winooski River. Therefore, this approach is not deemed feasible. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for standard mitigating measures.

Barriers

- Technical considerations: No new barriers are proposed for sea lamprey control on the Winooski River. The construction of a barrier (low-head, adjustable, or electrical) would be cost prohibitive and have major impacts on fish movement in a river as large as the Winooski River.

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey is not a proposed control option in the Winooski River. The technical feasibility of trapping adult sea lamprey in the Winooski River is poor due to the size of the river. Assessment trapping at sites in the vicinity of the Winooski One Dam was attempted in 1998, but no spawning-phase sea lamprey were captured. Furthermore, no sea lamprey have been captured in the Winooski One fish passage facility trap operating at the dam since its operation began in 1993, except for occasional parasitic-phase individuals attached to captured fish (VTDFW, Essex Junction, Vermont, unpublished data).

Winooski River Control Strategy

Feasible control methods for the Winooski River include TFM and TFM/niclosamide application. The estimated cost of applying the TFM/niclosamide combination is approximately one third less compared to TFM application alone. Several sensitive, endangered and threatened species documented in the Winooski River require mitigation measures to minimize potential nontarget impacts due to a lampricide treatment. As other control methods become feasible for use on the Winooski River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Apply TFM or a TFM/niclosamide combination at river mile 11.0 (Winooski One Dam). Applications will follow the Service's "TOP:011.1A Interim Protocol for Conducting Treatments of Streams with Populations of Young-of-Year Lake Sturgeon (*Acipenser fluvescens*)" *in Klar and Schleen (1999). Future updates to this protocol will be incorporated into treatment procedures. The time interval between treatments would likely be four years. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis.*

14a. Sunderland Brook

Sea lamprey habitat

Sea lamprey accessible habitat in Sunderland Brook extends from its confluence with the Winooski River, 3.2 miles upstream to the falls above U.S. Route 7 in Colchester, Vermont (see Figure VIII-14).

Treatment history/results

Sunderland Brook was not included in the experimental control program because sea lamprey abundance was insufficient to warrant treatment with TFM.

Screening Process

Estimated sea lamprey transformation

Transformer production is highly variable in Sunderland Brook; a larval assessment survey, conducted during the summer of 2000, found only one sea lamprey ammocoete (USFWS, Essex Junction, Vermont, unpublished data). Recent assessment trapping of spawning-phase sea lamprey may have suppressed sea lamprey production in Sunderland Brook.

TFM

- Technical considerations: A TFM treatment of Sunderland Brook appears to be technically feasible. TFM would only be applied to Sunderland Brook to coincide with a simultaneous lampricide treatment of the Winooski River. The relative discharge of Sunderland Brook compared to the Winooski River is too small for a prescribed TFM application to have a significant effect on the TFM concentration in the Winooski River below its confluence; therefore, the purpose of such an application would be to control sea lamprey in Sunderland Brook or as a supplemental application near its mouth to prevent sea lamprey in the Winooski River from entering fresh-water refugia in Sunderland Brook. Water chemistry, dye plume, and wetland studies need to be conducted prior to conducting TFM treatments.

- Nontarget concerns: The Vermont-listed, threatened American brook lamprey are present in Sunderland Brook and could be adversely impacted in areas exposed to TFM. This may require limiting the use of TFM to supplemental applications near the mouth of Sunderland Brook as described above, unless acceptable mitigation can be developed to meet state permitting requirements. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: A large vegetable farm occasionally draws water from Sunderland Brook for irrigation. Provisions will be made to supply irrigation water from alternative sources if necessary.

- Habitat impacts: No unique impacts.

Cost: The cost of treating Sunderland Brook is incorporated into the TFM treatment costs of the Winooski River.

TFM/Niclosamide

- Technical considerations: Sunderland Brook flows are too low to warrant the complex application of a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is inappropriate for the riverine environment of Sunderland Brook and is not proposed for use.

Barriers

- Technical considerations: The construction of a low-head sea lamprey barrier on Sunderland Brook is technically feasible (Anderson, B. E. et al. 1985), but is not being proposed as the primary method of sea lamprey control on this stream. However, the VTDFW has requested that a barrier be incorporated into the stream crossing structure of a planned future highway (river mile 2.1) at Malletts Bay Avenue. This plan may change pending further review, and construction is dependent upon approval and completion of the highway project. A sea lamprey trap or site for a PAT may be incorporated into the barrier's design to prevent redistribution of sea lamprey encountering the proposed barrier. This barrier is expected to prevent access to 100 percent of the adult sea lamprey spawning habitat. The applicability of an electrical barrier on Sunderland Brook has not been evaluated. An electrical barrier is not currently proposed as other effective control measures are expected to be less expensive and result in fewer nontarget impacts.

- Nontarget concerns: Sunderland Brook contains the Vermont-listed threatened American brook lamprey and mitigation may be necessary with any barrier depending on its distribution within the stream. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: If implemented, a barrier at Malletts Bay Avenue would be part of the highway construction project, at no cost to VTDFW.

Trapping

- Technical considerations: The Pine Island Road trapping site at approximately river mile 1.3 has proven to be an effective spawning-phase sea lamprey assessment trapping location. A trap at this site isolates all the spawning habitat from migrating adult lamprey. In 1998, 38 sea lamprey were captured and subsequent larval surveys found no young-of-the-year sea lamprey suggesting that trapping could be successful in preventing spawning. Only 10 adult lamprey were captured in 1999 and 27 in 2000 (USFWS, Essex Junction, Vermont, unpublished data).

- Nontarget concerns: American brook lamprey are found in Sunderland Brook but impacts of trapping to this species are expected to be negligible because they are smaller than adult sea lamprey and can readily pass through the trap screening or can be released alive. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost of trapping on Sunderland Brook is $5,064 per year.

Sunderland Brook Control Strategy

Technically feasible control methods for Sunderland Brook include trapping spawning-phase sea lamprey, establishing low-head barrier and TFM application. Of these strategies, trapping has proven to be an inexpensive and effective means of control in Sunderland Brook and has few associated negative impacts. The construction of a barrier in conjunction with the future highway is uncertain at this time but offers good potential for control. A supplemental TFM application near the mouth of Sunderland Brook simultaneously with a treatment of the Winooski River may be necessary to prevent escapement of sea lamprey larvae in the Winooski River into Sunderland Brook. TFM treatment for control in Sunderland Brook would require acceptable mitigation for adverse impacts to the American brook lamprey. As other control methods become feasible for use on Sunderland Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Trap adult sea lamprey at Pine Island Road (river mile 1.3).

2. Incorporate a sea lamprey barrier into the future highway bypass at Malletts Bay Avenue (river mile 2.1).

3. Apply TFM near the mouth of Sunderland Brook as a supplemental application in conjunction with a Winooski River lampricide treatment, to prevent escapement of Winooski River sea lamprey during treatment.

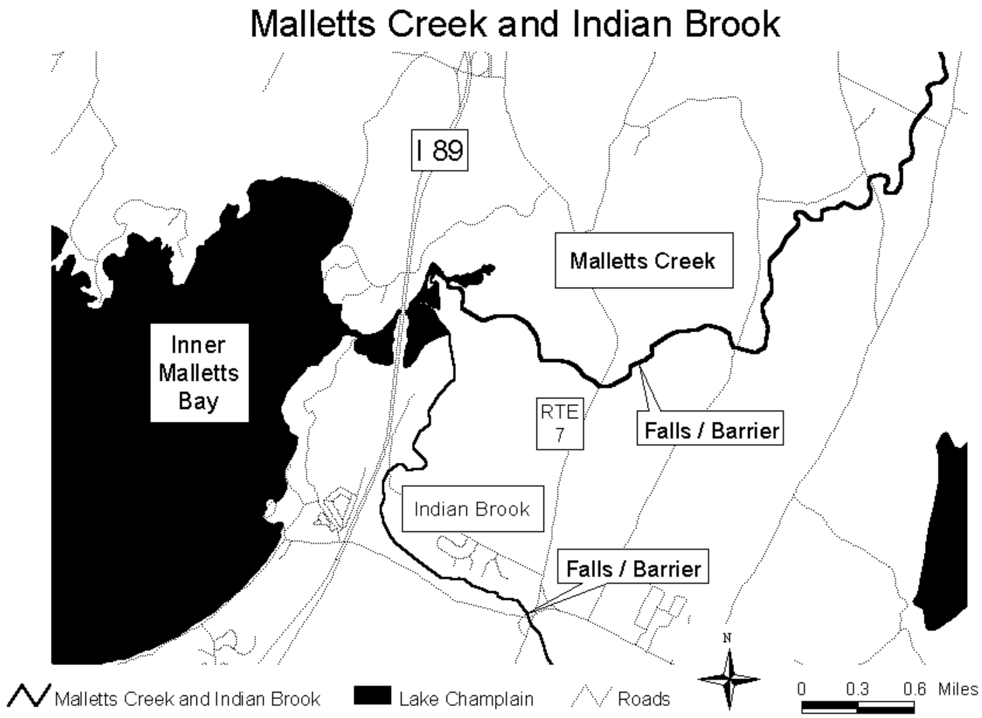
4. If trapping and/or barrier implementation becomes infeasible, or ineffective at controlling larval sea lamprey production, and if acceptable mitigation for potential impacts to American brook lamprey can be implemented, then apply TFM for control in conjunction with a Winooski River lampricide treatment. The application point of such a treatment would depend on the extent of the larval sea lamprey infestation and may be stipulated by acceptable American brook lamprey mitigation measures. The time interval between treatments would be four years or greater. This time interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis; however, TFM would most likely be applied infrequently, if at all.

15. Malletts Creek

Sea lamprey habitat

Sea lamprey have access to Malletts Creek from the mouth upstream 1.7 miles to approximately 500 feet below the falls upstream of U.S. Route 7 in Colchester, Vermont (Figure VIII-15).

Figure VIII-15.



<u>Treatment history/results</u>

Malletts Creek was not included in the experimental control program in order to protect the resident Vermont-listed endangered northern brook lamprey population.

<u>Screening Process</u>

Estimated sea lamprey transformation

Transformer production estimates are not currently available. Sea lamprey habitat assessment and larval surveys will be conducted to assess transformer production.

TFM

- <u>Technical considerations</u>: A TFM treatment of Malletts Creek appears to be technically feasible. Water chemistry and dye plume studies will need to be conducted prior to conducting TFM treatments.

- Nontarget concerns: A TFM application of Malletts Creek is not being considered at this time in order to protect the Vermont-listed endangered northern brook lamprey.

TFM/Niclosamide

- Technical considerations: Malletts Creek flows are too low to warrant the complex application of a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide is not proposed for use in Malletts Creek. Application of this formulation is inappropriate for the riverine environment of Malletts Creek and there is no evidence of a Malletts Creek Delta population of sea lamprey.

Barriers

- Technical considerations: The construction of a low-head sea lamprey barrier on Malletts Creek may be technically feasible (Anderson, B. E. et al. 1985). A suitable site is located 1.6 miles above the mouth and would eliminate approximately 95 percent of the sea lamprey spawning habitat. Sea lamprey production from the remaining portion of Malletts Creek below the barrier would be assessed and additional control measures may be applied. Definitive feasibility studies would be necessary. Studies regarding the applicability of an electrical barrier on Malletts Creek have not been conducted and an electrical barrier is not proposed at this time.

- Nontarget concerns: It will be necessary to assess the distribution of the Vermont-listed endangered northern brook lamprey within the stream to provide mitigation if a barrier is determined to significantly disrupt movements of this species. A sea lamprey/fish trap would be designed and built into the barrier to permit the collection of sea lamprey while passing other fish including northern brook lamprey. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: Spring lake levels often inundate lower Malletts Creek and can cause extensive flooding. A low-head sea lamprey barrier on Malletts Creek may cause additional flooding to adjacent agricultural lands. This may prevent these lands from being utilized until water levels recede.

- Habitat impacts: See discussion relative to flooding under human impacts section.

- Cost: The 1985 Malletts Creek preliminary feasibility study estimated the cost of a low - head barrier to be approximately $69,613. Adjusting for inflation (4 percent per year), the estimated cost in 2000 would be $125,369. This includes the estimated cost of a final feasibility study, land and easement acquisition, and final design and construction. The estimate does not include the cost of a sea lamprey/fish trap or the cost of operating the trap. The estimated annual cost is $2,507, assuming the barrier has a life expectancy of 50 years.

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey may provide effective control on Malletts Creek. Control may be enhanced by incorporating a trap with a sea lamprey barrier. Assessment trapping near the potential barrier dam site (see barrier discussion) yielded significant numbers of sea lamprey in spring 2001 (USFWS, Essex Junction, Vermont, unpublished data).

- Nontarget concerns: Northern brook lamprey are found in Malletts Creek but impacts of trapping to this species are expected to be negligible because they are smaller than adult sea lamprey and can readily pass through the trap screening or can be released alive. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: See habitat impacts associated with a barrier.

- Cost: The estimated cost of trapping on Malletts Creek is $5,050 per year.

Malletts Creek Control Strategy

Technically feasible control methods for Malletts Creek include establishing a low-head barrier with trap and TFM application. Spawning-phase sea lamprey trapping also appears to be technically feasible and will be evaluated. Of these methods, trapping alone may prove to be an effective means of control in Malletts Creek and have fewer negative impacts. Barrier feasibility on Malletts Creek may be compromised by high spring lake levels. The presence of the endangered northern brook lamprey precludes a TFM treatment of Malletts Creek. As other control methods become feasible for use on Malletts Creek the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Initiate long-term spawning-phase sea lamprey trapping at or near river mile 1.6.

2. If trapping alone proves ineffective, then conduct a detailed feasibility study to construct a low-head barrier with a trapping facility at river mile 1.6.

15a. Indian Brook

Sea lamprey habitat

Sea lamprey have access to Indian Brook from its confluence with Malletts Creek 2.7 miles upstream to the falls located just below the intersection of U.S. Route 7 and Vermont Route 127 in Colchester, Vermont (see Figure VIII-15).

Treatment history/results

Indian Brook was initially recommended for lampricide treatments as part of the experimental control program but was withdrawn to protect the resident Vermont-listed endangered northern brook lamprey.

Screening Process

Estimated sea lamprey transformation

Preliminary assessment surveys in 2001 have been negative for sea lamprey larvae in Indian Brook (USFWS, Essex Junction, Vermont, unpublished data). Further sea lamprey habitat assessment and larval surveys will be conducted periodically.

TFM

- Technical considerations: A TFM lampricide treatment of Indian Brook appears technically feasible. Water chemistry and dye plume studies need to be conducted prior to conducting TFM treatments.

- Nontarget concerns: A TFM application of Indian Brook is not being considered at this time in order to protect the Vermont-listed endangered northern brook lamprey.

TFM/Niclosamide

- Technical considerations: Indian Brook flows are too low to warrant the complex application of a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is inappropriate for the riverine environment of Indian Brook, and is not proposed.

Barriers

- <u>Technical considerations</u>: The construction of a low-head sea lamprey barrier on Indian Brook may be technically feasible (Anderson, B. E. et al. 1985). A barrier established at a site located 0.25 miles above the mouth would eliminate nearly 100 percent of the present sea lamprey spawning habitat. The applicability of an electrical barrier on Indian Brook has been evaluated.

- <u>Nontarget concerns</u>: It will be necessary to assess the distribution of the Vermont-listed endangered northern brook lamprey within the stream and to determine if mitigation is needed or possible. A sea lamprey/fish trap would be designed and built into a barrier which may allow the collection of sea lamprey and passage of other fish, including northern brook lamprey. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- <u>Human impacts</u>: No unique impacts.

- <u>Habitat impacts</u>: Spring lake levels often inundate lower Indian Brook causing extensive flooding. A low-head sea lamprey barrier on Indian Brook may cause additional flooding.

- <u>Cost</u>: The 1985 Indian Brook preliminary feasibility study estimated the cost of this barrier to be approximately $68,200. Adjusting for inflation (4 percent per year) the estimated cost in 2000 would be $122,824. This includes the estimated cost of a final feasibility study, land and easement acquisition, and final design and construction. This estimate does not include the cost of a fish trap nor the cost of operating the lamprey trapping facility. The estimated annual cost is $2,456, assuming the barrier has a life expectancy of 50 years.

Trapping

- <u>Technical considerations</u>: Trapping spawning-phase sea lamprey may provide effective long-term control of sea lamprey in Indian Brook. Annual assessment trapping efforts have reduced the adult sea lamprey spawning run from a high of 400 sea lamprey captured in 1990 to only 1 in 2001. Consequently, no sea lamprey larvae have been found in quantitative assessment surveys in 2001 (USFWS, Essex Junction, Vermont, unpublished data). Two trapping sites on Indian Brook (approximately river mile 0.9 and 2.4) have been utilized successfully to capture spawning-phase sea lamprey. The lower site is preferable as it prevents access to lamprey spawning habitat. This trapping site may be improved by the construction of a permanent trap or a platform to improve the efficiency of portable traps. The site at river mile 2.4 is at the base of a falls which act as a natural lamprey barrier.

- Nontarget concerns: The Vermont-listed endangered northern brook lamprey is found in Indian Brook. Impacts to this species from past trapping here have been negligible because they can pass through the trap screening. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost of trapping on Indian Brook is $5,050 per year.

Indian Brook Control Strategy

Technically feasible control methods for Indian Brook include trapping spawning-phase sea lamprey, establishing a low-head barrier and TFM application. Of these methods, trapping has proven to be an effective means of control in Indian Brook and has fewer negative impacts. Barrier effectiveness on Indian Brook may be compromised by high spring lake levels and would not necessarily eliminate trapping activities at the barrier site. The presence of the endangered northern brook lamprey precludes a TFM treatment of Indian Brook. As other control methods become feasible for use on Indian Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Initiate long-term spawning-phase sea lamprey trapping for control purposes, directing most effort to the site near river mile 0.9 with possible construction enhancement to improve efficiency.

2. If trapping alone proves ineffective, then the feasibility of constructing a low-head barrier with a trapping facility at river mile 0.25 should be investigated.

16. Trout Brook

Sea lamprey habitat

Sea lamprey habitat extends from the mouth of Trout Brook, upstream 1.3 miles to a waterfall in Milton, Vermont (Figure VIII-16).

Treatment history/result

The Trout Brook TFM treatment history is summarized in Table VIII-21 (Neuderfer 1995c; Fisheries Technical Committee 1999). The 1991 treatment was canceled due to the inability to meet permit conditions to mitigate impacts to the Vermont-listed endangered American brook lamprey. The American brook lamprey mitigation plan was later modified and the 1995 treatment was successfully completed (see Section VII.A.1.g.). In 1995, TFM was applied to the lower 0.4 miles of the brook (Neuderfer 1995c). No sea lamprey have been found in surveys conducted in years following the treatment and evidence of recolonization had not been found in the lower section of Trout Brook as of the last evaluation in 1997.

Figure VIII-16.

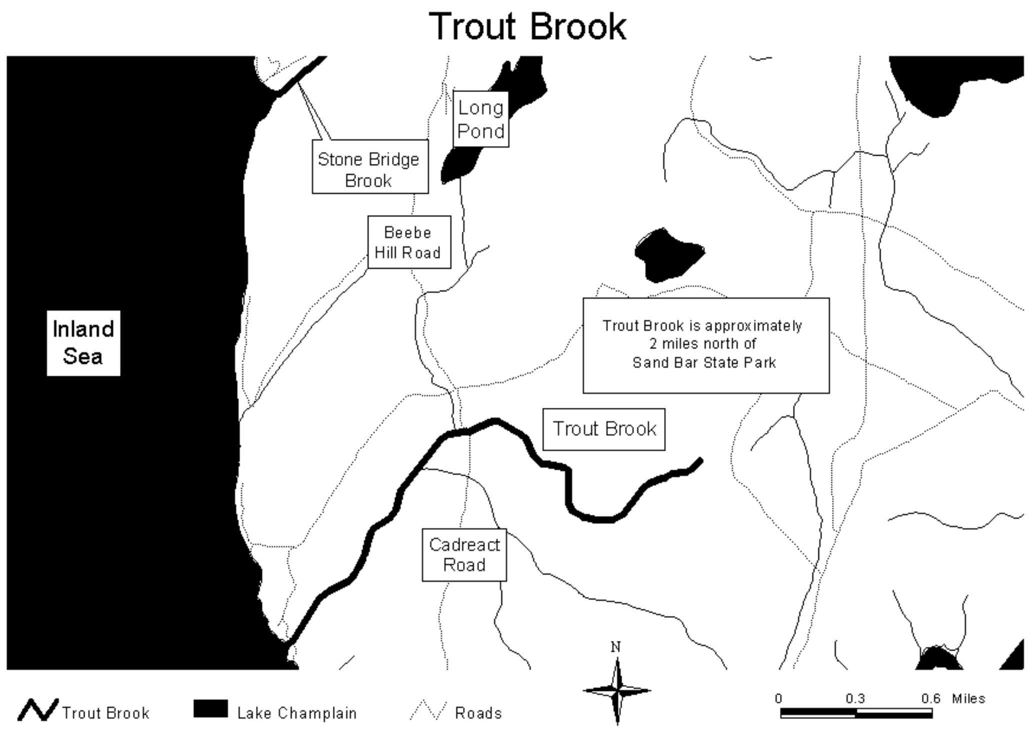


Table VIII-21. Trout Brook TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoetes Mortality	Estimated Transformers Mortality
1991	CANCELLED		
1995	0.4	182	75

Screening process

Estimated sea lamprey transformation

Trout Brook has the potential to produce at least 75 sea lamprey transformers annually in the lower 0.4 mile of stream as determined by target mortality assessment efforts evaluating the 1995 treatment. Sea lamprey habitat assessment and larval surveys will be conducted to further refine this estimate.

TFM

- Technical considerations: A TFM treatment of Trout Brook is technically feasible. The 1995 experimental TFM treatment was effective and accomplished without difficulty.

- Nontarget concerns: In 1995, TFM was applied to only the lower 0.4 miles of Trout Brook. This eliminated treating over 0.8 miles of the brook that had a large population of American brook lamprey. Prior to this treatment, 280 American brook lamprey were removed from the stream, held during treatment and released after the treatment to further reduce impacts to this species. Post-treatment surveys revealed an observed mortality of 92 American brook lamprey. Adverse impacts to American brook lamprey is likely if TFM is used as a control method; therefore, TFM application would require acceptable mitigation of these impacts to meet state permitting requirements. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of Trout Brook is estimated to cost $24,918 per treatment or $6,230 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: Trout Brook flows are too low to warrant the complex application of a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide is not proposed for use in Trout Brook or its delta. Application of this formulation is inappropriate for the riverine environment of Trout Brook, and there is no evidence of a Trout Brook Delta population of sea lamprey.

Barriers

- <u>Technical considerations</u>: The construction of a low-head sea lamprey barrier on Trout Brook may be technically feasible (Anderson, B. E. et al. 1985). Two potential barrier sites exist on Trout Brook. A site 0.25 miles above the mouth of the stream would eliminate all of the sea lamprey spawning habitat. A second site located approximately 0.4 miles above the mouth, at the site of a breached stone dam, may also prove effective but no feasibility studies have been completed for this location. However, the landowner declined to allow a structure be built on the property during the experimental program. Contact should be renewed periodically in the event that landowner reconsiders, or the property changes ownership. Specific studies regarding the applicability of an electrical barrier on Trout Brook have not been conducted but expected impacts (other than the increase potential for flooding) would be similar to other barriers when the barrier is activated. An electrical barrier is not proposed for Trout Brook as other control measures are expected to be less costly and have fewer nontarget impacts.

- <u>Nontarget concerns</u>: It will be necessary to assess the distribution of the Vermont-listed, threatened American brook lamprey within the stream and provide mitigation if needed. A sea lamprey/fish trap would be built into the barrier to prevent redistribution of sea lamprey encountering the barrier to other locations and provide passage for other fish possibly including the American brook lamprey. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- <u>Human impacts</u>: No unique impacts.

- <u>Habitat impacts</u>: No unique impacts.

- <u>Cost</u>: The 1985 Trout Brook preliminary feasibility study estimated the cost of a barrier to be approximately $52,310. Adjusting for inflation (4 percent per year), the estimated cost in 2000 would be $94,207. This includes the estimated cost of a final feasibility study, land and easement acquisition, and final design and construction. This estimate does not include the cost of a fish trap or the cost of tending the lamprey trapping facility. The estimated annual cost is $1,884, assuming the barrier has a life expectancy of 50 years.

Trapping

- <u>Technical considerations</u>: Trapping spawning-phase sea lamprey in Trout Brook appears technically feasible. Effective sea lamprey control on Trout brook may be achieved by a lamprey trapping program alone. Trout Brook has potential trapping sites near the mouth, at an old dam site (approximately river mile 0.4), and at Cadreact Road (river mile 1.3) in Milton. The lowest site would be preferred but this site may be affected by high spring lake levels making effective trapping difficult there.

- Nontarget impacts: Trapping impacts to the American brook lamprey will be negligible because they can pass through the trap screening, or can be released alive. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost of trapping on Trout Brook is $5,193 per year.

Trout Brook Control Strategy

Technically feasible control methods for Trout Brook include trapping spawning-phase sea lamprey, establishing a low-head barrier and TFM application. Of these methods, trapping may provide effective control and has the fewest negative impacts. Lack of landowner consent prevents further barrier dam investigations at this time. Any TFM application would require acceptable mitigation for adverse impacts to the American brook lamprey. As other control methods become feasible for use on Trout Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Initiate long-term spawning-phase sea lamprey trapping for control purposes, directing efforts to the mouth and river mile 0.4 sites.

2. If trapping alone proves to be ineffective and there is landowner consent, construct a sea lamprey barrier with trapping facility.

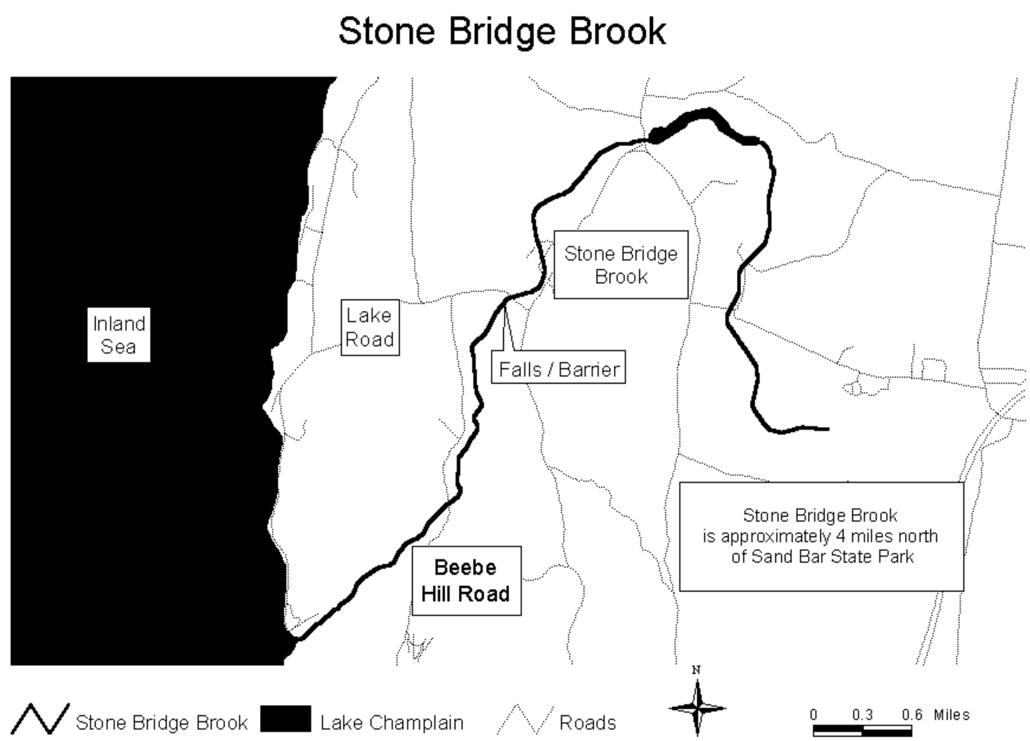
3. If trapping and/or barrier implementation becomes infeasible, or ineffective at controlling larval sea lamprey production, and if acceptable mitigation for potential impacts to American brook lamprey can be implemented, then apply TFM. The application point of such a treatment would depend on the extent of the larval sea lamprey infestation and may be stipulated by acceptable American brook lamprey mitigation measures. The time interval between treatments would be four years or greater. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis; however, TFM would most likely be applied infrequently, if at all.

17. Stone Bridge Brook

Sea lamprey habitat

Sea lamprey have access to Stone Bridge Brook from the mouth 2.7 miles upstream to a small waterfall near Lake Road in Milton, Vermont (Figure VIII-17).

Figure VIII-17.



<u>Treatment history/results</u>

The Stone Bridge Brook TFM treatment history is summarized in Table VIII-22 (Steinbach 1991b; Fisheries Technical Committee 1999). In 1991, a total of 2.9 miles of Stone Bridge Brook was treated with TFM. The primary application occurred at the Lake Road crossing in Milton, Vermont. A second simultaneous application occurred at the outlet of an in-stream pond at river mile 2.1 due to concerns that the chemical would significantly attenuate within the pond and greatly extend the time to complete the treatment. The TFM block within the pond behaved as predicted (Steinbach 1991b). A boost was also conducted at river mile 1.2 (Everest Road crossing). The scheduled 1995 treatment was cancelled because sea lamprey recolonization was insufficient to warrant treatment at the scheduled time. No evidence of recolonization was found during assessments in 1997 and 2001 (USFWS, Essex Junction, Vermont, unpublished data).

Table VIII-22. Stone Bridge Brook TFM treatment history and estimated sea lamprey mortality.

Year of Treatment	River Miles Exposed to TFM	Estimated Ammocoete Mortality	Estimated Transformer Mortality
1991	2.9	268	277
1995	CANCELLED		

Screening process

Estimated sea lamprey transformation

Stone Bridge Brook has the potential to produce at least 275 sea lamprey transformers annually as determined by target mortality assessment efforts evaluating the 1991 treatment. Since the initial TFM treatment, there has been no indication that transformers are being produced, possibly due to effective trapping of spawning-phase sea lamprey during spawning run assessments. Sea lamprey habitat assessment and larval surveys will be conducted periodically to assess lamprey populations in Stone Bridge Brook.

TFM

- Technical considerations: A TFM treatment of Stone Bridge Brook is technically feasible. The 1991 experimental TFM treatment was effective and accomplished without difficulty.

- Nontarget concerns: The cylindrical papershell, a Vermont-listed endangered mussel, occurs in Stone Bridge Brook and its delta. No endangered or threatened fish species are known to be present in Stone Bridge Brook. Silver lamprey are present, however, and are sensitive to TFM. Toxicity testing to determine the effect of TFM on the cylindrical papershell should be conducted prior to implementation of any treatment. Application of TFM at concentrations at or below the no observed effect concentration should mitigate potential impacts to this endangered species. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of Stone Bridge Brook is estimated to cost $27,906 per treatment or $6,977 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: Stone Bridge Brook flows are too low to warrant the complex application of a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide is not proposed for use in Stone Bridge Brook or delta. Application of Bayluscide 3.2% granules is inappropriate for the riverine environment of Stone Bridge Brook. There is no known delta population of sea lamprey.

Barriers

- Technical considerations: The construction of a low-head sea lamprey barrier on Stone Bridge Brook is technically feasible (Anderson, B. E. et al. 1985; Staats 1993). A suitable site exists 0.25 miles above the mouth and establishing a barrier at this location would eliminate approximately 95 percent of the present sea lamprey spawning habitat. The applicability of an electrical barrier on Stone Bridge Brook has not been evaluated, but expected impacts (other than the increase potential for flooding) would be similar to other barriers when the barrier is activated. An electrical barrier is not proposed because other effective control measures are expected to be less costly and have fewer nontarget impacts.

- Nontarget concerns: No endangered or threatened fish species are present in Stone Bridge Brook. A fish ladder to facilitate passage of jumping fish (i.e., salmonids) and a trap to facilitate the collection of sea lamprey and allow passage of other non-leaping fish, was originally incorporated into the 1993 barrier design. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The 1993 Stone Bridge Brook feasibility study estimated the cost of a barrier to be approximately $100,576. Adjusting for inflation (4 percent per year), the estimated cost in 2000 would be $132,351. This cost projection includes the cost of a final feasibility study, land and easement acquisition, and final design and construction. This estimate does not include the cost of tending the trapping facility. The estimated annual cost is $2,647, assuming the barrier has a life expectancy of 50 years.

Trapping

- Technical considerations: Effective sea lamprey control in Stone Bridge Brook may be achieved through a spawning-phase sea lamprey trapping program. After the 1991 TFM treatment, spawning-phase assessment trapping efforts at river miles 0.25 and 1.7 have been successful capturing spawning-phase lamprey and preventing sea lamprey recolonization of the stream (USFWS, Essex Junction, Vermont, unpublished data).

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost of trapping on Stone Bridge Brook is $5,265 per year.

Stone Bridge Brook Control Strategy

Technically feasible control methods for Stone Bridge Brook include trapping spawning-phase sea lamprey, establishing a low-head barrier and TFM application. Of these methods, trapping may provide effective control, with the fewest negative impacts. A barrier on Stone Bridge Brook would not eliminate trapping activities at the barrier site. The presence of the Vermont-listed cylindrical papershell may require mitigation to minimize potential impacts from both the barrier and TFM treatments. Continued TFM applications should not be necessary given that removal of spawners in annual assessment trapping has prevented recolonization for 10 years since the initial treatment. However, if unforseen circumstances result in sea lamprey recolonization beyond the control of preferred methods, TFM treatment could be required. The estimated cost of trapping is approximately $1,500 less annually compared to a TFM treatment. As other control methods become feasible for use on Stone Bridge Brook the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Initiate long-term spawning-phase sea lamprey trapping for control purposes, directing efforts to the river mile 0.25 site.

2. Construct a low-head sea lamprey barrier with trapping facility at river mile 0.25 should trapping alone prove ineffective.

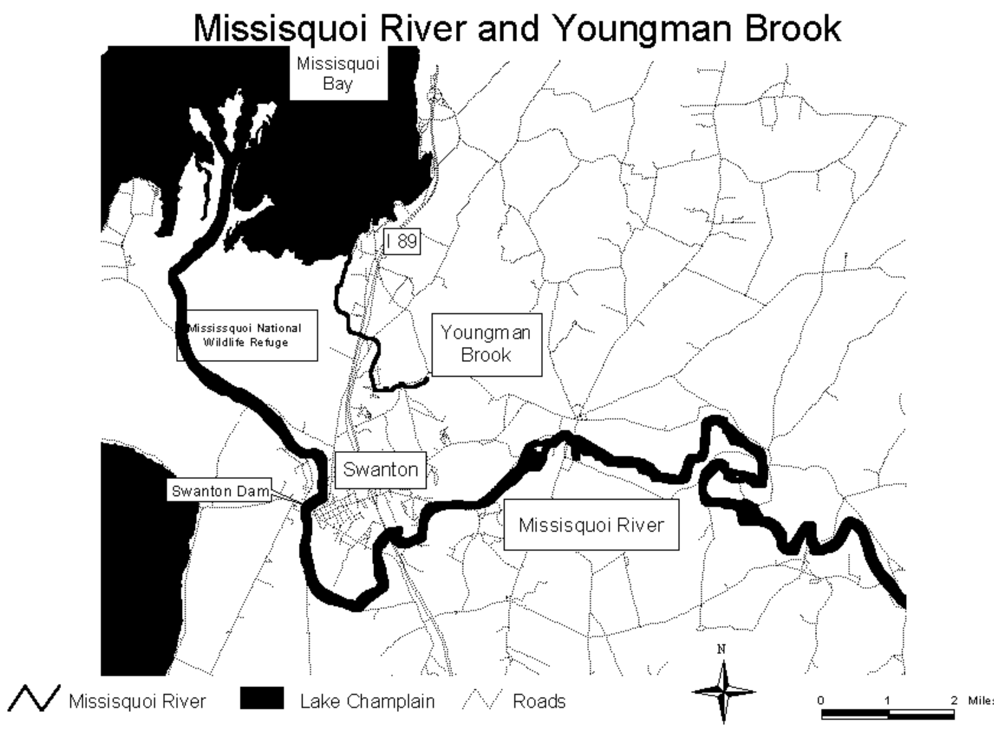
3. If trapping and/or barrier implementation becomes infeasible, or ineffective at controlling larval sea lamprey production, apply TFM at river mile 2.9. Target treatment concentrations will be less than or equal to levels shown not to cause mortality to resident Vermont-listed endangered cylindrical papershell. The time interval between treatments would be four years or greater. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis; however, TFM would most likely be applied infrequently, if at all.

18. Missisquoi River

Sea lamprey habitat

Sea lamprey have access to approximately 8.0 miles of the Missisquoi River to the Swanton Dam in Swanton, Vermont (Figure VIII-18).

Figure VIII-18.



Treatment history/results

The Missisquoi River was not included in the experimental control program because sea lamprey assessments indicated larval abundance was too low to warrant TFM treatment there.

Screening process

Estimated sea lamprey transformation

Preliminary assessment surveys have documented presence of sea lamprey larvae below the Swanton Dam, but no larvae have been found above (USFWS, Essex Junction, Vermont, unpublished data). Quantitative surveys of sea lamprey habitat and larval density will be conducted to determine if control is necessary in the Missisquoi River.

TFM

- Technical considerations: TFM treatment of the Missisquoi River may be technically feasible. Fall river flows occasionally exceed 1,000 cfs. Two hydroelectric facilities upstream of the sea lamprey infested areas might be utilized to stabilize river flow. River flows of this magnitude may restrict the timing of a treatment because of the high cost and amount of chemical needed to treat at such flows. Water chemistry and dye plume studies will need to be completed to determine proper lampricide application procedures and to define water-use advisory zones.

- Nontarget concerns: The Vermont-listed endangered lake sturgeon is known to utilize the Missisquoi River for spawning and the Vermont-listed threatened eastern sand darter inhabits the lower Missisquoi River. The Missisquoi River contains six mussel species listed in Vermont (endangered: black sandshell, pocketbook, fragile papershell, pink heelsplitter and cylindrical papershell; threatened: giant floater). Impacts to lake sturgeon will be mitigated by applying TFM in accordance with the Service's "TOP:011.1A Interim Protocol for Conducting Treatments of Streams with Populations of Young-of-Year Lake Sturgeon (*Acipenser fluvescens*)" as described in Klar and Schleen (1999). The interim protocol should also protect the other threatened and endangered species discussed above. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: A TFM application may potentially impact the Omer, Quebec municipal water supply and private intakes in Missisquoi Bay (Table VII-1). Prior to any proposed treatment, dye plume studies will be necessary to clarify the potential for impacts. Installation of carbon filters may be necessary to remove lampricide from drinking water (see Section VII.A.2.).

- Habitat impacts: The lower most portion of the Missisquoi River passes through the Missisquoi National Wildlife Refuge but no significant impacts are anticipated.

- Cost: TFM treatment of the Missisquoi River is estimated to cost $176,318 per treatment or $44,080 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: The larger size of the Missisquoi River makes it a candidate for treatment with a TFM/niclosamide combination. The treatment would be similar to that of a TFM application but would require an increase in application and analysis efforts associated with the addition of Bayluscide to the treatment (see Section IV.A.2.). Water chemistry and dye plume studies would be necessary to determine treatment specifics as described in the TFM discussion.

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: Human impacts would be similar to those indicated with TFM treatments except that the duration of water-use advisories may be shorter than treatments with TFM alone, due to an overall reduction in the amount of chemical used.

- Habitat impacts: No unique impacts.

- Cost: TFM/niclosamide treatment of the Missisquoi River is estimated to cost $120,694 per treatment or $30,174 per year based on a four-year treatment cycle.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is most frequently used in estuaries or lake regions (deltas). Bayluscide has been applied in defined areas within the St. Mary's River (the outlet of Lake Superior), which has a discharge of nearly ten times that of the Missisquoi River (Schleen and Klar 2000). If lamprey infestations within the river exist in specific areas within the Lake Champlain backwater and they can be demarcated, it may be technically feasible to treat these specific areas with Bayluscide granules by boat. This method of control would eliminate treating areas not inhabited by lamprey, potentially reducing nontarget impacts and reducing water-user impacts.

- Nontarget concerns: Mortalities to nontarget fish in Bayluscide-treated areas should be limited primarily to species which are strongly associated with the river bottom. Species of this nature found in the Missisquoi River may include eastern sand darter, tesselated darter, logperch, and juvenile lake sturgeon. Successful sturgeon reproduction has not been documented in the Missisquoi River but presence of adult sturgeon during their spawning period has been documented. Mussels and snails are particularly sensitive to Bayluscide and some mortalities would be expected. The Vermont-listed black sandshell, pocketbook, fragile papershell, pink heelsplitter, cylindrical papershell (all endangered) and the giant floater (threatened) may be adversely impacted from Bayluscide treatments. It will be difficult to effectively treat sea lamprey-infested areas of the Missisquoi River with granular Bayluscide without negatively impacting Vermont threatened and endangered mussel species. Therefore, this approach is not deemed feasible. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

Barriers

- Technical considerations: The Swanton Dam acts as a barrier to sea lamprey movement further up the Missisquoi River. The effectiveness of the dam in Swanton as a sea lamprey barrier should be maintained. The abandoned millrace on the west side of the dam should be inspected for barrier effectiveness. Presently, some leakage does exist around the deteriorating stop-logs at the head of the millrace that may, if not maintained, allow sea lamprey access to eight miles of the river and two tributaries above the dam. In 2001, one spawning-phase sea lamprey was trapped below the stop-log dam, suggesting that they may be attracted to the millrace discharge (USFWS, Essex Junction, Vermont, unpublished data). No other barriers are proposed for the Missisquoi River.

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts

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- Cost: No cost estimate.

Trapping

- Technical feasibility: Trapping spawning-phase sea lamprey in the Missisquoi River at the Swanton Dam is not an effective control option due to the large size of the river. A trapping site on the east side of the dam is accessible for the purpose of installing and operating a portable assessment trap. Establishing a permanent assessment trap here may be advantageous. In 1998, 36 spawning-phase sea lamprey were captured at this site (USFWS, Essex Junction, Vermont, unpublished data).

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost of trapping on the Missisquoi River is $5,522 per year.

Missisquoi River Control Strategy

Technically feasible control methods for the Missisquoi River include barrier maintenance and TFM or TFM/niclosamide application. The Swanton Dam would be maintained as a barrier to sea lamprey and trapping at the dam would continue. Should future larval assessment surveys reveal a need for control below the dam, lampricide application will be considered. Several endangered and threatened species documented in the Missisquoi River require mitigation measures to minimize potential nontarget impacts due to a lampricide treatment. As other control methods become feasible for use on the Mississquoi River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Maintain the Swanton Dam as a sea lamprey barrier.

2. Apply TFM or a TFM/niclosamide combination at river mile 8.0 (Swanton Dam) if sea lamprey populations warrant control. Applications will follow the Service's "TOP:011.1A Interim Protocol for Conducting Treatments of Streams with Populations of Young-of-Year Lake Sturgeon (*Acipenser fluvescens*)" *in Klar and Schleen (1999). The time interval between treatments would likely be four years. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis.*

19. Youngman Brook

<u>Sea lamprey habitat</u>

Sea lamprey have access to approximately 1.1 miles of Youngman Brook to just east of Interstate 89 in Highgate, Vermont (see Figure VIII-18).

<u>Treatment history/results</u>

Youngman Brook was not included in the experimental control program because sea lamprey larval abundance was too low to warrant a TFM treatment and to prevent possible impacts to resident American brook lamprey listed as threatened in Vermont.

<u>Screening process</u>

Estimated sea lamprey transformation

Preliminary assessment surveys in 2001 have documented presence of sea lamprey larvae in Youngman Brook (USFWS, Essex Junction, Vermont, unpublished data). Quantitative surveys of sea lamprey habitat and larval density will be conducted to assess transformer production.

TFM

- Technical considerations: A TFM lampricide treatment of Youngman Brook appears to be technically feasible. Water chemistry and dye plume studies may be needed prior to conducting TFM treatments.

- Nontarget concerns: The Vermont-listed threatened American brook lamprey is present in Youngman Brook. Adverse impacts to American brook lamprey would be likely if TFM was used as a control method; therefore, TFM application would require acceptable mitigation of these impacts to meet state permitting requirements. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: A TFM application may potentially impact the Omer, Quebec municipal water supply and other private water intakes in Missisquoi Bay. Prior to any proposed treatment, water chemistry and dye plume studies are necessary to clarify the potential for impacts. If dye studies predict that the Omer water intake will be exposed to TFM, mitigation may require the installation of activated carbon filters to remove lampricide from the drinking water (see Section VII.A.2).

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of Youngman Brook is estimated to cost $25,611 per treatment or $6,403 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: Youngman Brook flows are too low to warrant the complex application of a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide is not proposed for use in Youngman Brook. Application of Bayluscide 3.2% granules is inappropriate for the riverine environment of Youngman Brook. There is no evidence of a Youngman Brook Delta population of sea lamprey.

Barriers

- Technical considerations: The construction of a low-head sea lamprey barrier on Youngman Brook may be technically feasible (Anderson, B. E. et al. 1985). An acceptable barrier site is located at river mile 0.7 at the site of an existing U.S. Route 7 highway culvert in Highgate. A barrier here has the potential to eliminate 90 percent of the present spawning habitat and 2,000 feet of available larval habitat. Sea lamprey production from the remaining portion of Youngman Brook below the barrier, would still require assessment and possible additional control measures. The applicability of an electrical barrier on Youngman Brook has not been evaluated but impacts similar to those from a low head barrier would be expected when an electrical barrier is activated. An electrical barrier is not proposed because other effective control measures suggested for Youngman Brook are expected to be less costly and have fewer nontarget impacts.

- Nontarget concerns: Youngman Brook supports a population of American brook lamprey, listed as threatened in Vermont. It will be necessary to assess the distribution of this lamprey within the stream and provide mitigation if necessary. A sea lamprey/fish trap would be incorporated into the barrier preventing redistribution of sea lamprey to other locations and allow passage of other fish. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The 1985 Youngman Brook preliminary feasibility study estimated the cost of a barrier to be approximately $96,610. Adjusting for inflation (4 percent per year) the estimated cost in 2000 would be $173,989. This includes the estimated cost of a final feasibility study, land and easement acquisition, and final design and construction. This estimate does not include the cost of a trapping facility or the cost of operating a trap if included. The estimated annual cost is $3,480, assuming the barrier has a life expectancy of 50 years.

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey in Youngman Brook may be technically feasible. A suitable trapping site at the Interstate 89 highway culvert is downstream from 90 percent of the available spawning habitat. Spawning-phase assessment trapping in spring 2001 yielded no sea lamprey, however the trap did not completely block the stream, thus, some lamprey may have been able to pass without being captured (USFWS, Essex Junction, Vermont, unpublished data). A trapping facility could be incorporated into a barrier dam if constructed at this site (see barrier section).

- Nontarget concerns: American brook lamprey are found in Youngman Brook, but trapping impacts to this species will be negligible because they can pass through the trap screening, or be released alive. If trapping is proposed at the barrier, then impacts to American brook lamprey would be assessed and mitigated if necessary. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost of trapping on Youngman Brook is $5,522 per year.

Youngman Brook Control Strategy

Technically feasible control methods for Youngman Brook include trapping spawning-phase sea lamprey, establishing a low-head barrier and TFM application. Trapping may be an effective means of control in Youngman Brook and is determined to have the fewest negative impacts. The construction of a barrier in conjunction with an existing highway culvert offers potential for control but may not eliminate the need for trapping at the barrier site. Any TFM application would require acceptable mitigation for adverse impacts to the American brook lamprey. As other control methods become feasible for use on Youngman Brook, the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Initiate long-term spawning-phase sea lamprey trapping for control purposes at the Interstate 89 highway culvert.

2. Should trapping alone prove ineffective, then the feasibility of constructing a low-head sea lamprey barrier with trapping facility at river mile 0.7 (US Route 7 highway culvert) should be investigated.

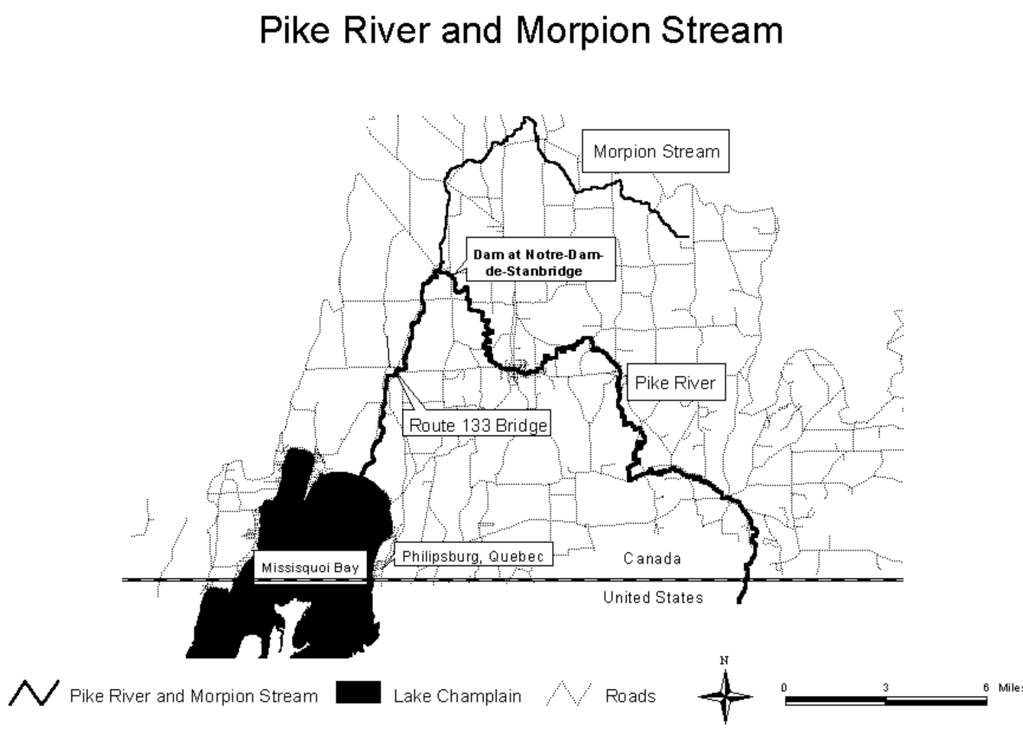
3. If trapping and/or barrier implementation becomes infeasible, or ineffective at controlling larval sea lamprey production, and if acceptable mitigation for potential impacts to American brook lamprey can be implemented, then apply TFM. The application point of such a treatment would depend on the extent of the larval sea lamprey infestation and may be stipulated by acceptable American brook lamprey mitigation measures. The time interval between treatments would be four years or greater. This interval could be adjusted should sea lamprey surveys indicate slow recolonization or early metamorphosis; however, TFM would most likely be applied infrequently, if at all.

20. Pike River

Sea lamprey habitat

Sea lamprey have access to 8.2 miles of the Pike River to the dam at Notre-Dame-de-Stanbridge, Quebec (Figure VIII-20). The dam is thought to be a barrier to upstream movement of sea lamprey. However, cracks in the structure may be compromising the dam’s effectiveness as a barrier (Wayne Bouffard, USFWS Essex Junction, Vermont, personal communication).

Figure VIII-19.



<u>Treatment history/results</u>
The Pike River was not included in the experimental control program because water quality studies revealed water chemistry conditions (low dissolved oxygen and large pH fluctuations) problematic for TFM treatment. The Pike River's location in Canada also precluded consideration for experimental control.

<u>Screening process</u>

Estimated sea lamprey transformation

Dean and Zerrenner (2001) estimated transformer production for the 5.3 miles of the wadeable waters of the Pike River below the dam at 2,264 individuals in 1999.

TFM

- <u>Technical considerations</u>: A TFM treatment of the Pike River is technically feasible

(Walrath and Swiney 2001). However, relatively large pH fluctuations resulting from extensive aquatic vegetation beds which grow throughout the lower reaches of the river during the summer and early fall, present a potential challenge for maintaining an effective and safe range of toxicity. Treating the Pike River in the early spring, before major growth of aquatic vegetation, may reduce the magnitude of diurnal pH fluctuations encountered, thereby minimizing associated fluctuations in TFM toxicity. Applying TFM at the dam at Notre-Dame-de-Stanbridge would result in the treatment of all sea lamprey larval habitat in the Pike River and would allow rapid mixing of TFM within the river. Since the Pike River/Morpion Stream (see Morpion Stream below) confluence is approximately 325 feet below the dam, a simultaneous application to Morpion Stream would be required to maintain the desired treatment concentration. Additional water chemistry and dye plume studies would be conducted to determine lampricide transport and define water-use advisory zones.

- Nontarget concerns: Cisco are presently listed as susceptible in Quebec, and were reported to be collected in the Pike River. Cisco are primarily a lake dwelling species and only transient individuals would be expected to occur in the river itself. A TFM treatment on the Pike River would likely result in mortality of American brook lamprey, silver lamprey, stonecat and logperch. These species are relatively sensitive to TFM and mortalities have been documented during previous Lake Champlain TFM treatments (Fisheries Technical Committee 1999). In addition, the area between Notre-Dame-de-Stanbridge and Saint Pierre de Véronne à Pike River has been designated as a fish sanctuary to preserve fish spawning activities, and angling regulations are more restrictive than in other sections of the Pike River. Since water chemistry concerns suggest a spring TFM treatment may be most appropriate for the Pike River, amphibians may also be affected. Frogs and toads will utilize quiet, shallow portions of the river to breed and larvae are somewhat sensitive to TFM. Spring peepers, bullfrog, northern leapord frog, gray tree frog, and American toad are known to inhabit the Pike River (Gratton 1995). See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: A TFM application on the Pike River may impact the Omer, Quebec municipal water intake. A Pike River dye study conducted on September 12, 1989 revealed the potential for Pike River water to be drawn into the Philipsburg municipal water treatment facility (NYSDEC, Avon, New York, unpublished data). Additional water chemistry and dye plume studies should be conducted to determine treatment specifics. Installation of an activated carbon filter will mitigate exposure of the Philipsburg water intake to TFM, if exposure is expected.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of the Pike River is estimated to cost approximately $168,818 per treatment or $42,205 per year assuming a four-year treatment cycle. This cost includes a simultaneous TFM treatment of Morpion Stream (see Morpion Stream).

TFM/Niclosamide

- Technical considerations: As with TFM, a TFM/niclosamide combination treatment of the Pike River may be desirable during the spring to avoid substantial diurnal pH fluctuations. Mean flow of the Pike River in the month of May averages 210 cfs, and is sufficient to realize a cost advantage using TFM/niclosamide application (Walrath and Swiney 2001). Since the Pike River/Morpion Stream (see Morpion Stream below) confluence is approximately 325 feet below the dam, a simultaneous TFM application to Morpion Stream may be required to maintain the desired lampricide concentrations. Water chemistry and dye plume studies would need to be conducted to determine treatment specifics.

- Nontarget concerns: Impacts of the TFM/niclosamide combination on nontarget organisms, and associated mitigating measures, are similar to those for TFM (See Sections VII.A.1. and VII.A.2.).

- Human impacts: Human impacts would be similar to those indicated with a TFM treatment except that the extent and duration of water use-advisories may be shorter than with treatments using TFM alone, due to the overall reduction in chemical used. This may reduce the potential for impacts to the Philipsburg water supply.

- Habitat impacts: No unique impacts.

- Cost: TFM/niclosamide treatment of the Pike River is estimated to cost approximately $106,223 per treatment or $26,556 per year based on a four-year treatment cycle. This cost includes a simultaneous TFM treatment of Morpion Stream (see Morpion Stream)

Bayluscide 3.2% Granules

- Technical considerations: Bayluscide is not proposed for use in the Pike River or its delta. Application of this formulation is inappropriate for the riverine environment of the Pike River. There is also no evidence of a Pike River Delta population of sea lamprey at this time.

Barriers

Construction of a barrier by U.S. Federal or state agencies in Canada presents unique institutional challenges. Unless there is a mutual interest, U.S. agencies cannot expend government funds for constructing facilities on another nation's soil. In the case of sea lamprey control in the Pike River and its tributaries, there may be a mutual interest among the jurisdictions. It will be necessary for the Lake Champlain Fish and Wildlife

Management Cooperative, Department of Fisheries and Oceans, Canada and the Quebec Ministere de l'Environement et de la Faune to develop an international cooperative agreement for construction and management of a barrier.

- Technical considerations: The construction of an adjustable crest barrier may be technically feasible directly below the Route 133 bridge (Walrath and Swiney 2001). At this location the river has an approximate drop of 1 foot over 250 feet, and thus, may avoid the creation of a large impoundment. One concern with this location is the possibility that the decrease in flow above the barrier may result in the formation of ice jams upstream from the Route 133 bridge. An adjustable crest barrier rather than a low-head barrier, may reduce the possibility of ice jams forming since the barrier would be lowered except during the spring sea lamprey spawning migrational period. Hydrologic studies must be completed to address this concern. As with the adjustable crest barrier, the Route 133 bridge appears to be the most appropriate location for an electrical barrier on the Pike River (Walrath and Swiney 2001). The placement of a barrier at the Route 133 bridge would restrict sea lamprey to all but 0.5 miles of wadeable river. Though not extensive, sea lamprey will still have a small amount of spawning habitat available directly below the Route 133 bridge (Dean and Zerrenner 2001). This spawning habitat may allow for the production of a substantial number of sea lamprey and additional sea lamprey control measures (i.e., trapping, chemical control) may be needed below the barrier. A barrier in the vicinity of the Route 133 bridge would eliminate any need for control on Morpion Stream (see below).

- Nontarget concerns: A barrier can not be proposed at this time on the Pike River due to unavoidable impacts to important migratory fish populations. Without effective fish passage, a barrier would block spawning migrations of several species including walleye and smallmouth bass which are of particular concern to local anglers. Allowing passage of nontarget species over any barrier would be essential to mitigate impacts to migratory fish species. The efficiency of a fish passage facility incorporated into a sea lamprey barrier on the Pike River is uncertain. Other lake species that utilize the Pike River for spawning are likely to be impacted by a barrier include white sucker, greater redhorse, silver redhorse, shorthead redhorse, and quillback. The river section directly above the Route 133 bridge is designated a fish spawning sanctuary and has fishing restrictions imposed.

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey alone as the method for sea lamprey control in the Pike River is not technically feasible (Walrath and Swiney 2001). The Service installed a PAT at the dam at Notre-Dame-de-Stanbridge and two fyke nets at the Route 133 bridge as an assessment tool during the 2000 spawning run. The results of this trapping effort suggest that while the trapping was effective as an assessment tool (39 individuals caught at the dam and 18 individuals at the Route 133 bridge), it would not collect enough sea lamprey to adequately reduce spawning potential, furthermore, trapping spawning-phase sea lamprey at the dam at Notre-Dame-de-Stanbridge allows lamprey that are not captured to utilize available spawning habitat below this location. Other sea lamprey control measures (i.e., chemical control) may still be required in addition to trapping.

Pike River Control Strategy

Technically feasible control methods for the Pike River include TFM and TFM/niclosamide application, and establishing a low-head or electrical barrier. Of these methods, a lampricide treatment was determined to have the fewest negative impacts. Several sensitive species documented in the Pike River require mitigation to minimize potential nontarget impacts due to a lampricide treatment. Establishment of an effective fish passage facility in conjunction with a sea lamprey barrier (low-head or electrical) is uncertain at this time and such a barrier does not eliminate the potential need for additional control measures below the barrier. As other control methods become feasible for use on the Pike River the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Apply TFM or a TFM/niclosamide combination at the dam (river mile 8.2) in Notre-Dame-de-Stanbridge, Quebec. The time interval between treatments would likely be four years or greater, based on current rates of sea lamprey transformer production. This interval may be adjusted should sea lamprey surveys indicate either slow recolonization or early metamorphosis.

20a. Morpion Stream

Sea lamprey habitat

Sea lamprey migration is unimpeded in Morpion Stream and access is available to all 17.1 miles of the stream (see Figure VIII-19). Morpion Stream enters the Pike River just downstream of the dam at Notre-Dame-de-Stanbridge, Quebec, Canada. Sea lamprey have been documented in one tributary to Morpion Stream, Barabe'-Santerre, while others have not been surveyed.

Treatment history/results

No sea lamprey control efforts have been conducted to date.

Screening process

Estimate of sea lamprey transformation

Dean and Zerrenner (2001) estimated transformer production for the wadeable waters of Morpion Stream at 1,863 individuals in 1999.

TFM

- Technical considerations: A TFM treatment of Morpion Stream may be technically feasible but would be a demanding process. Treatment of all available larval habitat in Morpion Stream would require exposure of the entire stream to TFM. The contribution of lamprey to Morpion Stream by Barabe'-Santerre may or may not be substantial enough to require this stream to be included in a treatment. Additional application points would be necessary to maintain the desired treatment concentrations for the entire stream length due to numerous water inputs (including Barabe'- Santerre, numerous agricultural drainage ditches and ground water sources) that increase the flow as it progresses downstream and the attenuation due to sediment adsorption, etc. TFM bars may be used in the mouths of small tributaries of Morpion Steam as a way to maintain the desired treatment concentrations. While Morpion Stream may be treated simultaneously with the Pike River, which is recommended, it may also be treated separately. Treatment of Morpion Stream would require considerable staff resources because of the need to conduct lampricide applications on numerous small tributaries. Water chemistry and dye plume studies need to be conducted to determine treatment specifics.

- Nontarget concerns: Silver and American brook lamprey have been documented in Morpion Stream and may suffer mortality as a result of a TFM treatment. Additional impacts are described in the Pike River TFM nontarget concerns section. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: A TFM treatment on Morpion Stream would have similar human impacts as in a Pike River treatment. If treated separately from the Pike River, however, the volume of TFM used would be much smaller, reducing the likelihood that the plume would reach to the Philipsburg municipal water intake.

- Habitat impacts: No unique impacts.

- Cost: TFM treatment of Morpion Stream is estimated to cost $35,493 per treatment or $8,873 per year based on a four-year treatment cycle.

TFM/Niclosamide

- Technical considerations: Morpion Stream flows are too low to warrant the complex application of a TFM/niclosamide combination.

Bayluscide 3.2% Granules

- Technical considerations: Application of Bayluscide 3.2% granules is inappropriate for the riverine environment of Morpion Stream.

Barriers

Construction of a barrier by U.S. federal or state agencies in Canada presents unique institutional challenges. Unless there is a mutual interest, U.S. agencies cannot expend government funds for constructing facilities on another nation's soil. In the case of sea lamprey control in the Pike River and its tributaries, there may be a mutual interest among the jurisdictions. It will be necessary for the Cooperative, Department of Fisheries and Oceans, Canada, and the Quebec Ministere de l'Environement et de la Faune to develop an international cooperative agreement for construction and management of a barrier.

- Technical considerations: The construction of a low-head barrier on Morpion Stream may be technically feasible. A preliminary survey of Morpion Stream has identified an area which may be appropriate for the installation of a low-head barrier dam (Guilmette 1997). The location, approximately 490 feet upstream of the first bridge crossing at river mile 0.12, appears to be far enough upstream to avoid any effects associated with high flows on the Pike River (Guilmette 1997). Guilmette suggested, however, that the low stream grade may cause flooding as far upstream as the next bridge (approximately 3 miles). Topographic surveys and hydrological analysis will be required to determine the extent of possible impacts. To mitigate concerns of flooding in the area, a low-head barrier dam could be built with removable slide gates or an adjustable crest barrier may be employed. If a low head or adjustable crest barrier is placed on Morpion Stream above the first bridge crossing, approximately 0.12 miles of stream would remain available for use as larval and sea lamprey spawning habitat (Dean and Zerrenner 2001). Sea lamprey production from the remaining portion of Morpion Stream below the barrier would require assessment and additional control measures may be required. An electrical barrier might also be placed under the first bridge crossing Morpion Stream (Walrath and Swiney 2001). Electrical power and telephone lines are readily available and the stream is only 49 feet wide at this location. The installation of an electrical barrier at the first bridge crossing would eliminate all spawning habitat available to the sea lamprey.

- Nontarget concerns: While there are no significant or unique nontarget impacts expected to be associated with the construction of a barrier on Morpion Stream, the addition of an adjustable crest or slide gates to a low-head dam or an electrical barrier has advantages. Lowering an adjustable crest, opening slide gates or deactivating an electrical barrier would allow for fish movement past the site during periods when spawning-phase sea lamprey are not migrating. During the spring migrational period, incorporation of a permanent trapping facility would allow the collection of sea lamprey to prevent their redistribution to other streams and allow passage of nontarget species. See Section VII.A.1 for additional information regarding nontarget impacts and Section VII.A.2. for mitigating measures.

- Human impacts: Fixed-crest or operational variable-crest (slide gates installed, variable crest at barrier height) low head barriers may aggravate upstream flooding during periods of high flows and may impact riparian areas utilized primarily for agriculture. Impacts associated with an electrical barrier involve potential public safety precautions. Lands adjacent to the proposed location of an electrical barrier are agricultural and residential. This area is used for picnicking and casual outdoor activities. However, since Morpion Stream drains heavily fertilized agriculture fields which results in poor water quality, water-based recreation is expected to be rare. Navigation and in water recreation will be prohibited in the vicinity of an electrical barrier when energized. This safety measure is likely to have little impact on human activity in the area. Appropriate safety precautions (fencing and/or warning signs) would be taken to reduce the risk to the public.

- Habitat impacts: Due to the low slope of Morpion Stream, establishment of a low head barrier could result in an increase in water depth and the potential for a substantial impoundment upstream. An adjustable crest barrier would be lowered except during the spring sea lamprey spawning migration period and would tend to reduce the size of the impoundment at all but the highest flows. Slide gates can also be removed from a fixed-crest barrier to reduce flooding outside of the sea lamprey spawning period. Slight decreases in water flow may increase sedimentation. Unless flooding occurs, a low-head barrier dam is not likely to cause profound changes to the surrounding landscape. During construction, habitat is likely to be temporarily altered or damaged but alterations are likely to be small and readily restored.

- Cost: The cost of construction of a low-head barrier on Morpion Stream is estimated at $195,000 (Walrath and Swiney 2001). The estimated annual cost is $3,900, assuming the barrier has a life expectancy of 50 years. The cost of construction of an electrical barrier on the Morpion Stream is estimated at $150,000 (Walrath and Swiney 2001). The estimated annual cost is between $12,000 and $18,000 (Walrath and Swiney 2001).

Trapping

- Technical considerations: Trapping spawning-phase sea lamprey with portable assessment traps is not being proposed as a means of sea lamprey control in Morpion Stream at this time. Suitable trapping sites do not exist that could effectively remove sufficient numbers of adult lamprey during the spring spawning period. A trap may be incorporated into a barrier structure should a barrier be established on Morpion Stream (see barrier section).

- Nontarget concerns: No unique impacts.

- Human impacts: No unique impacts.

- Habitat impacts: No unique impacts.

- Cost: The estimated cost of trapping on Morpion Stream is $10,637 per year.

Morpion Stream Control Strategy

Technically feasible control methods for Morpion Stream include TFM application and establishing a sea lamprey barrier. Of these strategies, a low-head barrier with trapping facility or an electrical barrier was determined to have the least negative effects to nontarget biota, humans, and habitat. A TFM treatment is possible but technically challenging. The estimated, annual cost of employing a low-head barrier with trapping facility is less than an electrical barrier and similar to TFM treatments. As other control methods become feasible for use on Morpion Stream the sea lamprey control strategy will be reevaluated. The following sea lamprey control strategy is recommended:

1. Construct a low-head barrier near river mile 0.1 or an electrical barrier further downstream at the first bridge crossing with spawning-phase sea lamprey trapping facilities if feasible (unique institutional challenges are resolved) and landowner(s) consents.

2. If an effective barrier with trapping facilities can be established as indicated above, apply TFM at river mile 0.1 at approximately four-year intervals only in conjunction with a Pike River lampricide treatment or separately as warranted.

3. If no barrier is constructed, apply TFM at river mile 17.1 at approximately four-year intervals in conjunction with a Pike River lampricide treatment or as a separate treatment if warranted.

B. Tributaries with Potential for Sea Lamprey Establishment

In addition to the streams discussed in Section VIII.A above, several streams provide the potential for the establishment of additional sea lamprey populations (Table VIII-22). Alternative 1 (Proposed Action) recognizes the need for the program to be flexible in terms of the streams included for control. These streams should be periodically assessed for presence of larval sea lamprey infestations. Should new or previously undiscovered populations of sea lamprey be found, the stream will be subjected to sea lamprey control screening as described for the Proposed Action. Should inclusion into the sea lamprey control program be recommended, appropriate environmental review and permitting would be addressed prior to implementation of a control strategy.

Table VIII-23. Potential sea lamprey-producing streams in the Lake Champlain Basin.

Main Lake	South Lake	Malletts Bay	Inland Sea	Missisquoi Bay
Vermont Little Otter Creek Kimball Brook Thorp Brook Holmes Creek Pringle Brook[a] McCabes Brook Monroe Brook Potash Brook Sucker Brook	**Vermont** Horton Brook East Creek	**Vermont** Pond Brook Allen Brook Lamoille River	**Vermont** Mill River Stevens Brook Jewett Brook	**Vermont** Carmen Brook Rock River Saxe Brook [f]
New York Corbeau Creek[b] Little Chazy Tracy Brook [c] Guay Creek Riley Brook Silver Stream Hoisington Brook Stacy Brook Kenney Brook Mill Brook Stony Brook McKenzie Brook Grove Brook	**New York** Ticonderoga Creek Charter Brook Mill Brook Pine lake Brook Pike Brook Spectacle Brook [d] Mettawee River Coggman Brook [e]			

[a] Tributary to Holmes Brook.

[b] Tributary to the Great Chazy River.

[c] Tributary to the Little Chazy River.

[d] Tributary to Mt. Hope Brook.

[e] Tributary to the Poultney River.

[f] Tributary to the Rock River.

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XI. APPENDICES

APPENDIX A

Scoping Summary

Scoping Summary

A federal register notice was published in November 1999 announcing the onset of scoping for the purpose of initiating the NEPA, EIS process regarding sea lamprey control for Lake Champlain. Within the federal notice a US Fish and Wildlife Service contact was provided for submission of written comments. Public meetings were scheduled and advertised in newspapers and news broadcasts throughout the Lake Champlain area. Meetings were held at convenient north and south locations near Lake Champlain (Plattsburgh and Ticonderoga, NY; Middlebury and Milton, VT). Scoping meetings provided introductory presentations regarding the results of the eight-year experimental sea lamprey program and defined the meeting structure (time constraints, topics covered, etc.). Materials available at scoping meetings included information regarding the NEPA process, a summary of alternatives being considered and executive summaries of the eight-year experimental sea lamprey control evaluation. Those wishing to make presentations at meetings were encouraged to do so. Comments made by the public were recorded and used in development of the Draft Supplemental Environmental Impact Statement (DSEIS). During the overview of the experimental program the following action alternatives were described to the public. These alternatives were numbered differently during scoping and have been renumbered to correspond with the alternatives as listed in the SEIS.

Alternative 1: Proposed Action. Begin extensive, stream specific strategies (lampricides, barriers, etc.) to control sea lamprey. Fine-tune stocked species mix and maintain moderate monitoring efforts.

Alternative 2: Status Quo Action. Continue reliance on chemical lampricides and ignore potential ways to improve control. Action would be restricted to areas treated during the experimental program. May test stocked fish strains, sizes, etc. to maximize returns.

Alternative 3: No Action. Abandon all efforts to control sea lamprey, adjust stocked species for best returns. Terminate most sea lamprey monitoring efforts, substantially reduce fish and fishery monitoring efforts.

Table A-1 describes the level of support or dissent resulting from comments received during the scoping process. Scoping officially closed February 4, 2000. Most comments were supportive of continued sea lamprey control. Dissenting comments were mostly in regard to pesticide use in the Poultney River. Philosophical opposition or nontarget toxicity concerns prevailed among the reasons for pesticide use opposition. Other dissenting comments suggested the use of alternatives to pesticides. Data gaps were suggested for sea lamprey barrier applications, wetland concerns, sea lamprey life history, relative parasitic sea lamprey contribution information and long term studies of pesticide effects.

Table A-1. Summary information of the 2000 scoping process.

Location	Date	Number of Registered Attendees	Number of Comments Offered	Results of Comments				
				Support Alternative 1 (Proposed Action)	Support Alternative 2 (status quo)	Support Alternative 3 (no action)	General Support	Opposed to all or a part of the sea lamprey control program.
Plattsburgh, NY	1/5/2000	23	8	6			2	
Ticonderoga, NY	1/6/2000	12	4	1			2	1
Middlebury, VT	1/10/2000	33	11	6			2	3
Milton, VT	1/11/2000	54	12	3			9	
Written Comments	Nov '99 - Feb '00		36	5	1		12	18
Total		122	71	21	1		27	22

APPENDIX B

Lampricide Labels:

United States and Canada

RESTRICTED USE PESTICIDE

Due to Acute Hazards to Eyes, Nontarget Aquatic Organisms, and to the Need for Highly Specialized Applicator Training.
Only for retail sale to and application by certified applicators of the U.S. Fish and Wildlife Service, Fisheries and Oceans Canada, and Provincial and State Fish and Game employees or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

BAYLUSCIDE®

3.2% GRANULAR
SEA LAMPREY LARVICIDE
FOR USE ONLY IN DETERMINING AND CONTROLLING POPULATIONS OF SEA LAMPREY LARVAE IN WATERS IN THE GREAT LAKES BASIN AND LAKE CHAMPLAIN SYSTEM

KEEP OUT OF REACH OF CHILDREN

DANGER

(See Below for Statements of Practical Treatment and Precautionary Statements)

ACTIVE INGREDIENT:
5-Chloro-*N*-(2-chloro-4-nitrophenyl)-2-hydroxybenzamide compound with 2-aminoethanol (1:1) 3.2%
INERT INGREDIENTS: 96.8%
100%

EPA Reg. No. 6704-91
EPA Est No. 043108-WI-001

STOP- READ THE LABEL BEFORE USE.

IMPORTANT: Read these entire Directions and Conditions of Sale before using BAYLUSCIDE 3.2% granular sea lamprey larvicide.

CONDITIONS OF SALE: THE DIRECTIONS ON THIS LABEL WERE DETERMINED THROUGH RESEARCH TO BE THE DIRECTIONS FOR CORRECT USE OF THIS PRODUCT. THIS PRODUCT HAS BEEN TESTED FOR A RANGE OF WEATHER CONDITIONS SIMILAR TO THOSE WEATHER CONDITIONS THAT ARE ORDINARY AND CUSTOMARY IN THE GEOGRAPHIC AREA WHERE THE PRODUCT IS USED. INSUFFICIENT CONTROL OF PESTS AND/OR INJURY TO THE CROP TO WHICH THE PRODUCT IS APPLIED MAY RESULT FROM THE OCCURRENCE OF EXTRAORDINARY OR UNUSUAL WEATHER, OR FROM FAILURE TO FOLLOW LABEL DIRECTIONS. IN ADDITION, FAILURE TO FOLLOW LABEL DIRECTIONS MAY CAUSE INJURY TO OTHER CROPS, ANIMALS, MAN, OR THE ENVIRONMENT. U.S. FISH AND WILDLIFE SERVICE OFFERS, AND THE BUYER ACCEPTS AND USES, THIS PRODUCT SUBJECT TO THE CONDITIONS THAT EXTRAORDINARY OR UNUSUAL WEATHER, OR FAILURE TO FOLLOW LABEL DIRECTIONS ARE BEYOND THE CONTROL OF U.S. FISH AND WILDLIFE SERVICE AND ARE, THEREFORE, THE RESPONSIBILITY OF THE BUYER.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

IMPORTANT: Sea lamprey larvicide. Use to Survey and Control Sea Lamprey Larvae. Bayluscide 3.2% Granular Sea Lamprey Larvicide is a useful tool for surveying and controlling sea lamprey larvae (*Petromyzon marinus*) in waters of the Great Lakes basin and the Lake Champlain system. The granules when applied to the waters surface fall rapidly to the bottom where they are lethal to lamprey larvae.

Measure the area to be treated (length x width in feet). Place markers to delineate the plot perimeter. Compute the total surface area to be treated in square feet. Application rate for the Bayluscide 3.2% Granular Sea Lamprey Larvicide is 5 lb. Active Ingredient/Acre. Compute the amount of granules to apply by: multiplying square feet x .00359 = lbs. of formulation. Distribute the required amount of the Bayluscide granule evenly over the area to be treated.

When applied as directed, Bayluscide 3.2% Granular Sea Lamprey Larvicide will not harm game fish populations that may be present in treated waters. Applications may kill freshwater clams and mussels and may kill fish species that are physiologically bound to the stream bottom.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in a cool, dry place and in such a manner as to prevent cross contamination with other pesticides, fertilizers, food, and feed. Store in original container and out of the reach of children, preferably in a locked storage area.

SPILLS: Handle and open container in a manner as to prevent spillage. If the container is leaking or material spilled for any reason or cause, carefully sweep material into a pile. Refer to Precautionary Statements on label for hazards associated with the handling of this material. Do not walk through spilled material. Dispose of pesticide as directed above. In spill or leak incidents, keep unauthorized people away. For decontamination procedures or any other assistance that may be necessary, contact Chemtrec at 800-424-9300.

PESTICIDE DISPOSAL: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

PESTICIDE CONTAINER: Triple rinse (or equivalent). Then offer for reconditioning, or puncture and dispose of in a sanitary landfill, or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER

Causes eye damage. May be harmful if swallowed or inhaled. Do not get in eyes. Do not breathe dust. Wash thoroughly with soap and water after handling. Wear goggles or face shield when handling. Wear a mask or respirator jointly approved by the Mining Enforcement and Safety Administration (formerly in U.S. Bureau of Mines) and by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

Do not contaminate feed or food. Keep out of reach of children.

STATEMENTS OF PRACTICAL TREATMENT

If in eyes: Hold eyelids open and flush with steady, gentle stream of water for 15 minutes. Get medical attention. **If on skin:** Wash immediately with soap and warm water. If irritation occurs, get medical attention. **If swallowed:** Drink promptly a large quantity of milk, or if milk is not available, large quantities of water. Avoid alcohol. Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage. **If inhaled:** Remove to fresh air. If not breathing, give artificial respiration. Get medical attention.

ENVIRONMENTAL HAZARDS

This product is toxic to fish. Shrimp and crab may be killed at rates recommended on this label. Do not apply where these are important resources.

Directions for use must be strictly followed to minimize hazards to non-target organisms. Do not contaminate water by cleaning of equipment or disposal of wastes.

NET WEIGHT 50 POUNDS

Manufactured by
Coatings Place, Inc.
Box 930310
Verona, WI 53593
For the
U.S. Fish and Wildlife Service
United States Department of the Interior
18th and C Streets, NW
Washington, DC 20240

BAYLUSCIDE

70% Wettable Powder

LAMPRICIDE

For control of sea lamprey larvae

RESTRICTED

GUARANTEE: Monoethanolamine salt of niclosamide: 72.3%

REGISTRATION NUMBER 25562 PEST CONTROL PRODUCTS ACT

NET CONTENTS ____ Kg

DANGER

POISON

KEEP OUT OF REACH OF CHILDREN

READ THE LABEL BEFORE USING

WARNING - EYE IRRITANT AND SKIN SENSITIZER

Manufactured and Packaged by:
Pro-Serve, Inc.
400 E. Broons Road
Memphis, TN 3818C

For:
United States Department of the Interior
Fish and Wildlife Service
Arlington Square Bldg. Mail Stop 725
Washington, DC 20240

Canadian Agent:
Dept. of Fisheries and Oceans (Canada)
Sea Lamprey Control Centre
1 Canal Drive
Sault Ste. Marie, Ontario P6A 6W4

Page 1 of 3
BAYLUSCIDE 70% WETTABLE POWDER

NOTICE TO USER: This control product is to be used only in accordance with the directions on this label. It is an offense under the PEST CONTROL PRODUCTS ACT to use a control product under unsafe conditions.
NATURE OF RESTRICTION: Only for sale to, and use only by, certified applicators of the U.S. Fish and Wildlife Service, Fisheries and Oceans Canada, or persons under their direct supervision in programs approved by the Great Lakes Fishery Commission.

DIRECTIONS FOR USE

BAYLUSCIDE 70% Wettable Powder may be used in the manufacture of pest control products registered in Canada or as a synergist in combination with registered pest control products containing TFM [Sea Lamprey Larvicide (Lampricide), PCP Nos. 11763, 21124] for control of sea lamprey larvae (*Petromyzon marinus*) in waters in the Great Lakes basin and the Lake Champlain systems.

Application of BAYLUSCIDE 70% Wettable Powder may be made as a simultaneous addition with TFM on larger rivers to reduce the amount of TFM required or as a subsequent addition downstream to enhance TFM larvicidal activity.

Prior to using BAYLUSCIDE-TFM, pretreatment surveys must be made to determine larvae populations.

All waters selected for treatment must first be analysed on site to determine both the minimum concentration of material required to kill lamprey larvae and the maximum concentration that can be applied without causing undue fish mortality. "Analysis:" constitutes live animal bioassay or the use of a regression established by past bioassays and total alkalinity and conductivity of water.

Lethal concentrations may vary depending upon water chemistry and temperature. Carefully calculate stream flow-rate and add the amount of material necessary to kill lamprey larvae with minimal fish mortality. Metering devices will be used that accurately deliver application rates as calculated. Chemicals will be monitored calorimetrically or by gas chromatography to insure that minimum lethal concentrations for sea lampreys are maintained and maximum allowable concentrations are not exceeded.

Aerial applications of BAYLUSCIDE are prohibited.

MIXING AND APPLICATION DIRECTIONS:
When using BAYLUSCIDE 70% Wettable Powder as a synergist in combination with TFM, mix in proportions so as to result in a final concentration of BAYLUSCIDE 70% Wettable Powder of not more than 2% of TFM by weight. BAYLUSCIDE 70% Wettable Powder may be added to TFM in 2 ways:

1. One method of application is a slurry of BAYLUSCIDE 70% Wettable Powder pumped into the water through a pump while the TFM is fed separately through a conventional fuel pump feeder in amounts calculated to deliver the desired rate of TFM to BAYLUSCIDE. BAYLUSCIDE is more easily mixed as a slurry than with TFM and more uniform feed rates result.
2. A second application method is used on the large river systems with multiple tributaries. The number of application sites on these large rivers precludes the use of the first method because of the number of feeders involved, the need for a 110-volt power source at each site to run a pump, and the often difficult access to these sites. BAYLUSCIDE is introduced into the streams in amounts calculated to produce the desired TFM to BAYLUSCIDE ratio. The TFM applications in tributaries are timed so that the individual chemical banks meet and form a chemical bank in the main stream that approximates the chemical concentrations in the tributaries. Since the banks are diluted by ground water, swamp seepage, untreated tributaries, occasionally rain, or other conditions that cannot be included when the application rates for the tributaries are calculated, the toxicity of the bank in the main stream must be raised by the addition of TFM or BAYLUSCIDE. The latter can be used in place of TFM because of the increased toxicity of the TFM-BAYLUSCIDE because of the increased toxicity of the TFM-BAYLUSCIDE mixture over TFM alone to sea lamprey larvae.

PRECAUTIONS

KEEP OUT OF REACH OF CHILDREN

DANGER: Causes eye damage. Causes skin irritation and sensitization. Harmful if swallowed or inhaled. Do not get in eyes, on skin, or on clothing. Do not breathe dust. Wear goggles or face shield, approved respirator (NIOSH/MSHA TC-23C-54 or equivalent), a chemical resistant suit (e.g. Tyvek), and rubber gloves when handling. Wash thoroughly with soap and water after handling and before eating or smoking. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS
Directions for use must be strictly followed to minimize hazard to nontarget organisms. When applied as directed, BAYLUSCIDE will not harm game fish populations that may be present in treated waters. Applications may kill freshwater clams and mussels and may kill fish species that are physiologically bound to the bottom. DO NOT contaminate water by cleaning of equipment or disposal of wastes. Consult local provincial authorities regarding appropriate use permits. Municipalities and agricultural irrigators that use streams requiring treatment for potable water or irrigation water must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators must turn off their irrigation systems for a 24-hour period during and after treatment.

Not to be used by unauthorized personnel.

FIRST AID: IF ON SKIN: Remove contaminated clothing. Wash skin with soap and water. If irritation occurs, get medical attention. **IF IN EYES:** Hold eyelids open and flush with steady gentle stream of water for 15 minutes. Get medical attention. **IF SWALLOWED:** Call a physician or Poison Control Centre. Drink promptly a large quantity of milk, or if milk is not available, large quantities of water. Avoid alcohol. **IF INHALED:** Remove to fresh air. If not breathing give artificial respiration. Get medical attention.

TOXICOLOGICAL INFORMATION: Probable mucosal damage may contraindicate the use of gastric lavage. No specific antidote is available. Treat sympotomatically.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

STORAGE: Store in a cool, dry place and in such a manner as to prevent cross contamination with other pesticides, fertilizers, food, and feed. Store in original container and out of the reach of children, preferably in a locked storage area.

CONTAINER DISPOSAL: Thoroughly empty contents of the container into the treatment area. Follow provincial instructions for any required additional cleaning of the container prior to its disposal. Make the empty container unsuitable for further use. Dispose of the container in accordance with provincial requirements. For information on the disposal of unused, unwanted product, and the cleanup of spills, contact the provincial regulatory agency or the manufacturer.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS (AND DOMESTIC ANIMALS)

DANGER / CORROSIVE

Causes burns and irreversable eye damage. May be fatal if swallowed. Harmful if absorbed through skin. Do not get in eyes, on skin, or on clothing. Wear goggles or face shield, protective clothing, and rubber gloves when handling. Wash thoroughly with soap and water after handling and before eating and smoking. Remove contaminated clothing and wash before reuse

ENVIRONMENTAL HAZARDS

Directions for use must be strictly followed to minimize hazard to non-target organisms. Do not contaminate water by cleaning of equipment or disposal of wastes.

Local, State, and Provincial Fish and Game Agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators that use streams requiring treatment as a source of irrigaiton water must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators must turn off their irrigation system for a 24-hour period during and after treatment.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.
Not to be used by unauthorized personnel.
Nr. 2039

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. SEE RIGHT PANEL FOR DIRECTIONS.

CATEGORY OF APPLICATOR

Aquatic pest control.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited.

STORAGE: Containers of LAMPRICIDE should be stored in an area where spills or leakage of the material can be contained.

DISPOSAL: LAMPRICIDE spray mixture or rinsate that cannot be used or chemically processed should be disposed of in a landfill approved for pesticides or buried in a safe place away from water supplies.

Triple rinse (or equivalent) and offer container for recycling, reconditioning, or disposal in approved landfill or bury in a safe place.

Consult federal, provincial, state or local authorities for approved alternative procedures.

RESTRICTED USE PESTICIDE

ONLY FOR SALE TO AND USE BY CERTIFIED APPLICATORS OF THE U. S. FISH AND WILDLIFE SERVICE, FISHERIES AND OCEANS CANADA, AND PROVINCIAL AND STATE FISH AND GAME EMPLOYEES OR PERSONS UNDER THEIR DIRECT SUPERVISION, AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATORS' CERTIFICATION.

LAMPRICIDE
SEA LAMPREY LARVICIDE

ACTIVE INGREDIENT: Sodium Salt,
a, a, a-Trifluoro-4-Nitro-m-Cresol * ________%
INERT INGREDIENT: ________%
*EQUIVALENT TO: % Free Cresol 100.0 %

THIS PRODUCT CONTAINS________ LBS. OF________PER GALLON

KEEP OUT OF REACH OF CHILDREN

DANGER-POISON

STATEMENT OF PRACTICAL TREATMENT

NO KNOWN EFFECTIVE ANTIDOTE:

IF ON SKIN: Wash with plenty of soap and water. Get medical attention
IF IN EYES: Flush with plenty of water. Call a physician.
IF SWALLOWED: Call a physician or Poison Control Center. Drink promptly a large quantity of milk, egg whites, gelatin solution, or if these are not available, drink large quantities of water. Avoid alcohol. Induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.
NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate the use of gastric lavage.
SEE LEFT PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

MFG. BY:	H & S CHEMICAL COMPANY, INC.
TOWN, COUNTRY:	CINCINATI, OHIO, USA
PACKED FOR:	U.S. FISH AND WILDLIFE SERVICE
TOWN, STATE:	WASHINGTON, DC 20240
ESTABLISHMENT NO:	066554-GA-001
EPA REGISTRATION NO:	6704-45
	NET CONTENTS________LBS.________

DIRECTIONS FOR USE

Pretreatment surveys are made to determine abundance of sea lamprey larvae (Petromyzon marinus). Waters in the Great Lakes Basin and the Lake Champlain system selected for treatment must first be analyzed on site to determine both the minimum concentration of LAMPRICIDE required to kill sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. This analysis constitutes live animal bioassay or the use of a multiple regression relating bioassay results to on-site determination of pH and/ or total alkalinity and conductivity of the body of water.

The concentration of LAMPRICIDE needed to kill sea lamprey larvae may vary depending upon water chemistry and temperature. Measure volume or flow-rate and add the amount of LAMPRICIDE necessary at rates based on the above analysis. LAMPRICIDE should be dispensed by application devices sufficiently accurate to maintain the predetermined concentration level. Concentration in the treated body of water must be monitored by colorimetric analysis, gas chromatography, or high performance liquid chromatography.

LAMPRICIDE may be used by itself in the treatment of waters in the Great Lakes Basin and the Lake Champlain System. At times, however, BAYLUSCIDE 70% Wettable Powder (EPA REG. No. 6704-87) may be used in combination with LAMPRICIDE (EPA REG. No. 6704-45) for control of sea lamprey larvae . Application of BAYLUSCIDE may be made as a simultaneous addition with LAMPRICIDE on larger rivers to allow reduction in the amount of LAMPRICIDE required, or as a subsequent addition downstream to enhance LAMPRICIDE larvicidal activity. Prior to using BAYLUSCIDE-LAMPRICIDE, surveys must be made to determine larvae populations. When using BAYLUSCIDE in combination with LAMPRICIDE, combine in portions that will result in a final concentration of BAYLUSCIDE of not more than 2% of LAMPRICIDE by weight. BAYLUSCIDE may be added to LAMPRICIDE in two ways:

1. One method of application is to add through a conventional pump, a slurry of BAYLUSCIDE pumped into the stream while the LAMPRICIDE is fed separately through a feeder pump in amounts calculated to deliver the desired ratio of BAYLUSCIDE to LAMPRICIDE. BAYLUSCIDE is more easily mixed as a slurry than by direct mixing with LAMPRICIDE and more uniform dispenser rates result.

2. A second application method may be used on the larger river systems having multiple tributaries. The number of application sites on these large rivers precludes the use of method one because of the number of feeder pumps involved, the need for a 110 volt power source at each site to operate the pump, and the often difficult access to sites. On these large systems, LAMPRICIDE alone is fed into the tributaries. Where the tributaries join to form the main stem of the river, BAYLUSCIDE is introduced into the chemical bank in amounts calculated to produce the desired LAMPRICIDE to BAYLUSCIDE ratio. The LAMPRICIDE applications in tributaries are timed so that the individual chemical banks meet and form a chemical mix in the main stream that approximates the chemical concentrations in the tributaries. Since the banks are diluted by ground water , swamp seepage, untreated tributaries, occasionally rain, or other conditions that cannot be included when the application rates for the tributaries are calculated , tne toxicity of the bank in the main stream must be raised by the addition of LAMPRICIDE or BAYLUSCIDE. The latter can be used in place of LAMPRICIDE because of the increased toxicity of the BAYLUSCIDE-LAMPRICIDE mixture over LAMPRICIDE alone to sea lamprey larvae.

NOTICE TO USER

This control product is to be used only in accordance with the directions on this label. It is an offense under the Pest Control Products Act to use a control product under unsafe conditions.

NATURE OF RESTRICTION

Only for sale to, and use only by, Certified Applicators of the U.S. Fish and Wildlife Service, Fisheries and Oceans Canada, and Provincial and State fish and game departments, or persons under their direct supervision, and only for those uses covered by the Certified Applicators Certification.

DIRECTIONS FOR USE

Pretreatment surveys are always made to determine abundance of sea lamprey larvae (Petromyzon marinus). All waters in the Great Lakes Basin and the Lake Champlain system selected for treatment must first be analyzed on site to determine both the minimum concentration of TFM required to kill the sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. "Analysis" constitutes live animal bioassay, or the use of multiple regression relating bioassay results to on-site determination of pH or total alkalinity and conductivity of the body of water.

The concentration of TFM needed to kill sea lamprey larvae may vary depending upon water chemistry and temperature. Measure volume or flow rate and add the amount of chemical necessary at rates based on the foregoing analysis. Concentration on the body of water must be monitored by spectrophotometric analysis, gas chromatography, or high performance liquid chromatography.

When submerged in water, TFM bars dissolve in approximately 8 to 10 hours at 17°C and 10 to 12 hours at 12°C in current velocities 0.09 to 0.12 meter/sec. More rapid velocities will cause the bars to dissolve faster. First calculate the amount of TFM (grams/hr) needed to supply a lethal concentration to larval sea lampreys in the stream. Then calculate the amount of TFM (grams/hr) released from a TFM bar based on the length of time the bars are expected to last at the prevailing temperature. Divide the amount of TFM needed by the amount released per bar to find the number of bars needed.

TFM BAR

RESTRICTED

GUARANTEE:
a,a,a-TRIFLUORO-4-Nitro-m-CRESOL,
FREE CRESOL..21.4%

KEEP OUT OF REACH OF CHILDREN
DANGER-CORROSIVE

READ THE LABEL BEFORE USING

FIRST AID:
NO KNOWN EFFECTIVE ANTIDOTE:
IF ON SKIN: Wash with plenty of soap and water. Get medical attention.
IF IN EYES: Flush with plenty of water. Call a physician.
IF SWALLOWED: Call a physician or Poison Control Center. Drink promptly a large quantity of milk, egg whites, gelatin solution, or if these are not available, drink large quantities of water. Avoid alcohol. Induce vomiting by touching back of throat with finger. Do not induce vomiting or give anything by mouth to an unconscious person.

TOXICOLOGICAL INFORMATION: Probable mucosal damage may contraindicate the use of gastric lavage.

SEE RIGHT SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

MFG. BY: BELL LABORATORIES, INC.
MADISON, WI 53704 U.S.A.
PACKED FOR: U.S. FISH AND WILDLIFE SERVICE AND/OR
DEPARTMENT FISHERIES AND OCEANS, CANADA
WASHINGTON, D.C. 20240 AND/OR
OTTAWA, ONTARIO, K1A OE6
EST. NO. 12455-WI-1
REGISTRATION NO. 22610
PEST PRODUCTS CONTROL ACT
NET CONTENTS: 27 x 0.9 Kg

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER: Corrosive. Causes burns and irreversible eye damage. May be fatal if swallowed. Harmful if absorbed through skin. Do not get in eyes, on skin, or on clothing. Wear goggles or face shield, protective clothing, and rubber gloves when handling. Wash thoroughly with soap and water after handling and before eating and smoking. Remove contaminated clothing and wash before reuse.

ENVIRONMENTAL HAZARDS

Directions for use must be strictly followed to minimize hazard to nontarget organisms. Do not contaminate water by cleaning of equipment or disposal of wastes.

Local State and Provincial Fish and Game Agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators that use streams requiring treatment as a source of irrigation water must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators must turn off their irrigation systems for a 24-hour period during and after treatment.

Not to be used by unauthorized personnel. Nr. 2039

CATEGORY OF APPLICATOR

Aquatic pest control.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

STORAGE: TFM Bars should be stored at 38°C or less and in an area where spills or leakage of the material can be contained. If product becomes soft or liquified due to high temperature, cooling to below 38°C will return it to a solid state.

DISPOSAL: 1. Rinse the emptied container thoroughly and add the rinsings to the spray mixture in the tank. 2. Follow provincial instructions for any required additional cleaning of the container prior to its disposal. 3. Make the empty container unsuitable for further use. 4. Dispose of the container in accordance with provincial requirements. 5. For information on the disposal of unused, unwanted product and the cleanup of spills, contact the Provincial Regulatory Agency or the Manufacturer.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS (& DOMESTIC ANIMALS)

DANGER

For use by trained operators only. May be fatal if swallowed or absorbed through skin. Avoid contact with skin and eyes. May produce severe burns: care must be exercised in handling the concentrated forms of LAMPRECID®. Protective clothing, rubber gloves, and face masks are necessary for the minimum protection of handlers. Wash thoroughly after handling.

ENVIRONMENTAL HAZARDS

Directions for use must be strictly followed to minimize hazard to non-target organisms. Do not contaminate water by cleaning of equipment or disposal of wastes.

Local, State, and Provincial Fish and Game Agencies must be contacted before product is applied. Municipalities that use streams requiring treatment as potable water sources must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators that use streams requiring treatment as a source of irrigation water must be notified of the impending treatment at least 24 hours prior to application. Agricultural irrigators must turn of their irrigation system for a 24-hour period during and after treatment.

Not to be used by unauthorized personnel.
Nr. 2039

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. SEE RIGHT PANEL FOR DIRECTIONS.

CATEGORY OF APPLICATOR

Aquatic pest control.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal. Open dumping is prohibited.

STORAGE: Containers of LAMPRECID® should be stored in an area where spills or leakage of the material can be contained.

DISPOSAL: LAMPRECID® spray mixture or rinsate that cannot be used or chemically reprocessed should be disposed of in a landfill approved for pesticides or buried in a safe place away from water supplies.

Triple rinse (or equivalent) and offer container for recycling, reconditioning, or disposal in approved landfill or bury in a safe place. Consult federal, provincial, state or local authorities for approved alternative procedures.

2039/9066

RESTRICTED USE PESTICIDE

ONLY FOR SALE TO AND APPLICATION BY CERTIFIED APPLICATORS OF THE U.S. FISH AND WILDLIFE SERVICE, FISHERIES AND OCEANS CANADA, AND PROVINCIAL AND STATE FISH AND GAME EMPLOYEES OR PERSONS UNDER THEIR DIRECT SUPERVISION.

SEA LAMPREY LARVICIDE LAMPRECID®

ACTIVE INGREDIENT:
α, α, α-TRIFLUORO-4-NITRO-m-CRESOL, SODIUM SALT: 42,432 %
EQUIVALENT TO 38,4 % FREE CRESOL
INERT INGREDIENT: 57,568 %
TOTAL: 100.00%

THIS PRODUCT CONTAINS 3,15 LBS./GMS. OF TFN PER GALLON/LITRE

KEEP OUT OF REACH OF CHILDREN
DANGER-POISON

STATEMENT OF PRACTICAL TREATMENT

NO KNOWN EFFECTIVE ANTIDOTE:

IF SWALLOWED, CALL PHYSICIAN IMMEDIATELY. INDUCE VOMITING by giving milk or white of egg beaten in water, then a tablespoon of salt in glass of warm water and repeat until vomit fluid is clear. Repeat milk or white of egg beaten with water.

IF ON SKIN, flush liberally with water for at least 15 minutes and wash with soap if possible.

IF IN EYES, flush liberally with water for at least 15 minutes; get medical attention.

SEE LEFT PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

Packed for: U.S. Fish and Wildlife Service
Washington, DC 20240
EPA Registration No. 6704-45

Fisheries and Oceans Canada, Ottawa, Ontario
Canadian Registration No. 11763 Pest Control Products Act

MFG. by: Hoechst Schering AgrEvo GmbH
Town, Country: Miraustrasse 54, D-13509 Berlin

AgrEvo

Batch No. 3026 IE 002

Net Contents 49,16 Lbs./Kgs.

DIRECTIONS FOR USE

Pretreatment surveys are always made to determine abundance of sea lamprey larvae (Petromyzon marinus). All waters in the Great Lakes Basin and the Lake Champlain system selected for treatment must first be analysed on site to determine both the minimum concentration of LAMPRECID® required to kill sea lamprey larvae and the maximum concentration that can be applied without causing undue mortality of non-target organisms. "Analysis" constitutes live animal bioassay, or the use of a multiple regression relating bioassay results to on-site determination of total alkalinity and conductivity of the body of water.

The concentration of LAMPRECID® needed to kill sea lamprey larvae may vary depending upon water chemistry and temperature. Measure volume or flow-rate and add the amount of LAMPRECID® necessary at rates based on the foregoing analysis. Dispense LAMPRECID® by application devices sufficiently accurate to maintain predetermined concentration. Concentration in the body of water must be monitored either by colorimetric analysis, gas chromatography, or high performance liquid chromatography.

LAMPRECID® may be used by itself in the treatment of waters in the Great Lakes Basin and the Lake Champlain system. At times, however, BAYLUSCIDE 70% Wettable Powder (EPA REG. NO. 3125-136) may be used in combination with LAMPRECID® (EPA REG. NO. 6704-45) for control of sea lamprey larvae. Application of BAYLUSCIDE 70% Wettable Powder may be as a simultaneous addition with LAMPRECID® on larger rivers to reduce the amount of LAMPRECID® required or as a subsequent addition downstream to enhance LAMPRECID® larvicidal activity. Prior to using BAYLUSCIDE-LAMPRECID®, pretreatment surveys must be made to determine larvae populations. When using BAYLUSCIDE 70% Wettable Powder in combination with LAMPRECID®, mix in proportions so as to result in a final concentration of BAYLUSCIDE 70% Wettable Powder of not more than 2% of LAMPRECID® by weight. BAYLUSCIDE 70% Wettable Powder may be added to LAMPRECID® in two ways:

1. One method of application is to add a slurry of BAYLUSCIDE 70% Wettable Powder pumped into the stream through a pump while the LAMPRECID® is fed separately through a conventional fuel pump feeder in amounts calculated to deliver the desired ratio of BAYLUSCIDE to LAMPRECID®. BAYLUSCIDE is more easily mixed as a slurry than by direct mixing with LAMPRECID® and more uniform dispenser rates result.
2. A second application method is used on the large river systems with multiple tributaries. The number of application sites on these large rivers precludes the use of the first method because of the number of feeder pumps involved, the need for a 110-volt power source at each site to run a pump, and the often difficult access to sites. On these large systems, LAMPRECID® alone is fed into the tributaries. Where the tributaries join to form the main stem of the river, BAYLUSCIDE is introduced into the chemical bank in amounts calculated to produce the desired LAMPRECID® to BAYLUSCIDE ratio. The LAMPRECID® applications in tributaries are timed so that the individual chemical banks meet and form a chemical mix in the main stream that approximates the chemical concentrations in the tributaries. Since the banks are diluted by ground water, swamp seepage, untreated tributaries, occasional rain, or other conditions that cannot be included when the application rates for the tributaries are calculated, the toxicity of the bank in the main stream must be raised by the addition of LAMPRECID® or BAYLUSCIDE. The latter can be used in place of LAMPRECID® because of the increased toxicity of the BAYLUSCIDE-LAMPRECID® mixture over LAMPRECID® alone to sea lamprey larvae.

APPENDIX C

Lampricide Registration Information

(From EPA 1999)

Lampricide Registration Information

The following "Executive Summary" is an excerpt from the Environmental Protection Agency *Registration Eligibility Decision (RED), 1999.*

EPA has completed its reregistration eligibility decisions for the pesticides trifluoro-4-nitro-m-cresol (TFM; Case 3082) and niclosamide (Case 2455) and determined that all lampricide uses, when labeled and used as specified in this document, are eligible for reregistration. There are two Special Local Needs labels for niclosamide which are eligible for reregistration assuming monitoring programs similar to those conducted by the U.S. Fish and Wildlife Service (USFWS) are instituted for these uses. The public health mollusicide use of niclosamide against snails that carry vectors for swimmer's itch has been voluntarily canceled by the registrant. The public health use for use of niclosamide against snails that carry vectors for schistosomiasis is ineligible for reregistration at this time. These reregistration eligibility decisions include a comprehensive reassessment of the required target data base supporting the use patterns of currently registered products.

This document contains the reregistration eligibility decisions for two compounds which are used alone or in combination against the same pest. TFM is the main chemical used to kill sea lamprey larvae in tributaries to the Great Lakes, the Finger Lakes, and Lake Champlain. Niclosamide is used to kill sea lamprey larvae in combination with TFM; granular niclosamide is also used in situations where TFM would not be appropriate, such as very deep waters, where it is cost prohibitive to treat the entire water column. Tributaries are screened for larvae which are ready to transform to the adult stage and when populations are high enough, the stream is treated. Streams harboring sea lamprey larvae are treated once every three to five years. Additionally, niclosamide is used as a mollusicide to kill freshwater snails which are vectors for human and fish disease agents.

There are no tolerances for TFM and niclosamide because the Agency considers the uses of these compounds to be non-food. Based on current use pattens and exposure profiles, residues in and on food and/or feed or in drinking water are not expected to occur. Therefore, a dietary risk assessment is not required.

Human risks from exposures to TFM and niclosamide do not exceed levels of concern for the currently registered uses. The USFWS exerts tight control over the use of these compounds including: (i) public notification prior to treating Great Lake tributaries to eliminate exposure to riparian water users including fishermen, boaters, and swimmers; (ii) dissemination of information describing the treatment programs and the associated application locations, dates, and duration; (iii) constant monitoring of the treated stream for TFM and niclosamide concentrations during treatment; (iv) if requested by a given state, concentrations at public water utility intakes are monitored and notification of state and local officials is made regarding monitoring results to permit implementation of activated charcoal use, if necessary; and (v) prohibition of irrigation during treatment.

There are ecological concerns with the use of these compounds since impacts are expected to nontarget aquatic organism populations; however, the benefits of controlling the populations of the introduced sea lamprey are expected to outweigh the risks to aquatic organisms. Most nontarget species are far less sensitive to the lampricides than are sea lampreys, and only a few are as sensitive. Pretreatment assessments that determine abundance and distribution of sea lamprey larvae are used to identify specific streams and stream reaches that require lampricide treatment. Sensitive nontarget species in the streams are identified prior to treatment, and measures are taken to protect them during applications of lampricides. Threatened or endangered species are identified through consultation with state and federal agencies. Procedures then are modified or developed, and employed to protect these species. Prior to treatment, toxicity tests and in-stream studies assess the effects of treatment on sensitive species or species of concern, and the results indicate if a modification of treatment procedures is required to assure the safety of nontarget organisms.

The USFWS which holds the registrations for these compounds has refined the use practices over the past several years in order to lower the impacts of these applications on nontarget organisms and to lower occupational and non-occupational exposure to people. Additional mitigation required by the Agency includes minor clarifications of label language. Aerial applications were prohibited on some of the current labels and will be prohibited on all new labels in order to lessen chances of nontarget human and other terrestrial animal exposures to these restricted use compounds. Some additional data are required to understand the photodegradation potential of TFM and niclosamide in water, and the aerobic and anaerobic aquatic behavior of niclosamide. The following data requirements are being held in reserve pending the results of an ongoing monitoring study the USFWS is currently conducting: the potential chronic effects of TFM and TFM/niclosamide mixture on fish and aquatic invertebrates, and the chronic sediment toxicity of niclosamide. Before reregistering the products containing TFM and niclosamide, the Agency is requiring that product specific data, revised Confidential Statements of Formula (CSF), and revised labeling be submitted within eight months of the issuance of this document. These data include product chemistry and acute toxicity testing for each registration. After reviewing these data and any revised labels and finding them acceptable in accordance with Section 3(c)(5) of FIFRA, the Agency will reregister a product. Those products which contain other active ingredients will be eligible for reregistration only when the other active ingredients are determined to be eligible for reregistration.

APPENDIX D

Lampricide Prediction Charts

(From Klar and Schleen 1999)

Table 1. Expected lethal concentration (LC) producing 99.9% mortality among sea lamprey (Petromyzon marinus) and lethal concentration producing 25% mortality among brown trout (Salmo trutta) and mayfly (Hexagenia sp.) larvae exposed to TFM at selected pHs and alkalinities at 12°C.

	SEA LAMPREY LC99.9 (mg/L) ALKALINITY									Brown Trout LC25	Mayfly LC25
pH	30	60	90	120	150	180	210	240	260	mg/L	mg/L
6.5	0.2	0.2	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.8	1.0
6.6	0.2	0.3	0.3	0.5	0.6	0.6	0.6	0.6	0.6	1.0	1.0
6.7	0.2	0.3	0.4	0.5	0.6	0.6	0.6	0.6	0.6	1.1	1.3
6.8	0.3	0.4	0.5	0.6	0.7	0.7	0.7	0.7	0.7	1.3	1.4
6.9	0.3	0.4	0.5	0.7	0.8	0.8	0.8	0.8	0.8	1.5	1.6
7.0	0.3	0.4	0.6	0.7	0.9	0.9	0.9	0.9	0.9	1.8	1.7
7.1	0.4	0.5	0.7	0.9	1.0	1.0	1.0	1.0	1.0	2.0	1.9
7.2	0.4	0.6	0.8	1.0	1.2	1.2	1.2	1.2	1.2	2.4	2.1
7.3	0.4	0.6	0.9	1.1	1.3	1.3	1.3	1.3	1.3	2.8	2.3
7.4	0.5	0.7	1.0	1.2	1.5	1.5	1.5	1.5	1.5	3.2	2.6
7.5	0.5	0.8	1.1	1.4	1.7	1.7	1.7	1.7	1.7	3.7	2.8
7.6	0.6	0.9	1.3	1.6	1.9	1.9	2.0	2.0	2.0	4.3	3.2
7.7	0.6	1.0	1.4	1.8	2.2	2.2	2.2	2.2	2.3	5.0	3.5
7.8	0.7	1.2	1.6	2.0	2.5	2.5	2.5	2.6	2.7	5.9	3.9
7.9	0.8	1.3	1.9	2.3	2.8	2.8	2.8	3.0	3.1	6.8	4.3
8.0	0.9	1.5	2.1	2.6	3.1	3.2	3.3	3.5	3.6	7.9	4.7
8.1	0.9	1.7	2.4	3.0	3.5	3.7	3.8	4.1	4.2	9.2	5.2
8.2	1.0	1.9	2.8	3.4	4.0	4.3	4.5	4.7	4.9	10.7	5.8
8.3	1.1	2.2	3.2	3.8	4.5	4.9	5.3	5.5	5.7	12.5	6.4
8.4	1.2	2.5	3.6	4.4	5.1	5.6	6.1	6.5	6.7	14.5	7.1
8.5	1.4	2.8	4.1	4.9	5.8	6.5	7.2	7.6	7.8	16.9	7.9
8.6	1.5	3.1	4.7	5.6	6.6	7.5	8.4	8.9	9.1	19.6	8.7
8.7	1.7	3.6	5.3	6.4	7.4	8.6	9.9	10.3	10.6	22.8	9.7
8.8	1.8	4.0	6.0	7.2	8.4	10.0	11.5	12.1	12.3	26.6	10.7
8.9	2.0	4.5	6.9	8.2	9.5	11.5	13.5	14.1	14.4	30.9	11.8
9.0	2.2	5.1	7.8	9.3	10.7	13.3	15.8	16.5	16.7	35.9	13.1
9.1	2.4	5.8	8.9	10.5	12.1	15.3	18.5	19.3	19.5	41.8	14.5
9.2	2.7	6.6	10.2	11.9	13.7	17.7	21.7	22.6	22.7	48.6	16.1
9.3	3.0	7.5	11.6	13.5	15.5	20.5	25.4	26.4	26.5	56.5	17.8
9.4	3.3	8.5	13.2	15.4	17.5	23.6	29.8	30.8	30.9	65.7	19.7
9.5	3.6	9.6	15.0	17.4	19.8	27.3	34.8	36.0	36.0	76.5	21.8

Table 2. Expected lethal concentration (LC) producing 99.9% mortality among sea lamprey (Petromyzon marinus) and lethal concentration producing 25% mortality among brown trout (Salmo trutta) and mayfly (Hexagenia sp.) larvae exposed to TFM/1% bayluscide at selected pHs and alkalinities at 12°C.

	SEA LAMPREY LC99.9 (mg/L) ALKALINITY									Brown Trout LC25 mg/L	Mayfly LC25 mg/L
pH	30	60	90	120	150	180	210	240	260		
6.5	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	1.0
6.6	0.1	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	1.1
6.7	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.5	1.3
6.8	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.6	1.4
6.9	0.2	0.2	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.7	1.6
7.0	0.2	0.3	0.3	0.4	0.6	0.6	0.6	0.6	0.6	0.8	1.7
7.1	0.2	0.3	0.4	0.5	0.6	0.6	0.6	0.6	0.6	0.9	1.9
7.2	0.2	0.3	0.5	0.6	0.7	0.7	0.7	0.7	0.7	1.1	2.1
7.3	0.3	0.4	0.5	0.7	0.8	0.8	0.8	0.8	0.8	1.2	2.3
7.4	0.3	0.4	0.6	0.7	0.9	0.9	0.9	0.9	0.9	1.4	2.6
7.5	0.3	0.5	0.7	0.8	1.0	1.0	1.0	1.0	1.0	1.7	2.8
7.6	0.3	0.6	0.8	1.0	1.2	1.2	1.2	1.2	1.2	2.0	3.2
7.7	0.4	0.6	0.9	1.1	1.3	1.3	1.3	1.3	1.4	2.3	3.5
7.8	0.4	0.7	1.0	1.2	1.5	1.5	1.5	1.5	1.6	2.6	3.9
7.9	0.5	0.8	1.1	1.4	1.7	1.7	1.7	1.8	1.9	3.0	4.3
8.0	0.5	0.9	1.3	1.6	1.9	1.9	2.0	2.1	2.2	3.5	4.7
8.1	0.6	1.0	1.5	1.8	2.1	2.2	2.3	2.4	2.5	4.1	5.2
8.2	0.6	1.1	1.7	2.0	2.4	2.6	2.7	2.8	3.0	4.8	5.8
8.3	0.7	1.3	1.9	2.3	2.7	2.9	3.2	3.3	3.4	5.5	6.4
8.4	0.7	1.5	2.2	2.6	3.1	3.4	3.7	3.9	4.0	6.4	7.1
8.5	0.8	1.7	2.5	3.0	3.5	3.9	4.3	4.5	4.7	7.4	7.9
8.6	0.9	1.9	2.8	3.4	3.9	4.5	5.1	5.3	5.4	8.6	8.7
8.7	1.0	2.1	3.2	3.8	4.4	5.2	5.9	6.2	6.3	10.0	9.7
8.8	1.1	2.4	3.6	4.3	5.0	6.0	6.9	7.3	7.4	11.6	10.7
8.9	1.2	2.7	4.1	4.9	5.7	6.9	8.1	8.5	8.6	13.5	11.8
9.0	1.3	3.1	4.7	5.6	6.4	8.0	9.5	9.9	10.0	15.6	13.1
9.1	1.5	3.5	5.4	6.3	7.3	9.2	11.1	11.6	11.7	18.1	14.5
9.2	1.6	4.0	6.1	7.2	8.2	10.6	13.0	13.5	13.6	21.0	16.1
9.3	1.8	4.5	6.9	8.1	9.3	12.3	15.3	15.8	15.9	24.4	17.8
9.4	2.0	5.1	7.9	9.2	10.5	14.2	17.9	18.5	18.5	28.3	19.7
9.5	2.1	5.8	9.0	10.4	11.9	16.4	20.9	21.6	21.6	32.9	21.8

Prediction Table Based on Total Alkalinity (U. S.)

Predicted Minimum Lethal Concentration (MLC) of TFM (mg/L) at selected total alkalinities (mg/L as $CaCO_3$) based on multiplicative regressions of data from toxicity tests with larval sea lampreys (Petromyzon marinus).

Alkalinity	MLC	Alkalinity	MLC
5	0.2	140	4.7
10	0.4	145	4.9
15	0.5	150	5.0
20	0.7	155	5.2
25	0.9	160	5.4
30	1.1	165	5.5
35	1.2	170	5.7
40	1.4	175	5.9
45	1.6	180	6.0
50	1.7	185	6.2
55	1.9	190	6.3
60	2.1	195	6.5
65	2.3	200	6.7
70	2.4	205	6.8
75	2.6	210	7.0
80	2.8	215	7.1
85	2.9	220	7.3
90	3.1	225	7.5
95	3.2	230	7.6
100	3.4	235	7.8
105	3.6	240	7.9
110	3.7	245	8.1
115	3.9	250	8.3
120	4.1	255	8.4
125	4.2	260	8.6
130	4.4	265	8.7
135	4.6	270	8.9

APPENDIX E

Stream Treatment Target and Nontarget Mortality Tables

Table E-1. Mortality estimates for all lamprey species during the TFM treatments of Lake Champlain tributaries. Included are mortality estimates for sea lamprey, nontarget American brook, northern brook and silver lamprey.

Year	Stream	Total Mortality All Lamprey	Total Mortality Sea Lamprey	Total Mortality American Brook Lamprey	Total Mortality *Ichthyomyzon spp.*	% Sea Lamprey
1990	Salmon R.	64,853	64,828	25		99.96%
	Little Ausable R.	122,530	122,456	74	0	99.94%
	Ausable R.	36,699	24,506	12,193		66.78%
	Boquet River	6,363	6,325		38	99.40%
	Beaver Brook	1,024	1,005		19	98.14%
	Putnam Creek	31,432	30,230		1,202	96.18%
	Lewis Creek	26,485	25,942		543	97.95%
	1990 Totals	289,386	275,292	12,292	1,802	95.13%
1991	Stone Bridge Br.	769	545		224	70.87%
	Mt. Hope Br.	27,145	26,970		175	99.36%
	1991 Totals	27,914	27,515	0	399	98.57%
1992	Saranac River	394	394			100.00%
	Great Chazy	132,993	132,796		197 (NBL)[a]	99.85%
	Poultney R.	298	197		101	66.11%
	Hubbardton R.	182	182		0	100.00%
	1992 Totals	133,867	133,569	197	101	99.78%
1994	Salmon River	63,686	63,648	38		99.94%
	Little Ausable R.	38,458	38,274	184	0	71.03%
	Ausable River	97,488	69,243	28,245		99.52%
	Boquet River	6,700	6,564		136	97.97%
	Putnam Creek	21,069	20,659		410	98.05%
	Lewis Creek	44,615	41,408		3,207	92.81%
	1994 Totals	272,016	239,796	28,467	3,753	88.15%
1995	Mt. Hope Brook	11,323	11,308		15	99.87%
	Trout Brook	249	157	92	0	63.31%
	1995 Totals	11,572	11,465	92	15	99.08%

Table E-1 (continued).

Year	Stream	Total Mortality All Lamprey	Total Mortality Sea Lamprey	Total Mortality American Brook Lamprey	Total Mortality *Ichthyomyzon spp.*	% Sea Lamprey
1996	Great Chazy R.	22,724	22,712		12 (NBL)[a]	99.95%
	Poultney R.	9,308	6,759		2,549	72.06%
	Hubbardton R.	20	20		0	100.00%
	1996 Totals	32,052	29,491	12	2,549	92.06%
1998	Putnam Creek	11,988	11,411		577	95.19%
	Little Ausable R.	12,244	12,219	25	0	99.80%
	Beaver Brook	954	954		0[b]	100.00%
	Salmon	18,751	18,751	0[c]		100.00%
	1998 Totals	43,937	43,335	25	577	98.63%
1999	Ausable River	47,894	26,591	21,303		55.52%
	Boquet River	2,109	1,971		138	93.46%
	Mt. Hope Brook	13,252	13,115		137	98.97%
	1999 Totals	63,255	41,677	21,303	275	65.89%
2000	Great Chazy R.	10,695	10,689		6 (NBL)[a]	99.94%

[a] All *Ichthyomyzon spp.* listed from the Great Chazy River are believed to be northern brook lamprey; all other *Ichthyomyzon spp.* listed in the table were silver lamprey.

[b] During the 1990 treatment of Beaver Brook, 3 silver lamprey were identified from post-treatment mortality collections. No silver lamprey were identified from the samples collected during the 1998 treatment.

[c] No American brook lamprey were identified from post-treatment mortality collections, however post-treatment electrofishing surveys confirmed their presance.

Table E-2. Estimates of nontarget fin fish mortality, excluding native lamprey, associated with TFM treatments by species, water and treatment year.

Species	Boquet			Little Ausable			Ausable			Salmon			Beaver		Putnam			Lewis	
	1990	1994	1999	1990	1994	1998	1990	1994	1999	1990	1994	1998	1990	1998	1990	1994	1998	1990	1994
Bowfin				6	2				1							1		6	
Rainbow trout																9	1		
Brown trout																2			
Brook trout														2		7			
Central mudminnow									1							2	14		
Redfin pickerel																		2	
Grass pickerel																			
Northern pike			1	2	16		1									1		23	
Muskellunge																			
Chain pickerel																	1	23	10
Cutlips minnow												1							
Brassy minnow																			
Silvery minnow																			
Golden shiner		2			1													1	1
Emerald shiner									1										
Bridle shiner																	4		
Common shiner	1	1	2	1				1	21		10	1		8			2	26	1

Table E-2 (continued).

Species	Boquet			Little Ausable			Ausable			Salmon			Beaver		Putnam			Lewis	
	1990	1994	1999	1990	1994	1998	1990	1994	1999	1990	1994	1998	1990	1998	1990	1994	1998	1990	1994
Blacknose shiner																	2		
Spottail shiner					1														
Rosyface shiner		1			1						1								
Sand shiner																	2		
Mimic shiner																4			
Northern redbelly dace														2			16		
Redside dace																	1		
Bluntnose minnow		1		1	4		12	1	48		1						16		
Fathead minnow													1	3					
Blacknose dace			6				1		130	1				115	8	424	11	66	
Longnose dace		3	23			1	2		11	3		1				2	3	53	2
Creek chub					1									118	1		29	11	
Fallfish		1		2	3			1		1	1								
Pearl dace																	1		
Unidentifd. *Notropis*																		2	

Table E-2 (continued).

Species	Boquet			Little Ausable			Ausable			Salmon			Beaver		Putnam			Lewis	
	1990	1994	1999	1990	1994	1998	1990	1994	1999	1990	1994	1998	1990	1998	1990	1994	1998	1990	1994
Unidentifd. Cyprinid						1								129					
Longnose sucker					1			1											
White sucker	1		14		10	2			25	2	1	2	1	33	8	9	19	29	
Yellow bullhead																	6		
Brown bullhead			160	1	28	1			105	18		4		8		3	2	18	6
Channel catfish																			
Stonecat				21	196	2				141	185	149							
Tadpole madtom				6															
Trout-perch																		20	
Banded killifish	1		1				21	1											
Brook stickleback							10		2										
Rock bass				3					5										
Pumpkinseed	1				1				1								2		
Bluegill					8														
Smallmouth bass		1			1				10									1	2
Largemouth bass								2											

Table E-2 (continued).

Species	Boquet			Little Ausable			Ausable			Salmon			Beaver		Putnam			Lewis	
	1990	1994	1999	1990	1994	1998	1990	1994	1999	1990	1994	1998	1990	1998	1990	1994	1998	1990	1994
Black crappie																			
Fantail darter								2	11										
Tessellated darter[a]	2	5	26	5	24	1	7	16	130	1	1		6	28	2	3	1	114	4
Yellow perch						1								1				1	1
Logperch			9		23	1	9	82	247			21			4	22	859	248	26
Slimy sculpin			2		1	1										13	4		
Unidentified fish		1						1	194										

Table E-2 (continued).

Species	Saranac	Poultney		Hubbardton		Great Chazy			Stone Bridge	Mount Hope			Trout
	1992	1992	1996	1992	1996	1992	1996	2000	1991	1991	1995	1999	1995
Bowfin							1			2			
Rainbow trout	5												
Brown trout													
Brook trout	1										1		
Central mudminnow							3			1	3	6	
Redfin pickerel													
Grass pickerel										4			
Northern pike						1		5	5				
Muskellunge						23	1						
Chain pickerel										78	19	6	
Cutlips minnow							5						
Brassy minnow			1										
Silvery minnow				1									35
Golden shiner										1			
Emerald shiner													
Bridle shiner													
Common shiner						1	1		5				

Table E-2 (continued).

Species	Saranac	Poultney		Hubbardton		Great Chazy			Stone Bridge	Mount Hope			Trout
	1992	1992	1996	1992	1996	1992	1996	2000	1991	1991	1995	1999	1995
Blacknose shiner										1			
Spottail shiner													
Rosyface shiner		1											
Sand shiner													
Mimic shiner													
Northern redbelly dace													
Redside dace													
Bluntnose minnow			1			9			725				
Fathead minnow			1										
Blacknose dace								7	6	2	8	5	1
Longnose dace							1	1					
Creek chub	2										4	18	
Fallfish	1	1	1			3	2				7		
Pearl dace											22		
Unidentifd. *Notropis*													

Table E-2 (continued).

Species	Saranac	Poultney		Hubbardton		Great Chazy			Stone Bridge	Mount Hope			Trout
	1992	1992	1996	1992	1996	1992	1996	2000	1991	1991	1995	1999	1995
Unidentifd. Cyprinid		1		1									
Longnose sucker													
White sucker			3			24	1	2	170	2	75	18	4
Yellow bullhead										9	12		
Brown bullhead						41	5	7	3	14	8	78	17
Channel catfish							1						
Stonecat	331					5,768	88	1,451					
Tadpole madtom													
Trout-perch													
Banded killifish	1												
Brook stickleback													
Rock bass						1	11						
Pumpkinseed				1						1			
Bluegill		1											
Smallmouth bass						2							
Largemouth bass			1									10	

Table E-2 (continued).

Species	Saranac	Poultney		Hubbardton		Great Chazy			Stone Bridge	Mount Hope			Trout
	1992	1992	1996	1992	1996	1992	1996	2000	1991	1991	1995	1999	1995
Black crappie							1						
Fantail darter						17	49						
Tessellated darter[a]			9	1	1		3		64	14	35	16	1
Yellow perch										1			
Logperch	32		4			561	28	478	7	10		7	1
Slimy sculpin											1		
Unidentified fish										1			

[a] There is possibility that some of these were misidentified, and may have been johnny darters.

Table E-3. Estimates[a] of nontarget macro-invertebrate and amphibian mortality associated with TFM treatments presented by species, water and treatment year.

Species	Boquet			Little Ausable			Ausable			Salmon			Beaver[b]		Putnam			Lewis	
	1990	1994	1999	1990	1994	1998	1990	1994	1999	1990	1994	1998	1990	1998	1990	1994	1998	1990	1994
Leech																			
Crayfish		1		4	8	3	2	6			4	1			1	3		3	
Mussel			4	1	1				2									8	
Red-spotted newt														14					
Two-line salamander									333			28		8			62		
Dusky salamander																			
Northern spring salamander														81			1		
Mudpuppy				3			35	22	186						5			17	9
Unidentified salamander				3	12	3	4	30		9	6		2	17	3	90	5	13	3
Leopard frog																			
Frog tadpole		3	435		6		4	2	6,975		1			23					
Frog adult		2			3			4								3			5
Unidentified worm																			
Unidentified snail									3										

Table E-3 (continued).

Species	Saranac	Poultney		Hubbardton		Great Chazy			Stone Bridge	Mount Hope			Trout
	1992	1992	1996	1992	1996	1992	1996	2000	1991	1991	1995	1999	1995
Leech							1						
Crayfish							4					1	
Mussel	2						13						
Red-spotted newt										295	67	176	
Two-line salamander								193		21	6	19	
Dusky salamander									14				
Northern spring salamander													
Mudpuppy								119					
Unidentified salamander[b]	4		2			1,209	442						
Leopard frog						1							
Frog tadpole						1,460	3,614	204	364	6	1		
Frog adult						4	11	3	1				
Unidentified worm										1			
Unidentified snail													

[a] Nontarget invertebrate and amphibian mortality was assessed by actual counts over most treated stream sections. Exceptions were Ausable Chasm which is inaccessible and a 1700' segment of section 9 of the Great Chazy River, where counts of nontargets in two 50' transects were expanded to provide total mortality estimates for the segment in 1992. The actual-count technique produces a minimum biased estimate of nontarget kill. Water clarity, light conditions, water depth, vegetation, substrate characteristics, etc., prevent detection of all affected organisms. Only large macro-invertebrates such as crayfish and mussels were counted.

[b] Most unidentified salamanders from the Great Chazy River were probably mudpuppies. Instead of all affected specimens, only representative samples were collected there. They have been sent to NYSDEC herpetologists for species identification. Please note that NYSDEC herpetologists have, in fact, identified many of the salamanders from other waters, which are listed above as unidentified. Most were not mudpuppies, but common salamanders such as the two-line salamander. The Breisch Amphibian Study (Breisch 1996) contains species identifications for most. Unfortunately, numbers of salamanders reported collected or observed by field assessment crews (above) do not always precisely correspond to the numbers reported identified by Breisch et al. Therefore, for the purposes of this table, no species listing was made.

APPENDIX F

Characteristics of the Lampricides

TFM and Niclosamide

CHARACTERISTICS OF THE LAMPRICIDES TFM AND NICLOSAMIDE

A. TFM

1. General Characteristics of the TFM Formulation

The field formulation of TFM most widely used for sea lamprey control is a liquid known as Lamprecid^R. It is a restricted use pesticide, liquid in form, and manufactured by the Clariant Corporation, Charlotte, North Carolina and H & S Chemical Company, Woodbridge, New Jersey. A solid TFM Bar formulation, manufactured by Bell Laboratories, Madison, Wisconsin, is also used on a more limited basis (See Section IV.A.1.). TFM is presently manufactured solely for the purpose of sea lamprey control and its use as a lampricide in the U.S. and has been approved by the EPA (See Section II.C for further details).

Lamprecid^R contains about 36% active ingredient with the remainder of the formulation consisting mainly of the inert ingredients isopropanol and water. Also present are minor quantities of impurities.

Isopropanol ($C_3 H_8 O$; molecular weight of 60.09), the solvent for TFM, currently comprises about 22% of the Lamprecid^R formulation. Isopropanol is used as a solvent for creosote, resins and gums and is miscible with water, alcohol, ether and chloroform. It is also used as an inert ingredient in other pesticide formulations according to the Merck Index (Anonymous, 1983). The significance of the use of isopropanol in the proposed program for sea lamprey control in Lake Champlain is discussed in Section VII.A.1. in this SEIS.

2. Physical-Chemical Properties

TFM is a halogenated mononitrophenol. It has a molecular formula $C_7 H_4 F_3 NO_3$ and a molecular weight of 207.11 (NRCC 1985). TFM has several chemical names but the two most commonly used is 3-trifluoromethyl-4-nitrophenol and ∝,∝,∝-triflouro-4-nitro-m-cresol, sodium salt (EPA 1999). The sodium salt of TFM has a solubility in water of 5g/l at 25°C and has a yellow color in an alkaline solution (NRCC 1985).

3. Mode of Action

The mode of action of TFM on sea lamprey and other fishes remains largely undefined. According to the NRCC (1985), symptoms described in sea lamprey include rupturing of gill tissue, dilation of blood vessels which supply the gills, excess mucous formation, and often hemorrhaging in the gill areas. These observations suggest that death is caused by general circulatory and respiratory collapse as was proposed by Applegate et al. (1961). A study by Mallat et al. (1985) on the ultrastructural effects of TFM on the gills of larval sea lamprey revealed that ion-uptake cells were adversely affected. This may be a contributing factor in the death of sea lamprey.

Other studies have shown that TFM interferes with the ability of the affected organism to use energy obtained from oxidation of internal fuels (nutrients) to drive life systems (NRCC 1985). The energy coupling process that is disrupted is known as oxidative phosphorylation. The lamprey's initial response is to increase oxygen uptake and later to become comatose as they run out of energy. Kawatski and McDonald (1974) reported similar effects in teleost fish, and attributed differential toxicity for various species of fishes to differences in rates of uptake, biotransformation and excretion.

4. <u>Selectivity</u>

The toxicological property of TFM which makes it lethal to sea lamprey also governs its toxicity to nontarget organisms. Upon entering an organism, TFM is either conjugated to the glucuronide complex and excreted, or it is accumulated as TFM (NRCC 1985). While not all groups of organisms have been studied, it has been demonstrated that those susceptible to TFM are unable to complete the conjugation and excretion process.

Glucuronide conjugation is a prerequisite for rapid excretion of TFM in all animals studied. The bioconcentration factor is a good indicator of an organism's ability to biotransform and excrete TFM. Those that are readily able to conjugate and excrete TFM will not be killed by concentrations used to kill sea lamprey. Those that are killed are unable to complete the conjugation process. Such species including some fishes and invertebrates, are likely to experience significant mortality during TFM treatments.

Glucuronide conjugation is the mechanism that protects teleost fish from the toxic effects of TFM (NRCC 1985; Kane et al. 1994). Fish injected with glucuronidation inhibitors had substantially lower LC_{50}'s and, correspondingly, elevated levels of unconjugated TFM. Sea lamprey exhibit poor ability to conjugate TFM and their net uptake is much greater than that of teleosts. Table F-1 illustrates the toxicity differential between sea lamprey and a few representative teleosts. Compared to sea lamprey, smallmouth bass and yellow perch are very resistant to TFM, while walleyes and white suckers are moderately sensitive to TFM (Boogard et al. in review).

Relative to conjugation, it has been demonstrated that the toxic effects of TFM to fish generally do not increase through extended exposure time. Toxicosis in sensitive fish is usually rapid during the first few hours after exposure but does not increase significantly in longer exposure. This is illustrated in Table F-2 which shows that 1 h LC_{50}'s were from 2-5 times higher than the 24 h LC_{50}'s but that there was little or no change in toxicity between 24 and 96 h. Data in this table also provide further confirmation of the variability in mortality among fish species from TFM noted previously (Table F-1).

Variation in the toxicity of TFM to various aquatic invertebrates is demonstrated in Table F-3. Most invertebrates which have been studied are resistant to TFM because of their limited uptake and rapid excretion of the chemical. However, some forms including aquatic worms and a few insect genera are sensitive, presumably because they lack the ability to conjugate or rapidly excrete TFM (NRCC 1985).

Further information on the selectivity of TFM is discussed in Section VII.A.1.

Table F-1. TFM toxicity to larval sea lamprey relative to other fish in paired tests (From Menzie and Hunn, 1974).

Test Fish	Average TFM Dose Required to Kill		Differential Toxicity (ratio)
	100% Larval lamprey (ppm)	25% Test Fish (ppm)	
Largemouth bass	6.3	31.5	5.0
Smallmouth bass	4.5	38.2	8.5
Bluegill	6.3	32.0	5.1
Walleye	6.7	8.3	1.3
Yellow perch	6.3	13.6	2.2
White sucker	5.7	8.3	1.5
Yellow bullhead	6.0	10.3	1.7
Blacknose shiner	6.3	19.9	3.2
Golden shiner	6.0	23.4	3.9
Fathead minnows	6.0	25.3	4.2
Rainbow trout	5.3	19.3	3.6

Table F-2. Toxicity of formulated TFM[1] to fingerling fish (1-1.5 g) (temperature 12° C, hardness = 40-48 mg/L, pH = 7.2-7.6) (adapted from Marking and Olson, 1975).

Species	LC_{50} (mg/L)			
	1 h	**24 h**	**96 h**	**96 h[2]**
Bluegill	-	7.05	7.05	4.89
Green sunfish	11.40	5.62	4.10	-
Golden shiner	8.19	3.57	3.32	-
Largemouth bass	-	2.63	2.63	-
Chinook salmon	5.06	2.62	1.85	-
Yellow perch	4.97	2.52	1.89	1.71
Fathead minnow	7.63	2.09	2.09	-
Brown trout	4.23	1.99	1.55	0.94
White sucker	4.35	1.96	1.72	-
Rainbow trout	2.56	1.69	1.69	1.81
Lake trout	6.37	1.69	1.29	1.78
Carp	3.60	1.46	1.46	-
Black bullhead	5.88	1.09	1.05	-
Channel catfish	5.19	1.05	0.60	0.75

[1] TFM is a 35.7% by weight active ingredient formulation for chinook salmon, brown trout, lake trout and rainbow trout and a 35.4% for all other species. Data were given as µL/L. Specific gravity was taken into account by multiplying by a factor of 1.23.

[2] From Bills and Marking (1976) using 0.5-1.5 g fish and a 35.7% by weight active ingredient formulation of TFM.

Table F-3. Toxicity of field grade TFM (calculated as active ingredient) in hard water to macroinvertebrates. Unless specified, all insect nymphs and larvae are late instars. (Continuous flow tests; alkalinity - 179 mg/1 $CaCO_3$, Hardness - 211 mg/1 $CaCO_3$, pH 7.79, Temperature - 12° C) (From Maki et al. 1975).

Species		LC_{50} (mg/liter)	
		24 h	**96 h**
Pelecypoda	*Sphaerium* sp.	17.5	7.6
	Pisidium sp.	16.9	11.2
	Ligumia sp. >16.0 cm	>18.0	11.7
	Ligumia sp. <9.0 cm	>11.2	8.3
Isopoda	*Asellus militaris*	17.0	9.7
Amphipoda	*Gammarus pseudolimnaeus*	38.0	13.5
Decapoda	*Orconectes propinquus* 3-4 mm	>36.4	>36.4
Ephemeroptera	*Hexagenia bilineata*	7.9	3.4
	Stenonema frontale	24.91	12.4
	Stenonema luteum	29.6	18.3
	Baetisca obesa	37.8	29.2
	Paraleptophlebia sp.	>34.6	32.4
	Tricorythodes	29.3	27.0
	Ephemerella cornuta 8 mm	>39.0	45.6
	Ephemerella cornuta <4 mm	36.2	24.0
	Baetis sp.	6.9	4.4
	Isonychia bicolor	18.3	12.3
	Cloeon sp.	11.1	7.2
Megaloptera	*Chaulioues* sp.	>36.0	>36.0
Plecoptera	*Paragnetina media*	21.5	12.5
	Isoperla slossonae	16.7	8.0
	Acroneuria lycorias	>34.0	>34.0
	Pteronarcys dorsata	32.2	27.1
Odonata	*Ophiogomphus* sp.	>38.0	>38.0

Table F-3. (Continued)

Species		LC_{50} (mg/liter)	
		24 h	**96 h**
Trichoptera	*Brachycentrus americanus*	10.5	6.6
	Lepidostoma sp.	15.0	9.1
	Chimarra obscura	3.8	2.8
	Cheumatopsyche sp.	28.3	26.7
	Hydropsyche sp.	>32.0	25.2
	Limnephilus consocius	>39.0	>39.0
	Macronemum sp.	>38.0	>38.0
Diptera	*Simulium pugetense*	6.1	2.1
	Pedicia sp.		>11.7
	Chrysops carbonarius		>35.8
Annelida	*Lumbricidae* 6-9 mm	6.6	5.3

5. Efficacy

TFM is extremely effective in killing sea lamprey ammocoetes in streams. Typically, from 95-99% of the ammocoetes present in streams are killed during the treatment (Daugherty 1985). Overall, it is estimated that the abundance of sea lamprey in the Great Lakes has been reduced to about 5-10% of their peak abundance (Walters et al. 1980). Similar results were obtained by the NYSDEC in the Seneca and Cayuga Lake systems in the 1980s (Kosowski and Hulbert 1993; Bishop and Chiotti 1996), and during the Lake Champlain experimental sea lamprey program from 1990 to 1997 (Fisheries Technical Committee 1999) .

In certain other pest control programs, the pests have developed genetic resistance to the pesticides. This has not occurred with sea lamprey and no change in the sensitivity of sea lamprey to TFM has been detected after over 25 years of use (Walters et al. 1980; Scholefield and Seelye 1990). Should such an adaptation occur, it would very quickly become obvious in the results of field toxicity tests or in post-treatment assessment surveys which are routinely conducted to determine treatment effectiveness.

Significant survival of sea lamprey ammocoetes following a TFM treatment indicates that some factor prevented maintenance of TFM at the minimum lethal concentration (MLC = sea lamprey 9-hour $LC_{99.9}$) for a sufficient period of time. This might include dilution by beaver dam impoundments, groundwater discharges into streams or sudden heavy rainfalls. In most cases, prior knowledge or experience with these factors enables treatment personnel to adjust to them and to obtain effective applications.

6. Factors Which Affect Toxicity

Synergism, a greater than additive effect observed when two or more compounds are present together in a treated system, can create unexpectedly severe toxic effects to stream biota. TFM has been tested for interactive effects against a variety of compounds including representative organic pesticides, heavy metals and industrial contaminants (Table F-4). Toxic effects have been simply additive for most contaminants tested singly with TFM; however, the combination of the insecticides Malathion and Delnav with TFM produces a synergistic effect (Marking and Bills 1985). Since mixtures of Malathion and Delnav are known to be synergistic with most pesticides, synergism with TFM was expected (Meyer 1985). Combination of TFM with carbaryl, DDT, nitrite, toxaphene, cadmium, copper and chlorine yielded results that were less than additive for one or more of the three fish species tested.

The additive mortality effect between TFM and other compounds is of practical concern, however. It has long been known that the presence of almost any kind of pollution will reduce the amount of TFM needed to kill either lamprey or nontarget biota because of the added toxicity contributed by the pollutant(s). The end result is usually a narrowing of the safety margin for nontarget organisms and an increase in the risk of nontarget mortality. However, this type of problem can be identified by careful selection of toxicity tests sites. On-site toxicity tests results, in turn, guide the selection of appropriate TFM concentrations to minimize impacts on nontarget biota while achieving the intended effect on the sea lamprey ammocoete population. Stresses on fish induced by excessively high or fluctuating water temperatures, low oxygen levels, or other factors such as spawning, can also lead to fish mortality when combined with the added stress of exposure to treatment levels of TFM. Stressed fish are most sensitive to TFM apparently because they are less able to mobilize the glucuronidation process which protects them.

Table F-4. Toxicity of mixtures of TFM and selected contaminants to fish (temperature = 12° C, hardness = 44 mg/L $CaCO_3$, pH = 7.4) (Marking and Bills 1985).

Chemical Combination	Additive Toxicity Index and Range for		
	Rainbow trout	White sucker	Fathead minnow
TFM and ammonium	(-)0.14 (-)0.49 to (+)0.15	(-)0.19 (-)0.84 to (+)0.29	(-)0.06 (-)0.48 to (+)0.70
TFM and carbaryl	(-)0.37 (-)1.59 to (+)0.38	(-)0.59 (-)1.14 to (-)0.17	(+)0.53 (-)0.09 to (+)1.56
TFM and chlordane	(-)0.50 (-)1.27 to (+).008	- - -	- - -
TFM and cyanide	(-)0.27 - -	(-)0.62 (-)1.8 to (+)0.07	(-)0.19 (-)0.74 to (+)0.23
TFM and Delnav	(-)0.26 (-)0.63 to (+)0.04	- - -	(+)0.32 (-)0.10 to (+)0.90
TFM and DDT	(-)0.37 (-)0.89 to (-)0.002	(+)0.05 (-)0.56 to (+)0.70	(+)1.04 - -
TFM and endrin	(-)0.52 (-)1.66 to (+)0.10	(-)0.56 (-)1.55 to (+)0.04	(+)0.20 (-)0.26 to (+)0.80
TFM and malathion	(+)0.05 (-)0.28 to (+)0.42	(-)0.05 (-)0.67 to (+)0.50	(+)0.33 (-)0.11 to (+)0.95
TFM and nitrite	(-)1.25 (-)2.00 to (-)0.69	(-)0.41 (-)1.78 to (+)0.36	(+)0.36 (-)0.75 to (+)2.22
TFM and tannic acid	(-)0.43 - -	(-)0.51 (-)1.47 to (+)0.08	(-)0.30 (-)0.89 to (+)0.12
TFM and toxaphene	(-)0.41 (-)0.98 to (-)0.01	(-)0.48 (-)1.19 to (-)0.001	(-)0.003 (-)0.59 to (+)0.58
TFM and cadmium	(-)0.23 (-)1.19 to (+)0.46	(+)0.07 (-)0.92 to (+)1.20	(-)0.91 (-)1.86 to (-)0.28
TFM and copper	(+)0.04 (-)0.66 to (+)0.77	(-)0.01 (-)0.84 to (+)0.79	(-)0.58 (-)1.45 to (-)0.01
TFM and zinc	(-)0.06 (-)0.72 to (+)0.52	(-)0.26 (-)1.43 to (+)0.53	(-)0.16 (-)0.88 to (+)0.39
TFM and chlorine	(-)1.04 (-)1.90 to (-)0.45	(-)0.28 (-)0.95 to (+)0.18	(-)0.63 (-)1.41 to (-)0.10

Water pH is the primary factor affecting toxicity of TFM (NRCC 1985; Bills et al. 1988). However, variations in other water chemistry parameters also affect the concentration of TFM required to kill sea lamprey or that causes mortality among nontarget organisms. This is illustrated in Tables F-5 and F-6.

During actual Great Lakes treatments, TFM concentrations have ranged from about 0.4 ppm in soft, acidic waters to as much as 20 ppm in hard, alkaline waters. In the past, alkalinity was the principal criterion used to determine treatment concentrations because alkalinity usually parallels pH. Presently, predictive toxicity charts based on a pH/alkalinity regression model (Bills et al. in review) are used to predict appropriate stream-specific MLC's (See Appendix D). Predicted MLC's are then verified with on-site toxicity testing for many Great Lakes treatments and for all Lake Champlain treatments. Water temperature does not affect the toxicity of TFM for sea lamprey; however, high temperatures may slightly increase its toxic effect on some teleosts, especially salmonids because of thermal stresses (Bills and Marking 1976).

Water chemistry affects the toxicity of TFM because it affects the uptake of TFM by organisms. At high pH and alkalinity, the available level of free phenol decreases and the level of complex ionized forms of TFM increases (Hunn and Allen 1974; Howell et al. 1980). Because these forms do not readily cross biological membranes, TFM uptake, and toxicity are reduced for larval sea lamprey as well as nontarget organisms.

There is an indication that small fish of some species (salmonids) are more sensitive to TFM than larger fish of the same species. For example, the 24 h LC_{50} for 1.3 g coho salmon was 5.53 mg/L compared to 13.10 mg/L for 7.4 g coho (Marking et al. 1975).

Table F-5. Effects of temperature, hardness, and pH on the 96-h LC_{50} of formulated TFM[1] and niclosamide (Bayluscide[2]) to sea lamprey (modified from Dawson et al. 1977).

Temp. (° C)	Hardness (mg/L $CaCO_3$)	pH	96-h LC_{50}	
			TFM (mg/L)	**Niclosamide (mg/L)**
7	44	7.5	0.345	0.0220
12	44	7.5	0.730	0.0400
17	44	7.5	0.496	0.0410
12	170	7.5	0.625	0.0350
12	300	7.5	0.710	0.0390
12	44	6.5	0.172	0.0300
12	44	8.5	1.30	0.0390

[1] TFM is a 35.7% by weight active ingredient formulation.
[2] Bayluscide is a 70% by weight active ingredient formulation.

Table F-6. Effects of temperature, hardness, and pH on the 96-h LC_{50} of formulated TFM[1] and niclosamide (Bayluscide[2]) to rainbow trout (modified from Bills and Marking 1976).

Temp. (° C)	Hardness (mg/L $CaCO_3$)	pH	96-h LC_{50}	
			TFM (mg/L)	**Niclosamide (mg/L)**
7	44	7.5	2.13	0.0620
12	44	7.5	1.81	0.0346
17	44	7.5	1.74	0.0439
12	10	8.1	9.00	0.0800
12	44	8.1	14.1	0.0755
12	160	8.1	14.1	0.100
12	300	8.1	17.3	0.0865
12	44	6.5	0.949	0.0261
12	44	8.5	5.40	0.0705
12	44	9.5	25.2	0.185

[1] TFM is a 35.7% by weight active ingredient formulation.
[2] Bayluscide is a 70% by weight active ingredient formulation.

7. **Fate in the Environment**

a. TFM

TFM is chemically and biologically stable in water (EPA 1999) and is not subject to volatilization (Kempe 1973, Thingvold 1975) or hydrolysis (Reynolds 1997, Kempe 1973). The principal mechanism of TFM degradation in aquatic systems appears to be photodegradation caused by exposure to sunlight.

The main supporting evidence for photodegredation is based upon extensive studies done under the direction of Dr. John Carey, National Water Research Institute, Canada Center for Inland Waters, Burlington, Ontario and reported in several publications (Carey and Fox 1981; Carey et al. 1982; Carey et al. 1988). The most important findings of this research were conveyed by Dr. Carey in sworn testimony during the NYSDEC Adjudicatory Hearing (Cayuga Lake Hearing) on March 12, 1985 in Ithaca, New York. Chemical reactions described by that work are provided by the following excerpt of Dr. Carey's testimony (Carey 1985): "The proposed pathway of TFM photodegradation is shown in the Figure. The initial step now appears to involve an isomerization of the nitro group to form a nitrite ester. This ester can undergo a number of reactions to give the products shown in Figure F-1. The major reaction appears to be a hydrolysis reaction to form nitrous acid and trifluoromethylhydroquinone (product D). At high TFM concentrations, the ester may also react with TFM to produce a dimer leading to product A. Other reactions of the ester include photoreduction to a nitrosophenol (product F) and thermal reactions to products G and C. The trifluoromethylhydroquinone (D) undergoes further reactions including both oxidation to trifluoromethylhydroquinone (E) and hydrolysis of the trifluoromethyl group to give gentisic acid (B, 1,5-dihydroxybenzoic acid). The final photodegredation products appear to be high molecular weight polymers which are likely produced via the oxidative polymerization of products B. D. E. This behavior is commonly observed in the photodegradation of substituted phenols and is thought to be similar to the production of humic compounds from naturally occurring phenolic material. The polymers formed from TFM are non-chromatographable and thus cannot be analyzed in the presence of naturally occurring humic material.

The above breakdown pathway was determined from laboratory studies. Traces of these products were detected in an analysis of water from a stream during an actual treatment with TFM. However, they were not observed in a set of three lined ponds to which TFM had been added. In this latter study, no decomposition products were observed under conditions where the TFM concentration in water and sediment decreased from the ppm level to undetected."

The final photodegradation products cannot presently be synthesized, so toxicity data are not available for them. However, their similarity to naturally occurring substances called humic acids is interpreted to mean that exposure of organisms to the final TFM photodegradation products poses little or no toxic hazard (Carey 1985).

The rate of photochemical breakdown of TFM depends upon light intensity. This in turn, depends upon such factors as time of the year, depth and clarity of the water. In flasks exposed to September sunlight, the half-life of TFM was 3 days (Carey and Fox 1981). In lined artificial ponds with depths ranging from 1 to 2.5 m, the half-life was 9 days for purified TFM and 12 days for the field formulation (Scott et al. 1984). The half life of TFM in two 0.9 acre ponds in central Ohio was reported as 10.3 days by Kane and Johnson (1989). Fathulla (1995) found that carbon 14-labeled TFM degraded rapidly in the dark under aerobic conditions with a half-life of 5.4 days. Under dark, anaerobic conditions, Fathulla (1996) found that carbon 14-labeled TFM degraded rapidly with a half-life of 2.1 days.

EPA (1999) reported there was conflicting evidence for photodegradation of TFM, citing the findings of Thingvold (1975), which concluded that aqueous solutions of TFM were very stable in the presence of sunlight. Preliminary results of a definitive study to address EPA's concerns support the importance of photodegradation, showing that TFM photodegrades rapidly. TFM half-lives in water buffered at pH's of 5,7, and 9 were 11.6, 4.2, and 3.4 hours, respectively; the half-life in raw lake water at ph 8.1-8.5 was 3.7 hours (Riyadh Fathulla, Covance Laboratories, Madison, Wisconsin, Personal Communication).

The major TFM degradation product is reduced TFM (RTFM) (Carey 1985). RTFM is structurally similar to TFM, differing only in the presence of an amine group, (NH_2) rather than a nitro group (NO_2). It does not reoxidize back to TFM under natural environmental conditions (Meyer 1985). RTFM is formed in sediments only under anaerobic conditions (Meyer 1985). Under these conditions, RTFM binds irreversibly to organic matter within the sediment. This binding process greatly reduces movement of RTFM through sediment. RTFM does not persist in the environment. It was not detectable several weeks after initial soil binding (Carey 1985).

Adsorption to soil is not an important source of loss of TFM from water. According to studies by Dawson et al. (1986), and Dawson (1986), most of the TFM adsorbed to bottom sediments during treatment is quickly released back into the water when the bolt of TFM-laden water has passed. TFM was most tightly bound to soils with high silt/organic content, but even then, 60% was released compared with 100% for sandy sediments (Dawson et al. 1986). Adsorption was nearly 10 times greater in silty as in sandy sediments and about 6 to 10 times as high at pH 6 as at pH 8. These studies indicate that adsorption would greatly restrict transfer through soils, particularly those with high silt and organic content and lower pH's, conditions that are characteristic of estuarine or wetland habitats. Similarly, significantly more binding resulted at lower temperatures and desorption from silty sediments was sometimes less than 30% (Dawson 1986). The estimated leaching distance in soil ranges from about 1 cm to 25+cm depending on soil type and pH (Dawson 1986). The tendency for TFM not to bind to sediments strongly, is readily reversed and is pH dependent was also noted by Carey et al (1988). As indicated previously, RTFM is more tightly bound in soils than TFM and less is released regardless of soil type, pH or temperature.

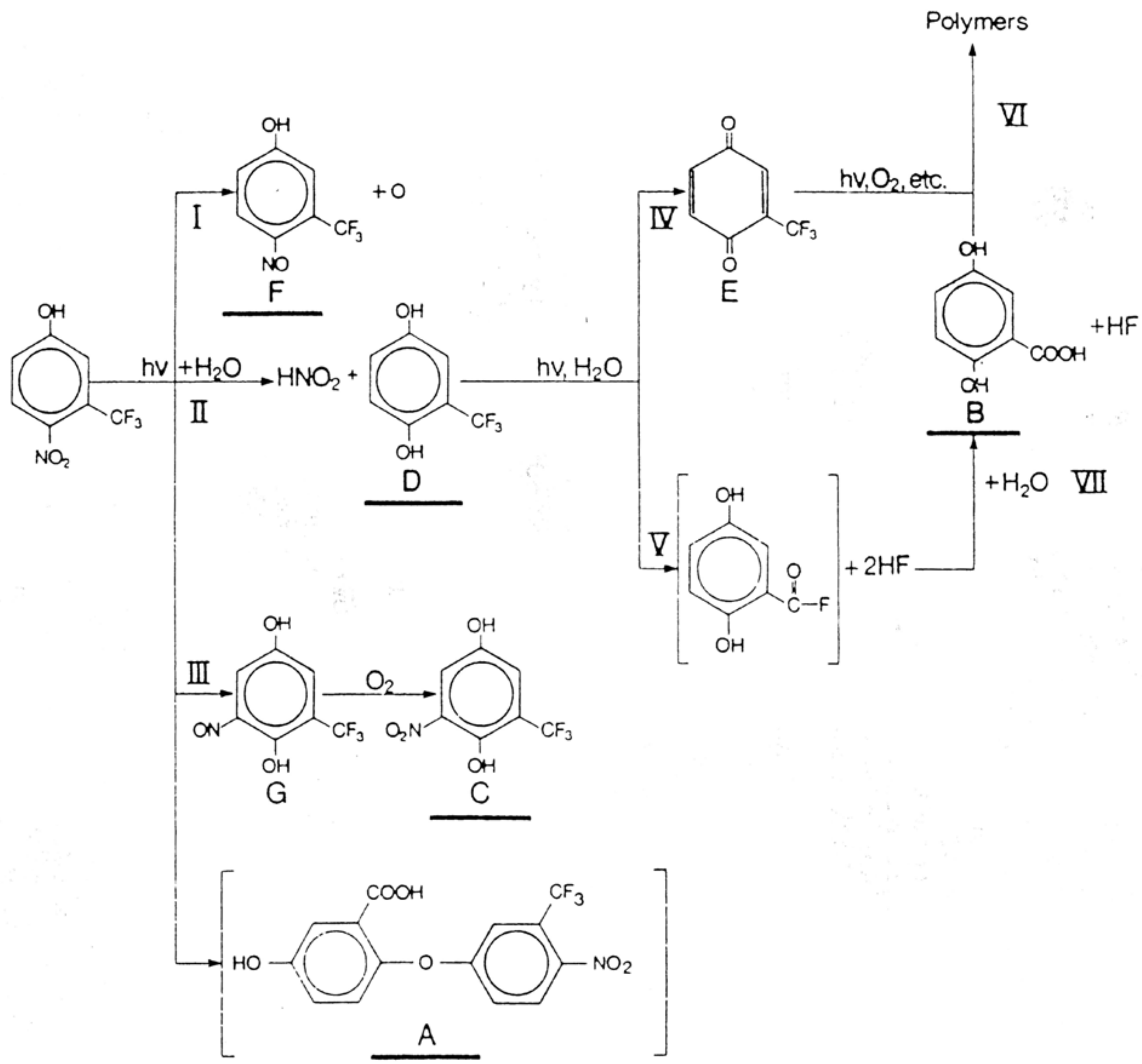

Figure F-1. TFM photoproducts observed in Lynde Creek, 1981. From testimony by Dr. John Carey presented at the adjudicatory hearing on sea lamprey control in Cayuga Lake.

Compared to photodegradation, bioconcentration of TFM results in a minor loss of TFM during stream treatments and is an unimportant factor in the ultimate fate of the chemical. Bioconcentration factors (BCF) for algae, aquatic macrophytes and invertebrates (Table F-7) show considerable variation. All are less than 100 and considered relatively low (Stern and Walker 1978). Highest BCF's were exhibited by annelid worms (50.5 times) and one species of caddisfly (62.2 times). The general uptake pattern shows that soft-bodied invertebrates tend to concentrate higher levels than those with hard exoskeletons (crayfish and snails). Following removal to TFM-free water, total residue levels were rapidly reduced in all but annelid worms. Kawatski and Bittner (1975) found that the midge *Chironomus tentans* was able to transform about 45% of accumulated TFM residues. In addition, about 2.5% of the TFM was reduced to RTFM.

The principal fate of TFM in fishes is glucuronide conjugation and excretion in the bile and is not expected to accumulate in fish (EPA 1999) (Table F-8). Other studies on fishes have produced similar results (see NRCC 1985). Hubert (1997) found that TFM residues accumulated in rainbow trout that were exposed to nonradiolabled plus uniformly phenyl ring-labled [^{14}C]TFM. Depuration of [^{14}C] residues was rapid, with >98.7 percent of accumulated eliminated by days 4, 15, and 11, respectively, from the viscera, fillet, and whole body samples. Among fishes, sea lamprey (and other lamprey) are an exception, as they conjugate much less and therefore accumulate much more TFM than other species (NRCC 1985).

When TFM was injected into rats about 60% was excreted in urine within 24 h and, of that, only 6% was unaltered TFM. The remainder appeared to consist of various other metabolites (Lech 1971). Information is unavailable concerning the fate of TFM taken up by amphibians, reptiles or birds. Studies cited in Section VII.A.1.k. in this SEIS suggest that TFM ingested by mammals is rapidly excreted through the urine.

b. Isopropanol

The reviews by Engstrom-Heg (1989) and the New York State Department of Health (1989) indicate that isopropanol is volatile and typically escapes into the atmosphere. Apparently biochemical degradation by microorganisms is the main mechanism for removal from water. Probable breakdown products are acetic and formic acids. EPA (1986) indicates that isopropanol is rapidly biodegraded or oxidized in the environment.

c. Formulation Impurities

TFM treatments have been associated with hepatic mixed function oxidase (MFO) enzyme detoxification activity and altered levels of circulating gonadal sex steroids in fish (Munkittrick 1994; Hewitt et al. 1998a). TFM itself was found to be a weak estradiol agonist, causing changes in steroid levels (Hewitt et al. 1998a), but it did not induce MFO activity (Munkittrick 1994). Fractions which contain trace amounts of several organic impurities suspected of inducing MFO activity have been isolated from TFM formulations, including chloro- and/or nitro- and/or triflouromethyl substituted phenols, diphenyl ethers, and tri-substituted dibenzo-*p*-dioxins; however, only tri-substituted dibenzo-*p*-dioxin cogeners were found to be responsible for MFO induction (Hewitt, et al. 1996 and 1998b). The environmental risk from tri-substituted dibenzo-*p*-dioxin impurities identified in TFM formulations is considered to be minimal since the noted MFO induction effect is temporary due to rapid metabolism and excretion of the compounds, and also due to the brief and infrequent nature of TFM applications (Hewitt et al. 1998b and 1998c).

Table F-7. Accumulation, bioconcentration factor and half-life of TFM in various components of a model stream community exposed to a concentration of 9 mg/L^{-1} TFM for 24 h (hardness = 211 mg/L $CaCO_3$, pH = 7.79) (adapted from Maki and Johnson 1977).

Matrix	Accumulation ($g.g^{-1}.d.w.$)	Bioconcentration Factor	Half-Life (h)
Green algae *Cladophora* sp. *Stigeoclonium* sp.	61.0	6.8	65.2
Green algae[1] *Cladophora* sp. *Stigeoclonium* sp.	106.3	11.8	25.8
Aquatic macrophytes			
Ceratophyllum demersum	109.3	12.1	437.5
Elodea canadensis	49.8	5.5	87.4
Annelid worms	454.8	50.5	5295
Isopod *Asellus militaris*[2]	151.2	16.8	194.4
Amphipod *Gammarus pseudolimnaeus*	169.8	18.9	26.2
Crayfish *Orconectes propinguus*	11	1.2	7.2
Mayfly *Hexagenia* sp.	76.9	8.5	38.6
Caddisfly[1]			
Glossoma sp.	306.6	34.1	7.9
Limnephilus sp.	174.3	19.4	14.0
Brachycentrus americanus	559.4	62.2	19.5
Snail *Physa* sp.	81.8	9.1	23.2
Fingernail clam *Pisidium* sp.	121.4	13.5	7.9
Sediment	35.2	3.9	171.7

[1] From riffle area, all other species from pool area.
[2] The exact identify of this organism cannot be determined.

Table F-8. Uptake and distribution of the various forms of TFM in bile and different tissues of fish.

Species	Bile/ Tissue	Exposure Time (h)	Concentration of TFM in Water (mg/L)	Concentration TFM in Tissue (µg/g)			Reference
				Free TFM	Conjugated TFM	Total TFM	
Rainbow trout	plasma	2 12	5.0 1.0	2.73 0.27	0.87 -	3.60 0.27	Hunn and Allen (1974)[1]
	bile	2 12	5.0 1.0	4.12 1.24	197 510	201 511	″
Largemouth bass	blood	12 24	1.0 1.0	- -	- -	1.71 1.29	Schultz et al. (1979)[2]
	bile	12 24	1.0 1.0	- -	- -	696.4 1497.3	″
	liver	12 24	1.0 1.0	- -	- -	22.52 18.03	″
	kidney	12 24	1.0 1.0	- -	- -	15.35 13.04	″
	brain	12 24	1.0 1.0	- -	- -	1.52 1.46	″

[1] Water hardness = 238-258 mg/L $CaCO_3$, pH = 7.6-7.9, temperature = 12° C.

[2] Water hardness = -, pH = 6.8, temperature = 12° C.

B. Niclosamide

1. General Characteristics of Niclosamide Formulations

The field formulations of niclosamide proposed for use in the Lake Champlain sea lamprey control program are known as Bayluscide 3.2% Granular Sea Lamprey Larvicide (Bayluscide 3.2% Granular) and Bayluscide 70% Wettable Powder. Both are restricted use pesticides (See Section II.C.). Bayluscide 3.2% Granular is a solid in the form of micro-encapsulated granules and is manufactured by Coatings Place, Inc., Verona, Wisconsin; this formulation replaces Bayluscide 5% Granular, which is no longer produced (See Section II.C.2.). Bayluscide 70% Wettable Powder is manufactured by Pro-Serve, Inc., Memphis Tennessee. Unlike TFM which is manufactured exclusively for sea lamprey control, niclosamide use for this purpose is minor when compared to its worldwide use for human health purposes. Outside the United States, niclosamide is the agent of choice for treating human tapeworms (Perera et al. 1970). Likewise, 5% aqueous Bayluscide is used in large quantities in tropical countries for spraying waterways to control snails, the intermediate hosts of Schistosomiasis disease. It is recognized by the World Health Organization as the best commercially available product for this purpose (WHO 1965).

In sea lamprey control, Bayluscide 70% Wettable Powder is sometimes mixed with TFM in stream treatments to reduce the amount of TFM needed and to cut treatment costs without loss of effectiveness (See section IV.A.2). The 3.2% Granular formulation is also used for ammocoete survey and control purposes in estuarine and lentic habitats (See Section IV.A.3.).

The Bayluscide 3.2 % Granular formulation consists of 3.2 % niclosamide and 96.8 inert ingredients. Silica Sand comprises 70% of the inert ingredients, with the remainder made up of Pluronic F-68, Ethyl Cellulose, and Hydroxypropyl Cellulose (Terry Hubert, U.S. Geological Survey Upper Midwest Environmental Sciences Center, LaCrosse, Wisconsin, personal communication). Bayluscide 70% Wettable Powder consists of 70% niclosamide, and the remainder of the formulation consisting primarily of magnesium silicate (talc) and silica.

2. Physical-Chemical Properties

Niclosamide, the active ingredient in Bayluscide formulations is 2',5-dichloro-4'-nitrosalicylanilide ($C_{13}\ H_8\ Cl_2\ -\ N_2\ O_4$) has a molecular weight of 327.13 according to the Merck Index (Anonymous 1983). The compound is also known medically as Yomesan or Bayer 2353. It is slightly soluble (5-8 mg/l) in distilled water at 20°C. For aquatic use, Bayluscide is formulated as the 2-aminoethanol salt of Bayer 2353 (NRCC 1985). This salt has a solubility of 230$\pm$ 50 mg/L in water at 25°C (Luhning et al. 1979). It becomes insoluble as pH drops below 7.0 (Meredith 1971). Solubility increases with temperature and in tap water it increases from 145 $\pm$ 33 mg/L at 20°C to 372 $\pm$ 86 mg/L at 50°C (Gonnert 1961).

3. Mode of Action

The mode of action of Bayluscide has not been elucidated but it is believed that it acts in a manner similar to TFM: as an uncoupler of the oxidative phosphorylation process (NRCC 1985).

4. Selectivity

Although there is considerable variability, niclosamide appears to be nearly as toxic to nontarget fish as it is to sea lamprey. It is extremely toxic to larval sea lamprey with the LC_{100} ranging from 0.06 to 0.15 ppm, depending on water hardness (King and Howell 1970), and it is more toxic to free-swimming lamprey, (12 h LC_{50} of 0.0625 ppm) than to burrowed lamprey (12 h LC_{50} of 0.110 ppm) (U.S. BSFW 1973). Table F-9 gives 24 h LC_{50}'s for other fish species. These range from 0.052 to 0.143 mg/L. As previously noted for TFM, it appears that toxicosis in fishes is very rapid shortly after exposure to niclosamide and that it does not change substantially with longer exposure. This is reflected in Table F-9 which shows a moderate reduction in LC_{50}'s between 1 to 24 h of exposure but very little change from 24 through 96 h. Data in this table also illustrate the point that species, such as brook trout and yellow perch, are more sensitive to niclosamide than carp or bluegills.

Because niclosamide is only slightly more toxic to larval lamprey than to many other fish species, it is not suitable for general use as a lampricide. However, because the use pattern of Bayluscide 3.2% Granular proposed for Lake Champlain will release most of the active ingredient near the bottom, some degree of selectivity will be maintained with free-swimming fish being able to escape by simply moving up in the water column. The concept of niclosamide stratification in the water column is supported by results of the study by Ho and Gloss (1987) in Seneca Lake where it was determined that concentrations were generally lowest at the surface and highest within a zone extending 0.1-1.0m up from the bottom. However, concentrations in the 11-60 ppb range were common at the surface, mid-depths and at all deeper water sampling stations (deepest 4.5m) with some surface concentrations briefly (1-2 h) reaching 100 ppb or above. Caged rainbow trout and largemouth bass were used to provide information on nontarget fish mortality and Bayer residues in fish muscle. The only substantial mortality (90%) was observed in one cage of rainbow trout 14 h after treatment. Excluding this incident, average fish mortality for the first 48 h was 0% for largemouth bass and 1.3% for rainbow trout (Ho and Gloss 1987). Mortality to uncaged fish at both sites in 1982 and 1984 was reported by Engstrom-Heg (1983) and Kosowski et al. (1987). In 1982, significant mortality of nontarget fish occurred at the Dresden site (12 species affected) while losses were very minor at the Watkins Glen site. Species most affected included the silvery minnow, spotfin shiner, white sucker, banded killifish, brown bullhead, johnny darter and smallmouth bass. Most fish killed were less than 4 inches in size. In 1986, using the same chemical application rate, the mortality was very minor and involving primarily bluntnose minnows.

Table F-10 indicates that invertebrates are generally more tolerant of niclosamide than fish, with soft-bodied forms such as turbellarians, oligochaetes and leeches being the most sensitive.

Except for snails, other forms are more resistant. Many forms would be unaffected by the maximum concentrations and duration of exposure observed in the Seneca Lake study (Ho and Gloss 1987). Further information on toxicity of niclosamide is discussed in Section VII.A.1.

Bayluscide 70% Wettable Powder, when used in combination with TFM (comprising 0.5 to 2.0 percent of the total active ingredient as niclosamide) is advantageous in larger rivers, since it can reduce the total amount of lampricide needed to effectively kill sea lamprey by as much as 50% (See Section IV.A.2.). However, the relative toxicity of the mixture to nontarget species is generally equivalent to, or slightly less than that of TFM alone (See Section VII.A.1.)

Table F-9. Toxicity of niclosamide[1] to fingerling fish (0.6-3.0 g) (temperature = 12° C, hardness = 40-48 mg/L, pH = 7.2-7.6) (modified from Marking and Hogan, 1967).

Species	**LC_{50} (mg/L)**			
	1 h	**24 h**	**96 h**	**96 h[2]**
Carp	0.300	0.143	0.139	-
Bluegill	-	0.105	0.094	0.152
Black bullhead	0.275	0.104	0.088	-
White sucker	0.180	0.084	0.081	-
Yellow perch	0.120	0.082	0.081	0.0639
Brook trout	0.077	0.061	0.061	0.0470
Rainbow trout	0.063	0.052	0.052	0.0346
Lake trout	-	-	-	0.0490
Channel catfish	-	-	-	0.0370
Brown trout	-	-	-	0.0282

[1] Niclosamide is a 99% by weight active ingredient formulation.
[2] Modified from Bills and Marking (1976) using 0.5-1.5 g fish.

Table F-10. Toxicity of niclosamide[1] to aquatic invertebrates[3] (hardness = 100-136 mg/L $CaCO_3$, pH = 8.2-8.3, temperature = 12.8º C) (adapted from Rye and King, 1976).

Organism	24-h LC_{50} and 95% confidence interval (mg/L) Bayer 73
Turbellaria *Dugesia tigrina*	0.048 (0.044-0.053)
Oligochaetes Anneldia *Tubifex tubifex*	0.034 (0.031-0.037)
Lumbriculus inconstans	0.14 (0.12-0.18)
Hirudinea Erpobdellidae	0.42 (0.38-0.47)
Crustaceans Cladocera *Daphnia pulex*	0.8 (0.68-0.94)
Isopoda *Asellus militaris*[2]	23.0 (18.4-28.8)
Amphipoda *Gammarus*	2.6 (2.34-2.88)
Decapoda *Orconectes* sp.	>50.0 -
Aquatic insects Plecoptera *Paragnetina* sp.	1.07 (0.79-1.44)
Odonata *Ophiogomphus* sp.	>50.0 -
Ephemeroptera *Hexagenia* sp.	6.9 (5.85-8.14)
Stenonema sp.	2.27 (1.68-3.08)
Megaloptera *Corydalus sp.*	>50.0 -

Table F-10 (continued).

Organism	24-h LC_{50} and 95% confidence interval (mg/L) Bayer 73
Aquatic insects	
Trichoptera	
Hydropsyche sp.	2.45 (1.88-3.19)
Helicopsyche sp.	1.67 (1.18-2.37)
Diptera	
Simulium sp.	0.255 (0.236-0.275)
Atherix sp.	>50.0 -
Molluscs	
Gastropoda	
Physa sp.	0.106 (0.097-0.116)
Pleurocerca sp.	0.355 (0.290-0.430)
Pelecypoda	
Elliptio dilatatus	0.382 (0.320-0.458)

[1] Niclosamide is in a 70% by weight active ingredient formulation.
[2] The exact identity of this organism cannot be determined.
[3] All aquatic insects were exposed as nymphs or larvae while all other invertebrates were exposed as adults.

5. Efficacy

As noted previously, niclosamide is extremely toxic to larval sea lamprey. Results are available from several field studies to determine the effectiveness of Bayluscide 5% Granular for sea lamprey control. King and Howell (1970) concluded from their studies on Houghton Lake that Bayluscide 5% Granular "when applied at a rate to give a concentration of 7.0 ppm in the bottom three inches of water (approximately 100 lb of granules per surface acre), will act as a potent sea lamprey larvicide with little or no damage to associated fish populations". The concentration referred to is the theoretical concentration. Bayluscide 5% Granular application rates ranging from about 22 - 66 lb per acre, produced mortalities among caged ammocoetes ranging from 39 - 66% in water 3 - 7 ft deep. Application rates ranging from 85 - 110 lb per acre, produced ammocoete mortalities ranging from 82 - 100% in water of the same depth. Engstrom-Heg (1983) and Kosowski et al. (1987) reported variable success in treating ammocoete populations in Seneca Lake where Bayluscide 5% Granular was applied by aircraft at 100 lbs/acre to a 102 acre site at Dresden and 9 acre site at Watkins Glen. Effectiveness was assessed in both years by the survival/mortality of caged sea lamprey ammocoetes. In 1986, mortality of caged ammocoetes at Dresden was 63.5% for the entire 102 acre treatment area; 78.5% for cages located north of a power plant uptake pipe; and 91.3% for cages placed in the most densely populated area north of the intake and inshore of the end of the pipe. Corresponding figures for 1982, corrected for control cage mortality, are 80.3%, 78.3% and 93.0%. In 1982, 91% of the cages in the treated area had mortalities of 50% or greater with a mean mortality in these cages of 89%. The corresponding zone of 50% or greater mortality in 1986 included 64% of the cages with a mean mortality in these cages at 89%. Cages with less than 50% mortality included those at the extreme south end and one near the offshore boundary. A strong south wind in 1986 appears to have shifted the zone of effective treatment northward, resulting in a poor kill in the lightly populated south end of the treated area.

The size composition of ammocoetes collected during the 1986 treatment, and the extreme scarcity of transformers, suggests that the 1982 treatment was more effective then the originally estimated 80%. In both years at the Dresden site, moderate numbers of gulls fed very actively on surfacing ammocoetes. This undoubtedly increased the overall mortality of ammocoetes and suggests that mortality estimates based only upon cage results may underestimate true losses, since gulls and other predators cannot feed on caged ammocoetes.

The 1982 Watkins Glen treatment was ineffective. The 1986 treatment was much more effective and resulted in a near total kill of ammocoetes in about one-half of the treated area. Mixed results at the site are attributed to excessive dilution of the chemical in the small narrow plot that is subject to strong water currents. This conclusion is consistent with the maximum concentration of 65 ppb of Bayluscide found at that site in the 1982 treatment (Ho 1985). This is near the lower limit of effective toxicity for sea lamprey.

Bayluscide 5% Granular was used effectively for nine Lake Champlain delta treatments in 1991 and 1995. Mortality of caged sea lamprey larvae in the treatment area was 100% in six of the treatments and ranged from 73 to 96% in the other three treatments (Fisheries Technical Committee 1999).

6. Factors Which Affect Toxicity

Niclosamide has been tested for synergistic effects against a variety of compounds, including representative organic pesticides, heavy metals and industrial contaminants (Table F-11). None of the combinations produced greater than additive toxicity and, in the case of at least 1 of 3 fish species, results were less than additive for ammonia, carbaryl, endrin, nitrite, tannic acid, toxaphene and chlorine.

As illustrated in Tables F-5 and F-6, temperature and water hardness have little effect on the toxicity of niclosamide to sea lamprey or teleost fishes (see also NRCC 1985). While pH has the most significant effect on the toxicity of niclosamide, it is substantially less than for TFM (Tables F-5 and F-6). Although niclosamide was 7 times more toxic to rainbow trout at pH 6.5 than at pH 9.5, its solubility decreases at lower pH's and it precipitates below pH 6.5 (NFRL 1983).

7. <u>Fate in the Environment</u>

Both photochemical degradation and biodegradation are important routes of removal of niclosamide in natural waters. These factors, plus binding to sediments, can cause as much as an 80% loss when niclosamide is used with TFM in a prolonged stream treatment (Dawson et al. 1986). Niclosamide solutions exposed to intense ultraviolet irradiation lose most of their activity in 24 h (Gillet and Braux 1962). In another study, Schultz and Harman (1978a) observed a 95% degradation with 7 unidentified photoproducts after 168 h of exposure to UV radiation.

Pseudomonas and *Aerobacter*, both abundant bacteria in natural waters, are capable of utilizing and degrading niclosamide (Etges et al. 1969). These authors also reported that fungi and yeast-like organisms were able to utilize as a sole source of nitrogen. The major products of microbial degradation are reduced niclosamide (2',5-dichloro-4'-aminosalicylanilide) and 2-chloro-4-nitroaniline (Muir and Yarechewski 1982). Although the fate of those compounds has not been described, significant amounts of oxygen were given off in the cultures, suggesting that active degradation continued.

Niclosamide binds much more tightly to sediments than TFM. Dawson, et al. (1986) hypothesized that this was an important mechanism involved in the loss of niclosamide activity during a 1980 treatment of the Ford River, Michigan. Sediment type affects adsorption with silty/organic sediments adsorbing the greatest amounts. Temperatures had virtually no effect on adsorption. Desorption of niclosamide was low when fresh water was introduced and release from organic silt was sometimes less than 5% (Dawson 1986). On the other hand, Muir and Yarechewski (1982) proposed that adsorption to sediments probably plays a minor role under field conditions and suggested that degradation was the major factor in reducing its efficacy.

While the mechanism of loss appears to be debatable, it is clearly evident that niclosamide does not persist for very long in the aquatic environment. Rapid disappearance of niclosamide from water has been reported in several studies. Ho and Gloss (1987) reported that in Seneca Lake most of the niclosamide concentrations were below 60 ppb 24 h after application and that all were below 30 ppb at 48 h following application. Webbe (1961) reported that detectable concentrations disappeared within 48 h in study ponds, while Strufe et al. (1965) observed a 50% decrease 25 h after application of 1,000 ppb to a slow-flowing canal.

Bioconcentration factors of niclosamide for several invertebrate species are presented in Table F-12. All are less than 100 and are not considered significant (Stern and Walker 1978). Residues in scuds and midges, species with the highest BCF values, were quickly cleared once animals were transferred to water free of the chemical and 90% was eliminated within 48 h after transfer to clean water (Sanders 1977).

Uptake and tissue distribution data for niclosamide in several fish species as shown in Table F-13 indicate a rapid uptake. Clearance of niclosamide residues in fish tissues except bile, was substantial after 72 h following transfer of exposed fish to clean water (Statham and Lech 1975; Schultz and Harman 1978b; Dawson et al. 1982). Hubert (1996) found depuration was rapid and fairly complete by day 10 of the elimination period. Levels of niclosamide in muscle and plasma of rainbow trout were below detection (0.01 µg/g) at 10 and 21 days post-exposure, respectfully (Dawson et al. 1982). High levels and longer presence in bile can be attributed to residues from other tissues continuing to empty into the bile. Large quantities of niclosamide in urine (Allen et al. 1979) and the bile (Statham and Lech 1975) indicate that these are important routes for excretion. The metabolic process for elimination of niclosamide in fish is similar to that for TFM: conjugation with glucuronic acid and excretion in the bile and urine (NRCC 1985). Residue patterns of niclosamide in muscle tissue of caged largemouth bass and rainbow trout from the 1982 Seneca Lake treatment followed the general pattern obtained by Dawson et al. (1982) but were still detectable in some samples 7 days after exposure (Ho and Gloss 1987).

No information is available on the uptake, distribution or elimination of niclosamide in sea lamprey, amphibians, reptiles, aquatic birds or aquatic mammals (NRCC 1985). A study by Griffiths and Facchini (1979) on rats revealed that after 20 mg. of 14_C-Bayer 2353 was administered, 51.5% was detected in the urine, 47.4% in the feces and 1.1% in the bile as various metabolites.

Table F-11. Toxicity of mixtures of niclosamide and selected contaminants to fish (temperature = 12° C, hardness = 44 mg/L $CaCO_3$, pH = 7.4) (from NFRL 1983; Marking and Bills, 1985).

Chemical Combination	Additive toxicity index and range for		
	Rainbow trout	White sucker	Fathead minnow
niclosamide and ammonium	(-)0.22 (-)0.33 to (+)0.97	(-)0.62 (-)1.43 to (-)0.09	(-)0.11 (-)0.26 to (+)0.36
niclosamide and carbaryl	(+)0.34 (-)0.19 to (+)1.12	(-)0.52 (-)1.27 to (-)0.01	(-)0.07 (-)0.64 to (+)0.41
niclosamide and chlordane	(-)0.36 (-)1.12 to (+)0.13	- - -	- - -
niclosamide and cyanide	(-)0.15 (-)0.68 to (+)0.26	(-)0.21 (-)0.74 to (+)0.17	(-)0.02 (-)0.50 to (+)0.46
niclosamide and Delnav	(+)0.08 (-)0.72 to (+)1.01	- - -	- - -
niclosamide and DDT	(-)0.22 (-)1.28 to (+)0.54	(+)0.11 (-)0.45 to (+)0.74	(+)0.41 - -
niclosamide and endrin	(-)0.88 (-)2.5 to (-)0.009	(-)0.26 (-)1.38 to (+)0.48	(-)0.38 (-)0.98 to (+)0.04
niclosamide and malathion	(+)0.81 (+)0.21 to (+)1.69	(-)0.03 (-)0.57 to (+)0.45	(-)0.09 (-)0.42 to (+)0.68
niclosamide and nitrite	(-)0.10 (-)0.72 to (-)0.42	(-)0.04 (-)0.99 to (+)0.78	(+)0.13 (-)0.77 to (+)1.24
niclosamide and tannic acid	(-)0.43 - -	(-)0.07 (-)1.03 to (+)0.06	(-)0.43 (-)0.97 to (-)0.03
niclosamide and toxaphene	(+)0.03 (-)0.46 to (+)0.56	(-)0.71 (-)1.78 to (-)0.06	(-)0.37 (-)1.19 to (+)0.17
niclosamide and cadmium	(-)0.73 (-)2.54 to (+)0.18	(-)0.10 (-)0.91 to (+)0.59	(-)0.38 (-)1.09 to (+)0.09
niclosamide and copper	(-)0.22 (-)1.55 to (+)0.70	(-)0.17 (-)0.96 to (+)0.42	(-)0.16 (-)0.78 to (+)0.31
niclosamide and zinc	(+)0.00 (-)0.68 to (+)0.70	(-)0.42 (-)0.56 to (+)2.13	(-)0.42 (-)1.04 to (+)0.01
niclosamide and chlorine	(-)0.91 (-)1.96 to (-)0.24	(+)0.39 (-)0.12 to (+)1.15	(-)0.38 (-)1.05 to (-)0.08

Table F-12. Accumulation of ^{14}C-Bayer 2353 from water by 7 aquatic invertebrates after a 24-h exposure (water hardness = 270 mg/L $CaCO_3$, pH = 7.4, temperature = 22º C for crayfish and midge, 18º C for all others) (from Sanders 1977).

Species	Concentration in Water (mg/L)	Concentration in Whole Body (µg/g wet weight)	BCF
Daphnia, 1st instar *Daphnia magna*	0.0014	0.075	53
Aquatic sowbug, mature *Asellus brevicaudus*	0.0011	0.025	23
Scud, mature *Gammarus pseudolimnaeus*	0.0012	0.080	67
Glass shrimp, mature *Palamonetes kadiakensis*	0.0010	0.004	4
Crayfish, juvenile *Orconectes nais*	0.0010	0.004	4
Damselfly, mature nymph *Ischnura verticalis*	0.0012	0.008	7
Midge, 4th instar *Chironomus plumosus*	0.0011	0.087	80

Table F-13. Uptake and distribution of niclosamide in bile and different tissues of fish.

Species	Bile/ Tissue	Exposure Time (h)	Concentration of niclosamide in Water (mg/L)	Concentration of niclosamide in Tissues (μg/g)	Reference
Rainbow trout	blood	12	0.05	4.35	Statham and Lech (1975)[2]
	heart	12	0.05	1.57	″
	muscle	12	0.05	0.08	″
	liver	12	0.05	12.5	″
	bile	12	0.05	277	″
Rainbow trout	plasma	12 24	0.05 0.05	7.66 [1] 5.30 [1]	Dawson et al. (1982)[3]
	muscle	12 24	0.05 0.05	0.045 0.024	″
	bile	12 24	0.05 0.05	380.0 [1] 473.0 [1]	″
Largemouth bass	blood	12 24	0.05 0.05	11.38 15.71	Schultz & Harman (1978b)[4]
	brain	12 24	0.05 0.05	0.77 0.92	″
	muscle	12 24	0.05 0.05	0.66 0.67	″
	kidney	12 24	0.05 0.05	7.24 9.34	″
	liver	12 24	0.05 0.05	13.33 12.41	″
	bile	12 24	0.05 0.05	317.52 411.25	″
Largemouth bass	muscle	12 24	0.05 0.05	0.058 0.048	Dawson et al. (1982)[5]
Channel catfish	muscle	12 24	0.05 0.05	0.022 0.019	″

[1] μg/mL
[2] water hardness = 134 mg/L $CaCO_3$, pH = 7.52, temperature = 12° C
[3] water hardness = 100 mg/L $CaCO_3$, pH = 8.2, temperature = 12° C
[4] water hardness = -, pH = 7.3, temperature = 13.5° C
[5] water hardness = 23.5 mg/L $CaCO_3$, pH = 7.3, temperature = 19° C

APPENDIX G

Public Review of The Draft Supplemental Environmental Impact Statement Regarding Long-term Sea Lamprey Control for Lake Champlain

The Draft SEIS was released for public review in early March, 2001. A Federal Register Notice published March 16, 2001, announced the availability of the DSEIS and officially opened the public review process. The Cooperative accepted public comment by email, letter and public address. Two well publicized and centrally-located public meetings (Willsboro, NY, March 28; South Burlington, VT, April 4) were conducted and transcripts of the proceedings were retained by the Cooperative for consideration. Approximately 200 individuals attended the public meetings. The public commenting period closed April 30, 2001.

In total, the Cooperative received input from 111 groups or individuals, of which, 80 indicated support for the Proposed Action, 22 expressed general or partial opposition and 9 neither supported nor opposed the Proposed Action. Comments requiring explanation or clarification in the form of a direct response from the Cooperative are included in this response summary. Individual letters, emails and excerpts from meeting transcripts expressing concerns are included with responses to common themes following the comments. The responses indicate which groups or individuals expressed the concerns that each response addresses. Comments not requiring responses are not included in this summary but are part of the administrative record maintained at the U.S. Fish and Wildlife Service, Lake Champlain Fish and Wildlife Resource Office.

Comments received were given careful consideration by the Cooperative and resulted in numerous revisions to the DSEIS. The Cooperative's response to comments indicate where revisions occurred for clarification and better explanation. The Cooperative is appreciative of the public input received and acknowledges the improvements in text and discussion incorporated into the Final SEIS as a direct result of that input.

Letters and Statements Regarding the Draft Supplemental Environmental Impact Statement Expressing Concerns and Requiring a Response as Identified by the Cooperative. Letters, included as Appendix H, are listed with page numbers.

Recommended Changes/Additions

Comment 1: There should be a strong, concise statement at the beginning of the SEIS summarizing in general terms the important outcomes or conclusions of the experimental sea lamprey control program. A brief statement at the beginning should address the demand for and importance of salmonid populations. (P. Neth)

Response 1: Some of the elements suggested have been added to the Introduction and additional information regarding the importance of salmonid populations has been added to the Purpose and Need sections. These changes have been added to the existing text where appropriate, to maintain the existing format and flow of the FSEIS.

Comment 2: The goal of the Proposed Action is too general. It should be ... to achieve fish population, recreational fishery, economic and environmental benefits that are at or above levels achieved during the eight-year experimental sea lamprey control program**.** (P. Neth)

Response 2: The Goal has been modified to incorporate the element of improved sea lamprey control.

Comment 3: Include discussion of the ultimate fate and decay rates of lampricides in the environment. (EPA)

Response 3: Environmental fate of lampricides has been included in Appendix F.

Comment 4: Discuss the potential for sea lamprey to develop a tolerance to lampricides. (EPA)

Response 4: The proposed sea lamprey control program uses an integrated approach that will limit lampricide use and reduce the overall probability of sea lamprey developing a tolerance or resistance to the lampricides used. Furthermore, there is no evidence that sea lamprey are developing resistance to lampricides. A statistical comparison of TFM toxicity test data from 1963 to 1987 showed no significant differences in the LC_{50} or $LC_{99.9}$ values for larval sea lamprey through this period (Scholefield and Seelye 1990). The study concluded that TFM resistance was not expected to develop in the future, since current treatment practices allow relatively few larvae to be exposed to sublethal doses of TFM, and because chronic exposure does not occur due to relatively rapid degradation of the chemical.

Recent analyses suggest that sea lamprey populations may adapt to sea lamprey control-induced reductions, through compensatory increases in growth and earlier metamorphosis to the parasitic-phase (Zerrenner and Marsden in review). Although this compensatory mechanism is not considered to represent a change in chemical tolerance, a marked change in larval transformation rates may require a change in treatment frequency or a change to alternative control measures if large numbers of parasitic-phase sea lamprey are produced between lampricide treatment intervals.

Comment 5: Provide analysis of the long-term impacts of stream lampricide treatments vs. barrier dams. (EPA)

Response 5: The long-term impacts of stream lampricide treatments and barriers are discussed in Section VII of the FSEIS. The rationale for the choice and prioritization of recommended sea lamprey control methodology to be applied to specific treatment locations, is provided in Section VIII. Additional comparative analyses of sea lamprey control method applicability on the Poultney River and Pike River systems can be found in Walrath and Swiney (2001). Noakes et al. (2000), provide a detailed overview of long-term barrier impacts. A long-term pre and post-TFM treatment study on Lewis Creek, Vermont indicated no post-treatment adverse effects with the macroinvertebrate and fish communities for three years following treatment (VTDEC 1994). Lyttle (1996) found no long-term depressions of mussel or snail populations on two Bayluscide-treated Lake Champlain deltas four years following treatments. The results of these studies and other long-term studies which covered lampricide use for 10 years or more (Dubois 1993; Dubois and Blust 1994; Schuldt and Goold 1980) are discussed in Section VII.A.1.

Comment 6: The goal, objectives and purpose should include minimizing nontarget impacts. (EPA, LCC, APA)

Response 6: The goal, objectives and purpose are centered around the intended positive response to the sea lamprey impacted fishery. Nontarget issues are appropriately addressed in the screening process and in sections regarding the environmental consequences of implementing the selected alternative. The Cooperative recognizes the need to minimize nontarget impacts associated with sea lamprey control; this responsibility is reflected in the screening process for establishing control methodologies. Numerous mitigation strategies considered and proposed are: no application of lampricides, reduced concentration lampricide treatments or the selection of non-chemical alternatives where feasible to do so. In many cases periodic chemical control methods would have fewer nontarget impacts than non-chemical sea lamprey control methods like barrier establishment.

***Comment* 7:** Incorporate a feedback mechanism into the screening diagram. (TNC)

***Response 7*:** The text and screening figure have been modified in Section IV to more clearly illustrate an adaptive management approach to sea lamprey control.

***Comment 8*:** Include cost-per-lamprey or minimum lamprey density thresholds prior to lampricide applications on lamprey-producing streams, in particular, the Poultney River system. (LCC, CLF, EPA, TNC, AV, W. Elton, J. Calvi, VTDEC)

***Response 8*:** It is necessary to proceed with lamprey control prior to finalizing a ranking system because unchecked lamprey production would severely impact ecological, economic and social values of Lake Champlain's fish populations. An adaptation of the Great Lake Fishery Commission's sea lamprey control lampricide application, decision-making model (Empirical Stream Treatment Ranking or ESTR) will be incorporated into the Lake Champlain sea lamprey control program as soon as the necessary information becomes available (see Section V.A). Until the Cooperative gains the necessary information to employ a ranking model, sea lamprey control strategies will be implemented as indicated in the SEIS.

***Comment 9*:** Remove/modify Sec.VIII-B, which inappropriately allows treatment of 37 additional streams. (LCC, EPA)

***Response 9*:** The FSEIS, Section VIII.B has been amended to indicate that if new sea lamprey production resulted in the Cooperative proposing control in tributaries that do not presently harbor sea lamprey populations, appropriate environmental review including NEPA analyses and state permitting processes would be addressed.

Comment 10: The stated objectives are so narrow as to rule out any alternatives other than chemicals. (CLF, VPIRG)

Response 10: All currently acceptable sea lamprey control methods have and will be considered as reasonable alternatives in meeting the program's objectives. Non-chemical techniques are currently proposed as the primary control methods for 9 of the 20 tributary systems. As stated in the purpose and need section of the SEIS, the underlying goal of the sea lamprey control program is to achieve fish population, recreational fishery and economic benefits. The wounding rate objectives established by the Cooperative are indicators of sea lamprey abundance in the lake. Wounding rate data are currently available and are readily monitored through electrofishing and gillnet surveys along with data collected at fishways.

Comment 11: The objectives are too narrowly focused. They should better relate to hoped-for outcomes for fish population, fishery, and economic improvement. (P. Neth)

Response 11: The text regarding the objectives has been modified with the addition of further background information to provide a better understanding of their development. The objectives were chosen because they were readily measurable, and with the recognition that wounding rate reductions will result in fish population, fishery, ecosystem and economic improvements. Fish population and recreational fishery assessment conducted as part of other Lake Champlain fisheries management activities will provide supplemental information for periodic reevaluation of objectives.

Comment 12: We are opposed to the addition of walleye goals because the document is "supplemental" to a salmonid document. (AV, W. Elton)

Response 12: The addition of a walleye objective (Section I.A) occurred out of concern for the additional pressures sea lamprey are posing to a formerly abundant Lake Champlain walleye population. Walleye are not as susceptible to sea lamprey predation as are salmonids, but management efforts geared toward increasing walleye abundances in Lake Champlain are attempting to bolster these populations in the presence of sea lamprey pressure. Walleye are attacked by sea lamprey and undoubtedly experience stresses as a direct result.

The FSEIS is supplemental to an EIS regarding experimental sea lamprey control. While the goal and parameters used to measure the success of the experimental program were linked to salmonid restoration efforts, walleye and other fish species in Lake Champlain are also impacted by sea lamprey. This impact has and can be measured. Walleye serve as an additional indicator of sea lamprey predation to a variety of other warm and coolwater species (see Section I.B). In the FSEIS, Section 1.A has been revised to appropriately recognize the linkage between sea lamprey control, salmonid restoration and walleye management efforts. A successful Lake Champlain sea lamprey control program will reduce sea lamprey predation on walleye in a predictable way and the wounding objective developed to gauge the walleye response to sea lamprey control is attainable and measurable.

Comment 13: Has the medical literature on TFM and niclosamide from 1990 to present been scanned to determine if there is new information available on adverse impacts or safety of the chemicals? (P. Neth) Mammal/human toxicology studies are outdated or incomplete. (M. Peden)

Response 13: The EPA recently completed a reregistration eligibility review for TFM and Niclosamide (*Reregistration Eligibility Decisions* (REDs), 1999). The EPA reviewed the most current data on the potential human health and environmental risks of the current product uses. The RED cites several recent studies that support earlier work referenced in the 1990 FEIS. These studies have been incorporated into the FSEIS.

Comment 14: Trapping adult lamprey in tributaries might be a useful tool to monitor sea lamprey abundance, sex ratios and lamprey size. (P. Neth)

Response 14: For years the Cooperative has engaged in trapping spawning-phase sea lamprey to monitor abundance, sex ratios and size at selected index sites (one permanent trapping station and several portable assessment trapping sites); that effort will continue. Trapping results are presented in the eight year experimental control evaluation report (Fisheries Technical Committee 1999). As new barriers are established, permanent trapping stations will be incorporated into barrier designs when feasible. New sites and more efficient traps will allow the Cooperative to expand our trapping operations and improve spawning-phase sea lamprey data collection efforts.

Deficiencies

Comment 15: The SEIS fails to commit to a regular re-evaluation provision/public process for changes. (EPA, VPIRG)

Response 15: A standard part of the Federal Aid in Sport Fish Restoration grant renewal process provides for project re-evaluation every five years, including NEPA review. In addition, approximately every five years, the Cooperative will hold public briefings to discuss sea lamprey control progress and receive public comment. Section V. of the SEIS has been modified to reflect this change. Also, an important aspect of this complex multi-jurisdictional program as discussed in Section II. D., is the requirement for multiple state agency permits prior to any lampricide application. These state agency permits are time-limited and thus periodic permit renewal will be required. This is especially true of the permits required for lampricide applications. Built into the permit application and renewal processes within each state agency are established public input procedures. Other permits (barrier dam construction permits for example) may not need periodic renewal but will incorporate public input processes into their permit application procedures.

Comment 16: The alternatives analysis is inadequate in that it completely rejects the use of barriers and trapping without any meaningful analysis. No consideration is given to any alternatives which do not include chemicals. (VNRC, J. Calvi, CLF, NAS, W. Elton, VPIRG)

Response 16: All reasonable alternatives for sea lamprey control currently found to be effective have been analyzed in the SEIS. As defined by the Council on Environmental Quality, a reasonable alternative must be practicable and feasible from a technical and economic standpoint. Both barriers and trapping are considered reasonable alternative methods for sea lamprey control. Through the screening process both barriers and trapping have been proposed for implementation in the SEIS.

Comment 17: The analysis is not balanced. This is illustrated by the fact that as the Proposed Action receives 115 pages on environmental consequences and the other alternatives only receive a few pages. (CLF, VPIRG)

Response 17: The SEIS provides a well balanced comparative analysis between the three reasonable alternatives presented in the document. The comparative analysis and examination of environmental consequences associated with the three alternatives is presented in Section V and VII of the document. All relevant impacts associated with their implementation have been discussed.

Using the amount of pages provided in the SEIS to determine whether the analysis is sufficient is an inaccurate indicator of the level of analysis, given that many of the impacts are cross referenced between alternatives to cut down on redundancies. In fact, the 115 pages referenced by the comment are referenced again in site-specific analysis of each tributary proposed for treatment in Section VIII of the document. The impacts discussed for each stream's treatment have been previously analyzed in the environmental consequences section of the document.

Comment 18: The SEIS fails to provide an adequate analysis of mitigation measures. (CLF)

Response 18: Mitigation measures are an intricate component of the SEIS analysis and in accordance with 40 C.F.R. 1502.14(f) have been developed wherever feasible through the screening process. Under the Proposed Action, mitigation measures have been designed specific to each tributary proposed for treatment. The mitigation actions focus on reducing nontarget mortality, impacts to threatened and endangered species and reducing human exposure. The actual mitigation actions proposed for implementation range from precluding some tributaries from overall lampricide treatment to designing barriers that minimize flood risks.

Comment 19: The cumulative impact analysis is inadequate. (VPIRG, CLF, TNC)

Response 19: The Cooperative has revised the cumulative effects analysis and included additional information on the cumulative impacts associated with the proposed sea lamprey control program (Section VII.D.). Although many of the activities identified in the cumulative impact analysis have little relevance or connection to the effects of sea lamprey control, the Cooperative has included them in accordance with 40 C.F.R.1508.7.

Comment 20: No wetland impact analysis is provided for new streams proposed for treatment. (EPA)

Response 20: The DSEIS stated that wetland assessments will follow the methodology of Greundling and Bogucki (1986), and will be conducted on each new stream proposed for lampricide treatment prior to obtaining state lampricide treatment permits. This discussion can be found in the FSEIS (Section VII.A.2.c.).

Comment 21: There is inadequate explanation of technical difficulties implementing non-chemical control. (CLF)

Response 21: The FSEIS discusses non-chemical methods of sea lamprey control within its screening process for all streams. All available control options are reviewed for technical feasibility, nontarget and habitat concerns, and human impacts (see Section V.A). Feasible alternatives to lampricides have been investigated for all tributaries proposed for sea lamprey control. The proposed program will continue to investigate new methods of lamprey control and employ them when and where applicable in the future (see Section IV.B).

Technical difficulties associated with the implementation of alternative control have been summarized in section VIII for each individual stream. The FSEIS has expanded these discussions to allow the reader a better understanding of these difficulties. Barriers were investigated in a *Preliminary feasibility study for sea lamprey barrier dams on Lake Champlain tributary streams* (Anderson, B.E. et al. 1985). Fifteen streams were investigated for the applicability of a lamprey barrier dam (see Section IV.A.4). More definitive studies on barrier dams were subsequently completed for Lewis Creek and Stone Bridge Brook. Ongoing trapping efforts have suggested that sea lamprey control on some of the smaller streams may be accomplished by trapping. Most recently, several control options on the Poultney and Hubbardton Rivers have been explored for applicability including barriers, trapping, sterile male releases, and pheromones. These methods were analyzed in *Sea Lamprey Control Alternatives in the Lake Champlain Tributaries: Poultney, Hubbardton and Pike Rivers and Morpion Stream* (Walrath and Swiney 2001) and summarized in the Section VIII.

Comment 22: There is insufficient analysis of effects of TFM on mussels and inadequate data on effects of lampricides on various species. Toxicity data on several threatened, endangered, and species of special concern (mussels, amphibians and fish) is inadequate or completely lacking. This includes studies on different life stages or year-classes, mussel host fish species and long-term effects. (CLF, EPA, TNC, AV, M. Peden, J. Leonard, VNRC, VINS, W. Elton)

Response 22: Toxicity tests have been conducted on five mussel species found in the Lake Champlain Basin (see Section VII.A.1.f). Some of these will be tested again while additional toxicity testing will be conducted on certain previously untested mussels species (See Section VII.A.2.f). Existing toxicity data combined with the field monitoring data indicating that these species persisted through the 8-year experimental program, demonstrates these populations have not been severely impacted by TFM lampricide treatment.

With regard to the effect of TFM lampricide on various species' life stages, the Cooperative carries out lamprey control using the best available information. Presently, little data are available on the effect of lampricides on juveniles of many species. The feasibility of assessing effects of TFM on early life stages of Vermont-listed mussels may be investigated in the future.

Mortality to some amphibian species will occur during lampricide treatments (See Section VII.1.h). The Cooperative intends to conduct further investigations on impacts to amphibians including various life stages.

Comment 23: There is no analysis of chronic long-term effects of TFM or niclosamide on benthic communities and habitats. (CLF)

Response 23: The SEIS discusses several long-term studies of impacts of lampricide treatments

(See Section VII.A.1.f). Long-term studies to assess the impacts on invertebrate and fish populations indicate that lampricide induced impacts are negligible.

Comment 24: Discuss effectiveness of fish passage at barrier dams. The SEIS fails to recognize the serious adverse effects of proposed barrier dams. (EPA, VNRC)

Response 24: A sea lamprey barrier dam is generally a low-head overflow weir intended to take advantage of the fact that sea lamprey do not leap vertical barriers. A minimum vertical drop of 18 inches is recommended to prevent sea lamprey movement over the dam. The effectiveness of fish passage at sea lamprey barrier dams depends on several variables. These included fish species requiring passage, timing of the spawning-phase sea lamprey migration, stream flow and lake level. Leaping species such as salmon or steelhead/rainbow trout can be accommodated with jump pools and are not as affected by barriers as non-leaping species such as walleye, smallmouth bass or suckers. Non-leaping fish require other means of passage in the form of a fish ladder or trapping and transfer system. While fish passage for non-leaping species has been employed with limited success in many circumstances, moving fish past barriers in conjunction with sea lamprey blockage can be more difficult. A passage system must incorporate a trapping component to capture the sea lamprey while passing other species. Trapping is labor intensive, may be stressful to other species being sorted and released, may impede the natural movement of other species and is adversely affected by high stream flows. Sea lamprey migration typically begins during periods of high river flows and continues as water levels vary to low summer levels. This necessitates that barriers have some means of crest adjustment to allow for changing stream levels or that the barrier be built to operate at the maximum anticipated flows. Trapping activity could impact the spawning migrations of some species and affect subsequent natural reproduction.

The FSEIS does propose the use of barriers on some smaller streams. However, prior to their construction, appropriate studies will be conducted to more completely assess the feasibility of such barriers including nontarget species impacts analyses. Finally, the construction of barriers will require review and issuance of appropriate local, state and federal permits (see Section II.D).

Comment 25: The SEIS does not acknowledge that habitat for a wide variety of species and natural communities is a valid use of Lake Champlain tributaries (i.e. the Poultney River) with a user constituency. This point is not addressed in user conflict section. (AV, J. Calvi)

Response 25: Some user groups may believe the Proposed Action will conflict with their use of the resource. The FSEIS User Conflicts section has been modified to better address user group concerns (See Section VII.A.1.l).

Threatened and Endangered Species

Comment 26: Don’t treat tributaries with threatened and endangered species / don’t treat Poultney and Missisqoui Rivers because of threatened and endangered species. (LCC, AV)

Response 26: The FSEIS addresses state-listed threatened and endangered species (T&E spp) with various mitigation strategies. Sea lamprey control activities consider the potential impacts to T&E spp and mitigation is proposed to safeguard them. These mitigation strategies are addressed for all T&E spp in section VII (Environmental Consequences), and within the screening of each proposed sea lamprey control location (Section VIII)**,** of the FSEIS. Regulatory requirements as indicated in permits (to be obtained prior to regulated sea lamprey control activities), will incorporate the safeguards and conditions under which sea lamprey control activities can occur. The Cooperative will comply with all state and local laws and regulations.

Comment 27: Analysis of impacts on state-listed species needs elaboration. There is inadequate analysis of effectiveness of/or description of mitigation. (EPA, CLF, VPIRG)

Response 27: The FSEIS discusses the relative sensitivity of listed species to the lampricides proposed, in section VII.A.1.. Impacts to nontargets as the result of treatments during the experimental control program are described in *A Comprehensive Evaluation of an Eight Year Program of Sea Lamprey Control in Lake Champlain* (Fisheries Technical Committee 1999) and were determined to be acceptable. Potential impacts to listed species by control methods in the Proposed Action are discussed on a stream-by-stream basis in Section VIII. The Cooperative has designed stream-specific control strategies that will avoid or minimize impacts to threatened and endangered species. If threatened and endangered species are determined to be at risk, mitigation measures will be developed prior to sea lamprey control within the context of the state permitting processes.

Comment 28: Is there a chance for severe interspecific competition between any of the threatened and endangered mussels and zebra mussels? Reduction in populations of threatened and endangered mussels as a result of zebra mussel expansion and domination, should not be blamed on the sea lamprey control program. (P. Neth)

Response 28: There will undoubtedly be severe impacts with threatened and endangered mussel species as the direct result of zebra mussel infestation. Sea lamprey stream lampricide applications will occur using “No Observable Effect” lampricide concentrations or acceptable mitigation will be employed when threatened and endangered species exist in areas to be treated.

The impacts to mussel populations associated with Bayluscide treatments is discussed in Section VII, (Environmental Consequences). Section VII. D, (Cumulative Impacts), has been modified to recognize the potential cumulative impacts of additional stress to mussels occuring in the limited areas receiving Bayluscide applications.

Compliance with Federal/State Law

***Comment 29*:** The Cooperative should ensure that state lampricide registrations/applicator certifications are current. (EPA)

Response 29**:** Vermont is currently updating their lampricide registrations and the process will be completed prior to the release of a record of decision regarding the SEIS. New York's pesticide registrations are current and up to date. All personnel handling pesticides will be state certified in the appropriate pesticide application category or under the supervision of a certified applicator according to state regulations.

Comment 30**:** The US Fish and Wildlife Service has responsibilities for Sec. 106 (Historic Pres) in barrier construction. (EPA)

Response 30**:** The Cooperative will adhere to all federal, state and local statutes and regulations.

Comment 31**:** The SEIS fails to identify specific sea lamprey control actions and thus must be considered a programmatic SEIS. Additional site specific NEPA analysis will be required before sea lamprey control methods can be applied. (CLF)

Response 31: The SEIS develops a distinct program to control sea lamprey in Lake Champlain. The Proposed Action and alternatives analysis in the SEIS examines a range of specific actions which are currently considered acceptable sea lamprey control techniques. Methods currently deemed acceptable include barriers, trapping and chemical control with TFM and Bayluscide.

The FSEIS includes a specific control strategy for each Lake Champlain tributary system known to be infested with sea lamprey. The specific control strategies found in section VIII of the document, were developed by applying the screening process identified under the Proposed Action. Through the screening process, a specific sea lamprey control strategy is developed after considering the estimated sea lamprey transformation, nontarget mortality, human impacts, technical concerns and cost associated with treating each tributary. The dynamic factors unique to each tributary system require that a flexible approach be utilized to develop tributary specific control strategies.

Additional NEPA analysis will be conducted when new control technologies become available or environmental impacts are identified which were not adequately considered in the SEIS.

Comment 32: The SEIS must discuss any inconsistencies of the Proposed Action with any approved state and local laws 40 C.F.R. 1506.2(d). (CLF)

Response 32: The Proposed Action is not inconsistent with state and local laws. As completed for the 1990 experimental program, all proposed sea lamprey treatments will comply with applicable state and local laws and regulations prior to implementation. Where pertinent the FSEIS analysis may be used to support state and local permit applications.

Comment 33: Discharges of lampricides into waterways discussed under the Proposed Action may require authorization by a National Pollution Discharge Elimination System (NPDES) permit under section 402 of the Clean Water Act. (EPA)

Response 33: The Cooperative thanks EPA for informing us of the section 402 permit issue. The proposed sea lamprey program will comply with all applicable federal statutes in carrying out the proposed sea lamprey control program. The New York State Department of Environmental Conservation has determined that application of pesticides to kill lamprey does not require a State Pollution Discharge Elimination System (SPDES) permit. The Department of Environmental Conservation held that lampricides are not "chemical wastes" under Section 17-0105(17), defining "pollutant." [DEC Declaratory Ruling 24-07 (Richard Booth)(1983)].

Comment 34: Revisions to the Mitigating Measures - Human Exposure section are recommended, regarding the procedure for lifting of water use restrictions; inclusion of water uses that are restricted; and clarification of the 4-day agriculture water use restriction for granular Bayluscide application. The VT and NY Prior Notification and Water Supply Plans should be revised where appropriate to provide consistency; 14 specific changes were recommended for the VT plan. (VTDOH)

Response 34: Text in the Mitigating Measures - Human Exposure section (DSEIS pages 174-175) has been clarified to address specific VTDOH comments. The *Vermont Prior Notification, Posting and Water Supply Plan for Lampricide Applications* has been revised (Chipman 2001), incorporating recommendations by VTDOH. This plan is cited appropriately in the FSEIS.

Comment 35: Consult with the Vt. Pesticide Advisory Council for consistency with Vt. House Bill 851/Act 141 (6 VSA Sec. 1102) - pesticide reduction. (EPA, LCC, NAS, W. Elton)

Response 35: 6 VSA Section 1102, as amended by Act 141 on July 1, 2000, defines the structure and functions of the Vermont Pesticide Advisory Council (VPAC). The major function in this statute referred to by reviewers is for VPAC "to recommend benchmarks with respect to the state goal of achieving an overall reduction in the use of pesticides consistent with sound pest or vegetative management practices...". The proposed program and the DSEIS was discussed with VPAC on June 18, 2001. VPAC has not submitted any comments specifically on the DSEIS, or recommended pesticide reduction benchmarks, but did urge the Cooperative to minimize use of chemical lampricides wherever possible (Doug Burnhan, VPAC Chair, VTDEC, Waterbury, Vermont, personal communication). The integrated pest management approach inherent in the Proposed Action provides the framework to achieve the goal of pesticide minimization in 6 VSA Section 1102.

Comment 36: The Proposed Action is not consistent with the Vermont Agency of Natural Resources mission (J. Calvi), or the VTDFW mission (CCC).

Response 36: Sea lamprey management is a tool to protect and enhance the Lake Champlain ecosystem and provide public benefits through the restoration of native fish populations. Decreasing the deleterious impacts of sea lamprey, a non-native invasive species, is critical to the natural resource conservation management effort to restore the form, structure and process of the Lake Champlain ecosystem. Implementation of the integrated pest management approach inherent in the stream-specific screening process in the Proposed Action will balance the needs to maximize the reduction in sea lamprey abundance with minimization of adverse effects on the nontarget environment. Continuing research to develop improved control methods should provide further protection of natural stream systems while maintaining and enhancing the integrity of the Lake Champlain ecosystem. This approach is consistent with the missions of the Vermont Agency of Natural Resources and VTDFW.

Comment 37: The SEIS fails to address how the Proposed Action will comply with state laws (CLF)

Response 37: Implementation of any proposed sea lamprey control actions will commence only after achieving compliance with applicable state laws and regulations. All state regulatory requirements for sea lamprey control in the Lake Champlain Basin are listed in Section II.D. In addition, the ramifications of Vermont's Outstanding Resource Water designation of the Poultney River are discussed in Section VIII.11. Each applicable sea lamprey control proposal must be reviewed and approved under the appropriate state regulatory processes before the action can be implemented. The SEIS cannot specifically address compliance; it is the statutory authority of the appropriate state regulatory body to make determinations of compliance with state laws based upon information provided by the applicant.

Comment 38: The construction of barriers is inconsistent with Vermont Water Quality Standards. (VNRC)

Response 38: As noted in Section II.D.2., water quality certification, under Section 401 of the Clean Water Act, must be issued to authorize construction of any sea lamprey barrier. In Vermont, Section 401 Water Quality Certification applications are reviewed to determine if the activity will comply with the Vermont Water Quality Standards adopted by the Vermont Water Resources Board and any other requirements of state law.

<u>Cost/Benefit</u>

Comment 39: The benefit-cost analysis doesn't account for costs of nontarget mortality from lampricide applications. (W. Barnard, CLF, EPA, TNC)

Response 39: Estimation of the economic costs related to losses of nontarget organisms from lampricide applications requires measurement of existence values for these organisms. An existence value is the value of the public's knowledge of the existence of a resource, apart from any direct or indirect use of it (Talhelm 1987). The benefit-cost analysis did not include estimation of existence values for nontarget organisms or other derivation of costs associated with nontarget mortality; however, existence values for salmonids and other Lake Champlain fishes which would benefit from sea lamprey control were not directly determined either.

Existence values are likely to reasonably reflect public attitudes towards the existence of the resources in question (Talhelm 1987). The high value placed on continuation of sea lamprey control in Lake Champlain by anglers and non-anglers alike (see responses to Comments 41 and 43) is indicative of public attitudes and the widespread level of public support for the program. Gilbert (1998) surveyed heads-of-households within a 35-mile radius of Lake Champlain and found that 80.6 percent of the economic value of sea lamprey control was related to non-use values, of which, existence values are a component. It can be inferred from these findings that positive non-use values associated with sea lamprey control far exceed any negative values (costs) of nontarget mortalities incurred.

Comment 40: The benefit-cost analysis fails to account for costs associated with water quality degradation from increased fishery development, e.g., pollution from 2-stroke boat engines and fish propagation. (VPIRG)

Response 40: Costs associated with these pollution sources, as they relate to sea lamprey control, are expected to be negligible. Increased use of cleaner-burning 4-stroke and direct fuel-injection 2-stroke boat motors may offset any marginal increases in fuel emissions from projected increases in boating activity. Improved survival of stocked salmonids and resulting increases in natural reproduction enabled by sea lamprey control should lead to decreased needs for stocking; less fish produced for stocking will equate to lower levels of hatchery waste produced.

Comment 41: The SEIS should estimate the value of lamprey control to non-anglers. (EPA)

Response 41: The economic value of sea lamprey control to non-fishing users was not directly estimated in the economic studies for the experimental program. However, a comparison of results from surveys of Lake Champlain anglers (Gilbert 1999b) and heads-of-households within a 35-mile radius of Lake Champlain (Gilbert 1998) suggests that the annual value of sea lamprey reduction to the non-fishing public is approximately $2.0 million. Text expanding on this has been added to the economic impacts discussion (Section V.F.3.).

Comment 42: The SEIS should include the rationale for the statement that increased recreational boating and swimming would occur as a result of sea lamprey control. (EPA)

Response 42: Increases in boating, swimming and other non-fishing water-based recreation in Lake Champlain attributable to the experimental program, and expected increases if sea lamprey control were to continue, were directly estimated from a survey of heads-of-households within a 35-mile radius of Lake Champlain (Gilbert 1998). This is discussed in Section VII.A.6.c. (ancillary growth). Widespread complaints about sea lamprey attaching to swimmers, divers, boats, sailboards and other recreational items have been received, especially before the effects of the experimental program were realized. These incidents have undoubtedly influenced water-based recreation participation for many people.

Comment 43: Sea lamprey control benefits accrue to only a tiny segment of the population.

(VPIRG)

Response 43: Benefits from continued sea lamprey control are expected to accrue to members of an estimated 150,567 New York and Vermont households within a 35-mile radius of Lake Champlain; 96,591 (64%) of these households participate in fishing in Lake Champlain (Gilbert 1998). Substantial benefits are expected to occur for businesses not traditionally associated with the fishing industry (ie. automotive fuel, lodging, retail sales, food, entertainment, transportation).

<u>Monitoring and Assessment</u>

Comment 44: The SEIS should combine data on transformer production for streams and deltas to provide a clearer picture of the relative importance of streams to the sea lamprey control program. (P. Neth)

Response 44: Until recently the Cooperative has not been able to derive reliable estimates of larval sea lamprey or transformer production on deltas. With the development of the deepwater electrofisher we now have a technique employable to that task. With development of a new sampling strategy, a concerted sampling effort, and adaptation of the gear to suit the Lake Champlain setting, the Cooperative is gaining the ability to provide larval sea lamprey estimates on deltas. In time, the resulting data may be further defined to provide meaningful transformer production data that can be combined with Quantitative Assessment Survey data to provide stream system estimates that includes delta sea lamprey transformer production.

Comment 45: Nontarget mortalities should be documented on a stream-by-stream basis. (S. Knight)

Response 45: We will continue to monitor nontarget species impacts in accordance with conditions in permits as required by the regulatory agencies involved, or through the standard methods as described in Section IV. A.1. These will be compiled on a stream-by-stream basis.

Comment 46: Streams not previously treated with lampricides should be test sites for non-chemical control. (S. Knight)

Response 46: The Cooperative describes its control strategy selection process in Section V.A. Any stream, whether previously treated or not, will undergo this same control strategy selection process. As new non-chemical means become available as viable control techniques, they too will be included in the array of possible control strategies.

Comment 47: Lamprey monitoring is insufficiently prioritized. (LCWA)

Response 47: Larval sea lamprey assessment protocols as described in the Standard Operating Procedures for the chemical control of sea lamprey used by the Great Lakes Fishery Commission are proposed for use in Lake Champlain sea lamprey ammocoete monitoring.

Comment 48: Population sustainability of mudpuppies should be demonstrated through studies starting at least 3 years prior to treatment. (RASAG)

Response 48: Section VII.A1.h. discusses expected effects of lamprey control on amphibians. The preponderance of evidence in the Champlain Basin and Great Lakes indicates that while some limited mudpuppy mortality does occur, populations are not at risk. However, special efforts will be made in Vermont to monitor the effects of proposed TFM treatments on the Lewis Creek mudpuppy population.

Comment 49: The SEIS fails to commit to a monitoring program for mitigation which is mandatory under NEPA. (CLF)

Response 49: As stated throughout the document, monitoring and post treatment assessment are important requirements of the proposed sea lamprey treatment program. All lampricide applications include detailed monitoring procedures that follow those established by the Great Lakes Fishery Commission. Monitoring during lampricide treatments is required to ensure that lampricide concentrations remain within their effective ranges, while also being restrictive to minimize impacts to nontarget species.

Monitoring and post treatment assessments are also relied upon to measure nontarget mortality and validate whether the Cooperative is attaining the wounding rate objectives established for the Proposed Action.

Comment 50: The SEIS provides little information to clearly explain the current status and likely future conditions of the sea lamprey population in the lake, its tributaries and deltas. (EPA, VTDEC, APA)

Response 50: Sea lamprey populations in Lake Champlain tributaries have been monitored by the US Fish and Wildlife Service since the 1970's. Gersmehl and Baren (1985) provide a detailed assessment of the biology and distribution of sea lamprey in Lake Champlain and an assessment of lamprey predation on several sea lamprey prey fish species. Additional information on sea lamprey impacts is presented in *A comprehensive evaluation of an eight year program of sea lamprey control in Lake Champlain* (Fisheries Technical Committee 1999). The FSEIS further describes sea lamprey population distribution on a stream specific basis in Section VIII.

Comment 51: No basis for wounding rates or wounding rate objectives is provided in the SEIS. (EPA, TNC)

Response 51: The text of the SEIS in Section I.A. has been modified to provide a more complete explanation of the rational behind the development of the adopted wounding rate objectives.

Comment 52: Toxicity studies referred to in the SEIS were conducted with small sample sizes and duplicate testing is needed to determine accurate impacts to nontargets. (AV)

Response 52: All toxicity studies were conducted in accordance with appropriate testing protocols as established in *Standard Operating Procedures* (Klar and Schleen 1999). These tests were developed to be consistent with acceptable toxicity testing practices used throughout the scientific community. Two Great Lakes Basin studies where TFM toxicity was assessed using caged organisms in treated streams (Schuldt et al. 1996; Weisser et al. 1994) were discussed in Section VII.A.1. There were small sample sizes of some of the organisms in these cage tests, and thse facts wer noted in Section VII.A.1. as limitations of the applicable results.

Comment 53: The 2000 Quantitative Assessment Sampling (QAS) estimate is not meaningful or statistically significant when only 3 transformers were collected. It is not known whether sea lamprey travel from the Poultney River system to the Main Lake and beyond. The SEIS does not make clear the contribution of Poultney River sea lamprey to the lakewide sea lamprey population. There is no information regarding the contribution of Poultney River sea lamprey to the lakewide wounding rates for salmonids. (AV)

Response 53: The QAS protocol provides a statistically reliable estimate of larval sea lamprey densities that, when combined with measures of habitat, is used to estimate larval abundance. Assessment of larval sea lamprey in Lake Champlain is a dynamic process that will continue to grow as does our knowledge and understanding of sea lamprey population dynamics. Improvements in our current methodology are dependent on periodic review of current techniques, identification of areas that need improvement, and supportive research (Slade et. al. in review).

The life history of sea lamprey (FSEIS Section I.B.) has been updated to include information supporting the Cooperative's interpretation that sea lamprey from the Poultney River likely impact the Main Lake fishery.

A research project on survival and population size estimates of sea lamprey transformers and movements of adult sea lamprey in Lake Champlain and its tributaries will begin in the fall of 2001. Initial work will focus on tagging sea lamprey in four tributaries including the Poultney River, in an effort to compare production estimates from mark-recapture and QAS methodologies. Additional objectives of the project include: 1) estimate survivorship from individual streams to the parasitic phase; 2) estimate the distribution and movement rates of parasitic phase sea lamprey relative to their stream of origin; and 3) determine if sea lamprey transformer size or age influences the likelihood of survivorship to spawning.

Comment 54: Delta sea lamprey population status - No data on delta sea lamprey populations is available. (LCWA)

Response 54: The Cooperative recognizes that some deltas may contribute substantial numbers of sea lamprey to the Lake's parasitic population. As indicated in Section V.A. of the FSEIS, delta assessments will be conducted using deepwater electrofishing techniques or lampricide plot surveys. Sea lamprey densities will be identified and mapped prior to delta sea lamprey control activities.

Comment 55: The Cooperative uses poor experimental design in evaluating nontarget effects. (CLF)

Response 55: The Cooperative uses accepted, standardized testing procedures for toxicity testing developed by the Great Lakes sea lamprey program as indicated in the *Standard Operating Procedures* (SOP) (Klar and Schleen 1999). The Cooperative is obligated by the EPA to adhere to the lampricide usage guidelines as indicated in the SOP. These tests were developed to be consistent with acceptable toxicity testing practices used throughout the scientific community. Flow-through toxicity testing will be conducted to determine appropriate lampricide concentration levels prior to TFM treatments of tributaries containing threatened, endangered and other species indicated by permit or otherwise necessary to test to determine treatment concentrations.

Nontarget assessment will follow SOP guidelines and other procedures as indicated in permits.

General Program Comments

Comment 56**:** Use a sub-basin approach omitting the South Lake Basin from sea lamprey control and managing the South Lake Basin as a warm-water fishery. (TNC)

Response 56**:** The FSEIS discussion of sea lamprey life history has been expanded to include more detail regarding parasitic-phase sea lamprey habitats and migrations (see Section I.B). Since the South Lake Basin of Lake Champlain is shallow and river-like, sea lamprey transformers likely outmigrate with the currents toward the deeper waters of the Main Lake region. Sea lamprey are known to travel long distances. In addition, passive transport likely occurs to the Main Lake where they feed on a variety of hosts (lake whitefish, cisco, white and redhorse sucker, yellow perch, burbot, channel catfish, northern pike, bass, carp, bowfin, sturgeon and walleye to name a few), but most notably trout and salmon. Further, there is evidence to support the inter-basin migrations of sea lamprey in the Great Lakes and in Lake Champlain. Dye marked transformers marked and released in one Lake Champlain sub-basin have been recaptured in another sub-basin. Further studies are planned that will provide more parasitic-phase sea lamprey information using tag/recapture methodology (See Response 53).

The sub-basin approach is discussed in the FSEIS (Section V.D.3.).

Comment 57**:** All tributaries should be treated with lampricides at least once every two years, more if necessary. Every Delta should be treated yearly. (ECF&G, others)

Response 57**:** The sea lamprey control cycle of lampricide application described in the SEIS are based on knowledge of vulnerable life-stages and rates of sea lamprey metamorphosis from larval to parasitic-phase adults. Treatment cycles are designed to maximize effectiveness and minimize unnecessary use of lampricides and associated unintended impacts. Non-chemical alternatives were proposed where they provided the best control option or where lampricide applications were inappropriate due to environmental, biological or cultural considerations.

Comment 58: There may be a higher risk of nontarget mortality associated with concurrent stream/delta lampricide treatments. (P. Neth)

Response 58: Page and location information provided with the comment does not pertain to the item referred to by the reviewer. We surmise that the reader may have misinterpreted the text. Combination treatment of TFM and niclosamide (wettable powder) occurs through simultaneous chemical application and is appropriate for stream treatments only. Bayluscide, an encapsulated granular formulation of niclosamide designed to sink to estuarine or lentic substrates, is used for delta treatments. Delta bayluscide applications would not occur concurrently with stream TFM or TFM/niclosamide treatments.

Comment 59**:** Barriers should be developed for all 20 stream systems; sea lamprey control should be a permanent ongoing eradication program; objectives should be no more than 1 wound per 100 trout or salmon. (ECF&G, others)

Response 59**:** It would be environmentally damaging to establish barriers on all sea lamprey-producing tributaries. Barriers have been proposed where the environmental, biological and cultural setting allows effective sea lamprey control without unacceptable risk to man or environment.

The reasoning behind the sea lamprey control program objectives is described in Section I (Purpose). The objectives established are thought reachable with full implementation of the Proposed Action given the setting and amount of sea lamprey habitat present. Wounding rates of 1 wound per 100 trout or salmon may be unattainable even if the program were to go far beyond what has been proposed in the preferred alternative. Sea lamprey eradication is currently unattainable.

Comment 60**:** Fishing sea lamprey may be useful to augment control. (EPA)

Response 60: This methodology was scrutinized in the 1990 FEIS and in the current FSEIS in sections detailing “Unacceptable Techniques.” As a control method, the Cooperative views parasitic-phase sea lamprey fishing as ineffective. For years, fisherman, fisheries managers and researchers who have encountered adult lamprey attached to fish or objects, have destroyed the animals or collected them for study. This process will undoubtedly continue and may be enhanced to some degree to support a planned, parasitic sea lamprey adult trap/mark/recapture research project. These efforts do not result in substantive sea lamprey population reductions.

Comment 61: The lamprey-salmon problem is a classic predator prey relationship where lamprey are simply responding to an increased number of salmon, a preferred prey species. (W. Barnard, VINS)

Response 61: Section V.D.5 of the FSEIS addresses this comment. In the absence of salmonids sea lamprey predation would be redirected to other species.

Comment 62: Conducting lampricide treatments to protect an unsustainable, inedible fishery (a few relatively common sport fishes) is a non-essential use of pesticides. The fishery is artificial. (VIPRG, NAS, LCC)

Response 62: Providing a recreational fishery is a component of the program's goal. Consumption advisories have been issued for certain fish or fish sizes associated with those recreational fisheries. This does not indicate that Lake Champlain fish are inedible. Program benefits, however, go beyond the angling experience. Landlocked Atlantic salmon and lake trout were native to Lake Champlain, but habitat degradation, pollution and over-fishing eliminated them from Lake Champlain ecosystem (see Section I of the FSEIS). The restoration of native fish populations is an important goal of the Cooperative. While it is doubtful that a recreational salmonid fishery could be completely sustained by natural reproduction, the restoration of naturally reproducing lake trout and salmon populations is attainable. The successful restoration of lake trout and salmon in the Lake Champlain Basin is an indication of the Cooperative's commitment to maintaining a healthy ecosystem. Without salmonid stocking and continuation of the sea lamprey control program, salmon and trout populations would decline.

Comment 63: Long-term repetitive lampricide treatments are not consistent with the ecosystem approach [states and federal government]. (TNC)

Response 63: The Cooperative disagrees with this assertion. Salmonid population restoration and invasive species management are integral to the maintenance and health of the Lake Champlain ecosystem. An important, but often overlooked, aspect of the Cooperative's proposed sea lamprey control program is that it involves ecosystem restoration; one of the Cooperative's goals is to reestablish viable populations of lake trout and landlocked Atlantic salmon, two species once native to Lake Champlain. Clearly, the benefits of this laudable goal should receive consideration, especially in light of the lack of substantial negative impacts from TFM treatments on stream and lake ecosystems. See Response 36 for further discussion.

Comment 64: A severe lamprey reduction could trigger a prey/predator imbalance. (TNC)

Response 64: Reductions in sea lamprey abundance will increase salmonid survival resulting in greater pressures on the lake's forage base (see Section VII.D). The Cooperative monitors the primary forage for salmonids and walleye (rainbow smelt) in Lake Champlain and will continue to do so as a component of the Lake Champlain fishery management program. Appropriate management actions will be taken to maintain the stability of the Lake Champlain smelt population.

Comment 65: Lampricide toxicity is higher in Lake Champlain than in the Great Lakes based on higher nontarget effects. (TNC)

Response 65: Higher nontarget effects (i.e. greater numbers of nontarget mortalities) are not an indicator of increased toxicity relative to the Great Lakes. Differences in species present, population densities, monitoring effort, and other factors, all affect the numbers of nontarget mortalities observed. Toxicity testing is the valid method to assess lampricide toxicity. Toxicity tests have been conducted on numerous tributaries and for numerous taxa in the Champlain system. Lake Champlain toxicity data is supplemented with Great Lakes toxicity data collected using known water chemistry parameters. Resulting information is comparable and appropriate to use in the determination of lampricide treatment concentrations.

Comment 66: Sea lamprey are/may be native and therefore should not be treated as an exotic species. (M. Peden, VNRC, VINS)

Response 66: It is the Cooperative's opinion that the sea lamprey in Lake Champlain are non-native invaders. Historical accounts prior to the establishment of canal systems regarding native Lake Champlain salmonids, bear no mention of sea lamprey or sea lamprey wounding. Regardless of endemicity, it has been established that sea lamprey are a major impediment to the fishery management efforts of the Cooperative, including re-establishing species clearly documented to be native. Sea lamprey induced wounding and mortality is excessive and incompatible with those restoration efforts. Sea lamprey will not be eliminated, but re-establishing the known natives will become feasible.

***Comment 67*:** Agencies should reduce other contaminants (PCB's, Mercury) (LCC, J. Bond).

Response 67: This comment is beyond the scope of the FSEIS. The agencies of the Lake Champlain Fish and Wildlife Management Cooperative are exerting efforts to reduce contaminants. Agencies are constrained by funding and staffing limitations that preclude greater effort towards reduction of contaminants such as PCB's and mercury in Lake Champlain.

Comment 68: Sublethal or time-delay effects from stream lampricide treatments are not accounted for; concern is expressed for the temporary loss of invertebrate forage for eastern sand darter and channel darter, and potential predation on narcotized mussels. (AV)

Response 68: It is possible that declines in abundance of the relatively few macroinvertebrate taxa known to be sensitive to stream lampricide treatments (see Section VII.A.1.f.), could result in temporary shortages of preferred prey for some stream fishes. Most insectivorous fish are generalists, however, and can temporarily shift to other prey species during periods when preferred prey may be scarce; for example - after emergence of adult forms, or due to natural variation in the taxon's abundance. The state-listed threatened eastern sand darter feeds primarily on midge (Chironomidae) larvae and microcrustaceans, while the state-listed endangered channel darter also feeds on midge larvae, as well as mayfly and caddisfly larvae (Smith, C. L. 1985). Chironomids and crustaceans are resistant to TFM at stream treatment levels (Gilderhus and Johnson 1980), as are most mayflies and caddisflies; therefore, it is unlikely that eastern sand darters or channel darters would face temporary food shortages due to lampricide treatment.

Sublethal effects of stream lampricide treatments on mussels include narcosis, as noted in Section VII.A.1.f. However observations of narcotized or dead mussels during or following Lake Champlain stream treatments have been quite rare. Neuderfer (2001) noted that most pocketbook mussels exhibiting signs of narcosis after 12-hour toxicity test exposures to TFM remained buried in the test container substrate. This suggests that if some of these mussels become temporarily narcotized during treatments, most will remain buried and be less susceptible to predation before recovery. It is also apparent that in the various toxicity studies discussed in Section VII.A.1.f., nearly all mussels which survived test exposures but experienced narcosis recovered within 36 hour post-exposure; therefore, the period of potential susceptibility where those which are narcotized and are not buried, is relatively short.

<u>Stream Specific Comments</u>

Comment 69: Unless spawning can be stopped on the Salmon River, NY, delta treatments cannot be avoided. (P. Neth)

Response 69: The importance of continued lampricide applications in the absence of barrier establishment on the Salmon River, NY is recognized and is incorporated in the discussions of lampricides in the screening process (Section VIII.A.3).

Comment 70: Given the nontarget mollusc concerns on the Poultney River, be very cautious about the TFM/niclosamide formulation unless you have good bioassy data to support safe treatment. (P. Neth) Under no circumstances should the combination of TFM/niclosamide be used in the Poultney River. The Poultney River is a clay-based River and is frequently turbid making it an unlikely candidate for effective TFM/niclosamide use.(TNC)

Response 70: Should a lampricide application be conducted on the Poultney River, the Cooperative has agreed that the first treatment to occur would be with the TFM formulation alone. If, however, appropriate toxicity testing is conducted to address substantive nontarget issues associated with the TFM/niclosamide mixture, the combination treatment as identified in the FSEIS screening process, remains a potential sea lamprey control option to be considered for subsequent treatments should the need be identified. Combination treatment offers several advantages over TFM treatment including comparative reductions in the amount of lampricide required, reduced chemical concentrations in the river and lake, and possible reductions in water-use advisory times for impacted lake-water users. The findings discussed in Section VII.A.1. suggest that nontarget effects of combination treatments are comparable to those of TFM treatments alone.

Consultations with Great Lakes personnel experienced with the use of TFM/niclosamide applications indicate that the relatively short reach of the Poultney River treatment may allow an effective treatment even under turbid water conditions.

Comment 71**:** Several comments suggested the time frame for sea lamprey control activities proposed for the Poultney River System is too short. (AV, W. Elton, TNC, CLF)

Response 71**:** The Cooperative has determined as stated in Section VIII.A.11 that a five year delay is sufficient to evaluate a sea lamprey control program for Lake Champlain without lampricide application to the Poultney River. A five year delay upon program initiation (anticipated in fall 2001) would allow five years of Lake Champlain integrated sea lamprey control implementation and collection and interpretation of wounding data. The Cooperative has added an additional year to the draft's proposed four-year lampricide application delay, to allow a year for contingencies and ample time for assessment of the program response after a full round of implementation. Wounding data will be compared to the wounding rate objectives adopted in the SEIS. No lampricide application would be proposed unless assessments indicate that wounding objectives have not been met. Under this scenario, lampricide application could occur no sooner than 2007. This delay will give managers and researchers an opportunity to complete: 1) a tag/recapture parasitic-phase sea lamprey research project that will include the Poultney River (See Response 52); 2) mandated NEPA review of Federal Aid in Sportfish Restoration Act 5-year grant renewals for the States of Vermont and New York; 3) additional toxicity studies for applicable state-listed or lampricide sensitive species; and, 4) sufficient opportunity for all or most sea lamprey transformer attrition to occur from stream larval populations to the parasitic-phase lake population on streams where trapping will occur and barriers are established. Opportunities to conduct field research on non-chemical control methods will be sought during the delay period. The Poultney/Hubbarton River System will be considered as a top priority for study.

***Comment* 72:** The Poultney River should receive priority for non-chemical control alternative testing. (CLF)

Response 72: See response 71.

Comment 73**:** Adopt a clear commitment to non-chemical controls on the Poultney River and other streams when they become feasible. (LCC, TNC)

Response 73**:** The Cooperative is committed to use of nonchemical alternatives wherever technically, environmentally, and economically feasible and effective. As stated in Section V.F.1 of the FSEIS "*A variety of control methods would be examined for each stream to increase the effectiveness of the control program and minimize, to the extent practical, the use of chemical lampricides.*" A logical process is followed to identify and prioritize the use of applicable sea lamprey control methods, including available non-chemical methods as identified during screening. It is a potentially false assumption that non-chemical control methodologies have fewer negative environmental consequences than treatment with lampricides. As illustrated in the screening diagram in Section V., the cooperative will periodically review control methodologies for a particular stream, taking into consideration information gained through monitoring control activities and ongoing research into alternative control techniques. The Poultney River with its Vermont designation as an Outstanding Water Resource water, will receive priority for future non-chemical methodologies should they become available.

Comment 74**:** A more iterative process on the Poultney River is more consistent with ecosystem approach/adaptive management. (TNC)

Response 74**:** The Cooperative has worked diligently to ensure that the Proposed Action uses a logical, well-thought-out process that combines all of the components of an adaptive management process. Figures and text in Section V have been modified to more clearly express a feedback component. The Cooperative will learn from monitoring activities and make appropriate program adjustments through time. Feedback into the sea lamprey control decision-making process will incorporate all new information and benefit from the sea lamprey control experiences on Lake Champlain and elsewhere. The Cooperative maintains and builds upon its information base and remains vigilant to new information. The Cooperative will actively participate with the development of sound research opportunities within its jurisdiction. Important partnerships have been developed and will continue to be sought to maintain a broad-based cooperative relationship with agencies and constituents.

Comment 75: Detailed monitoring of environmental impacts should occur for all species in Lewis Creek (LCA)

Response 75: As discussed in Sections VII. A.1.f. and VII. A.1.g., special studies were conducted on the effects of the 1990 TFM treatment on Lewis Creek's nontarget fish and macroinvertebrate communities. Section VII A.1.g. has been revised in the FSEIS to more clearly convey the results of Lewis Creek nontarget studies. Nontarget species monitoring in Lewis Creek will continue as described in Section IV. A.1 and as required by Vermont permits.

Comment 76: TFM may persist longer in the Poultney River due to low light conditions caused by high silt loads. (CLF)

Response 76: TFM application periods typically last12 hours and TFM concentrations are quickly reduced as the lampricide block is flushed out of the stream system by the river flow and diluted in the lake. Light and silt conditions have only a small effect on the maintenance of lampricide toxicity in streams because lampricide is often flushed from the system before chemical breakdown occurs. In previous treatments of the Poultney River, the duration for TFM concentrations to decrease to below 20 ppb. was 2 days for the section of river between Carvers Falls and the Hubbardton River and 6 days for the remainder of the river to South Bay. Further discussion of the environmental fate of TFM can be found in Appendix F.

Comment 77: Poultney River nontarget mortality data from the eight year experimental control program suggests that risks are unacceptable for TFM treatments with listed rare and endangered species living in the stream. (J. Calvi)

Response 77: Overall nontarget mortality levels observed following the Poultney River TFM treatments were among the lowest of any treatments during the experimental program. The risk to nontarget species in the Poultney River is negligible. See Appendix E and sections VII.A.1g and VIII.A.11 for further information regarding nontarget species effects associated with sea lamprey control.

Comment 78: The Cooperative claimed and advertised a successful experimental program prior to the 1996 effective treatment of the Poultney River. It would appear that treatment of the Poultney River was not necessary. (J. Calvi)

Response 78: The eight-year evaluation of experimental sea lamprey control provided evidence that the program reduced sea lamprey numbers, improved the salmonid fishery and had positive associated economic benefits. The program resulted in marked reductions in sea lamprey wounding among prey species, but wounding rates achieved were indicative of a sea lamprey population that prevented the attainment of the Cooperative's fishery management goals. The experimental program was successful from the perspective of a positive fishery response but to a degree well below the response necessary for the Cooperative to realize the fishery improvements sought. The long-term program anticipates the dynamic nature of lamprey distributions and is formulated to include newly infested streams in addition to those included during experimental control. The Poultney River contains a sizeable population of sea lamprey contributing to degradations in Lake Champlain fisheries. The Poultney River is justifiably included as a potential component of a sea lamprey control effort to realize the program objectives of a long-term control program for Lake Champlain.

Comment 79: Long-term repetitive lampricide treatment is inconsistent with the Poultney River's Outstanding Water Resource designation. (TNC, J. Calvi)

Response 79: An Outstanding Resource Water designation in Vermont does not preclude the use of lampricides applications or other sea lamprey control methods in such a water. As stated in the Poultney River screening process discussion (Section VIII.A.11), applications for aquatic nuisance control permits in Outstanding Resource Waters are held to a higher standard than for waters without such designation.

Comment 80: The LaPlatte River control strategy should include a sound review of non-chemical control alternatives to comply with provisions for issuance of a Vermont Aquatic Nuisance Control Permit. (VTDEC)

Response 80: Alternatives to the use of lampricides in the LaPlatte River will be thoroughly evaluated prior to applying for a permit, should lamprey production warrant control there. The text of the LaPlatte River control strategy (Section VII.A.13.) has been revised to reflect this committment.

Comment 81: Disappointment is expressed with the lampricide treatment delay for two known lamprey-producing waters; specifically, the Poultney and Hubbardton Rivers (TU, others)

Response 81: The Cooperative recognizes the State of Vermont's "Outstanding Resource Water" designation of the Poultney River and has agreed to delay the application of lampricides on the Poultney and Hubbardton Rivers for five years (See response 71).

Comment 82: Explore the potential for lamprey control efforts to increase the threat of zebra mussels infesting Lake Bomoseen, on the native mussel community in the Lake's Poultney River outlet. (EPA)

Response 82: Zebra mussel adults are sessile or attached to substrates but their reproductive cycle produces planktonic or free-swimming larval young, called veligers. These veligers are distributed to the surrounding waters, are widespread and occur in very high numbers. The two-stage life cycle of the zebra mussel is such that water flowing from an upstream area of infestation could result in colonization of zebra mussels in downstream areas. A 12 hour release from Lake Bomoseen (to more closely control TFM concentration) would only slightly alter the timing of veliger movement, not the overall abundance or impacts of such movement. If zebra mussel veligers are present in the waters of Lake Bomoseen then they will be present in the Poultney River regardless of a small release from the impoundment.

Since TFM or TFM/niclosamide applications will occur at "No Observable Effect" concentrations where threatened and/or endangered species (mussels) are known to exist, the Cooperative expects no additional stresses to mussels occurring in zebra mussel infested waters associated with TFM or TFM/niclosamide applications. The expected or potential impacts of sea lamprey control options are fully discussed within Section VII of the FSEIS.

APPENDIX H

Public Communications Containing Comments Responded to in the Final Supplemental Environmental Impact Statement

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