GREAT LAKES FISHERY COMMISSION

2000 Project Completion Report[1]

Sea Lamprey Barrier Life Cycle and Operational Protocols

by:

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Prepared by the
Sea Lamprey Barrier Transition Team

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Acronyms

ABACUS-Departmental financial management system of DFO

ACHP- Advisory Council on Historic Preservation (U.S.)

AHP-Analytic Hierarchy Process model

ANSI-Area of Natural and Scientific Interest (OMNR)

APE- Area of Potential Effect

APEO-Association for Professional Engineers in Ontario

BAWP-Barrier annual work plan

B/C-Benefit to cost ratio

BOTE-Board of Technical Experts (GLFC)

CA-Cooperative agreement with a barrier owner

CADD – generic term used to describe computer assisted drawing/drafting software

CAF- Consistency Assessment Form under New York SEQR

CEAA-Canadian Environmental Assessment Act

CEQ- Council on Environmental Quality under NEPA

CET- civil engineering technologist

CDN-Canadian

CFR-U.S. Code of Federal Regulations

CGS- Contracting and General Services (CGS) in the FWS regional office in Minneapolis, MN

CHRS-Canadian Heritage River System

COSEWIC-Committee on the Status of Endangered Wildlife in Canada

CPI-Continuous process improvement

CWT-Coded wire tag

DEIS- Draft Environmental Impact Statement (NEPA)

DFO-Department of Fisheries and Oceans Canada

DFO-FHM- Department of Fisheries and Oceans Fish Habitat Management

DFO-SLCC-Department of Fisheries and Oceans Sea Lamprey Control Centre

DNAP- ODNR Division of Natural Areas and Preserves (Ohio)

DOE-Department of Environment Canada

DOI- U.S. Department of Interior

DPW- Department of Public Works Canada

DSS- Department of Supply and Services Canada

EIS- Environmental Impact Statement

EA-Environmental Assessment

EAF- Environmental Assessment Form under New York SEQR

EPA-U.S. Environmental Protection Agency

ESA- Endangered Species Act (Canada)

ESO- Ecological Services Office of the FWS

FAR-Federal Acquisition Regulations (U.S.)

FCAF- Federal Consistency Assessment Form under New York SEQR

FEAI-Federal Environmental Assessment Index (Canada)

FEIS-Final Environmental Impact Statement under NEPA

FERC-Federal Energy Regulatory Commission (U.S.)

FONSI- Finding of No Significant Impact in an EA under NEPA

FWS- U.S. Fish and Wildlife Service

GLFC-Great Lakes Fisheries Commission

HADD-Maintain without harmful alteration, disruption, or destruction

HBBS-Hammond Bay Biological Station (of the USGS Biological Resources Division located in Michigan on the northwestern shore of Lake Huron between Roger City and Mackinaw City)

HEC-Hydrologic analysis software developed by the Hydrologic Engineering Center of the USACE

HEC-RAS-River Analysis System hydrologic analysis software developed by the Hydrologic Engineering Center of the USACE

H&H-hydraulic and hydrologic design

HRTS- Habitat Referral Tracking System HRTS of the Department of Fisheries and Oceans

IMSL-Integrated Management of Sea Lamprey

INAC-Indian and Northern Affairs Canada

LCSS- Lamprey Control Selection System software which is under development by the GLFC secretariat to estimate transformer production

LWMD-Land and Water Management Division (MDEQ)

MDEQ-Michigan Department of Environmental Quality

MDNR-Michigan Department of Natural Resources

MOA- Memorandum (or Memoranda) of Agreement

MOU- Memorandum (or Memoranda) of Understanding

NEPA- National Environmental Policy Act (U.S.)

NMFS-National Marine Fisheries Service (U.S. Department of Commerce)

NPP- Navigation Protection Program (DFO)

NREPA-Natural Resources and Environmental Protection Act (MI)

NWPA- Navigable Waters Protection Act (DFO) (administered by NPP)

NYCRR-New York Consolidated Rules and Regulations

NYDEC-New York Department of Environmental Conservation

ODNR- Ohio Department of Natural Resources

OEPA- Ohio Environmental Protection Agency

OEPC- U.S. Department of Interior Office of Environmental Policy and Compliance

O&M-Operations and maintenance

OMNR-Ontario Ministry of Natural Resources

PCM- Property and Contract Manager (DFO-SLCC)

P.Eng.- registered (state or province) professional engineer

PERM-Partnership in Environmental Research and Management (MDNR, GLFC, USGS, and Michigan State University)

PFD-Personal floatation device

PIWG-Program Integration Working Group (GLFC, report to SLIC)

PMT-Project Management Team for the Sea Lamprey Barrier Transition Project

PR&CE-Program Requirements and Cost Estimates (a GLFC budget document)

PWGSC-Public Works and Government Services Canada

QAS- Quantitative assessment survey of sea lamprey larvae in a river/stream bed

RFP-Request for proposal(s)

ROD- Record of Decision for an EIS under NEPA

RPWG-Research Priorities Working Group (GLFC, report to SLIC)

SAAF-State Archaeological Assessment Form (New York)

SEQR- State Environmental Quality Review Act (New York)

SHPA-State Historic Preservation Act (New York)

SHPO-The State Historic Preservation Office (a unit of the Michigan Department of State)

SLBTF-Sea Lamprey Barrier Task Force (GLFC, report to SLIC)

SLBTT-Sea Lamprey Barrier Transition Team (GLFC, report to PMT)

SLIC-Sea Lamprey Integration Committee (GLFC)

SLPM-Sea Lamprey Program Manager (GLFC Secretariat)

SMRT-Sterile male release technique

SOP- Standard operating procedures

SRI- Smith-Root, Inc.

UPA- Uniform Procedures Act (NYCRR Part 621)

U.S.-United States of America

USACE-U.S. Army Corps of Engineers

USFS-U.S. Forest Service

USGS-U.S. Geological Survey

WDNR-Wisconsin Department of Natural Resources

WO/DHC- FWS Washington Office/ Division of Habitat Conservation

Glossary

Adjustable-crest barrier - (also known as a variable-crest barrier which includes an inflatable barrier). A hybrid lamprey barrier for which the crest height can readily be changed either locally through the raising and lowering of a crest plate, with the use of stop logs, or through automatic controls such as with an inflatable-crest barrier. The crest of the barrier is raised at the beginning of the sea lamprey spawning run and lowered after the spawning run for the remainder of the year to allow passage of fish.

AHP Model – An analytical hierarchy process model that permits numerical expressions of various factors and their weighting such that one or more preferred options can be selected from a multitude of options and alternatives. This model is one of the methods used to rank barriers in the GLFC's Barrier Strategy and Implementation Plan.

Applicant - The names of the person or legal entity pursuant to the application to a regulatory body for an environmental assessment, construction, and/or other permit requiring approval. Assumes applicant is someone authorized to act on behalf of the owner of the property.

Attractant flow - A flow of water at a barrier used to attract lamprey and/or fish into a device so the lamprey can be trapped and removed and the fish allowed to bypass the barrier.

Barrier - A physical blockage or impediment in a stream, to the movement or migration upstream of sea lamprey and fish, such as a waterfall (natural barrier) or a dam (man-made barrier).

Barrier Annual Work Plan - A yearly plan for planning, constructing, operating, and maintaining sea lamprey barriers (complete life cycle) for the current fiscal year and the one two years hence.

Barrier Coordinator - Representatives, one from each of the two control agents, who are appointed by the GLFC to coordinate and implement the sea lamprey barrier program.

Barrier Engineer - A registered professional engineer who has extensive experience in the design, construction, and operation of sea lamprey barriers in the Great Lakes Basin. In Ontario this person must be a licensed professional engineer. In the U.S., if under the employ of the federal government, these persons are not required by law to be licensed. Licensure may be required in some states where plans are submitted for permitting under dam safety statutes and when work is outsourced to consulting engineers.

Barrier leakage - Escapement of spawning adult lamprey through holes and/or channels in or around barrier or dam structures, including the appurtenant works.

Barrier owner - Any legal entity that has title to a sea lamprey barrier structure or to the specific piece of land on which it is physically located. This entity could be any individual, partnership, public utility, cooperative, trust, corporation, association, federal/provincial/state/or interstate agency, city, village, tribe/First Nation, county, conservation authority, or special purpose district, such as a drainage district or a public inland lake protection and rehabilitation district.

Coefficient of variation - A dimensionless value that expresses sample variability relative to the mean of the sample.

Control agents – Organizations contracted by the GLFC to conduct a program of sea lamprey control. Historically, two agents (one in the United States-the USFWS, and one in Canada-the DFO-SLCC) have delivered the program on behalf of the GLFC. Also described as agent.

Conventional barrier - A barrier design that met program requirements at two or more sites for three or more years.

Cooperating agencies - The GLFC designation for government and institutional agencies involved in fisheries management in the Great Lakes by virtue of their regulatory authority and other legally defined interests in the fishery. Includes the states of New York, Pennsylvania, Ohio, Michigan, Illinois, Indiana, Wisconsin, and Minnesota; the province of Ontario; and tribal councils (U.S.) or First

Nations (Canada) with fishery rights through court decisions or treaties. Also called cooperators or cooperator agencies.

Crest height - The elevation of the lowest section of a spillway or the height of the crest above the downstream water level.

Cut-and-fill - The term refers to the amount of earth that is removed (cut) or added (fill), usually during the construction of a barrier.

Dam - Any artificial barrier in or across a waterway that has the primary purpose of impounding or diverting water.

Decommissioning - Removal of a barrier and restoration of a barrier site, often to its original condition, by the owner.

De facto barrier - A dam or weir that was originally built for purposes other than sea lamprey control but which may be retrofitted (lamprey proofed) to provide lamprey control.

Denil fishway – A chute with baffles extending from the sides and bottoms that are angled upstream. The roughness caused by the baffles slows the flow enough that fish can negotiate it. Denil fishways accommodate more species of fish than other types of fishways and have been used successfully for passing a wide variety of riverine and anadromous fish. Denil fishways function in a wider range of flow conditions than pool and weir fishways. They resist sedimentation but are vulnerable to obstruction by debris. Alaska steep pass fishways are a variation on the Denil.

Design-build - A process where both engineering design and construction are contracted for as one complete package.

Detection survey - A survey that is the most efficient in examining larval habitat in a stream in order to search and locate larval sea lamprey populations and to determine the presence and/or absence of larval lamprey by means of standard electrofishing methods.

Electrical barrier (also known as a gradient-field electrical barrier) - A barrier consisting of a controlled electrical field through two or more metal electrodes built into the streambed that inhibits the upstream passage of fish and sea lamprey. The electrical barrier permits fish passage when the field is off. These electrical barriers are controlled and monitored by a computer system. The technology is patented in the United States and Canada and is available under license from the patent owner, Smith-Root, Inc., Vancouver, Washington.

Emergency Action Plan - Any owner or operator of a dam or reservoir, that may cause loss of life or serious damage to property if a failure of the dam occurs, may need to develop an emergency action plan to be followed in the event of a dam hazard emergency. The plan shall be prepared in accordance with the requirements of state/provincial dam safety statutes and regulations.

Erosion and Sedimentation Control Plan - A set of drawings, showing work areas, cofferdams, sediment control measures, such as silt curtains, to prevent environmental damage during construction, and a schedule outlining phases of instream work which are submitted to agencies for review.

Escapement - The passage of spawning adult lamprey past a barrier that may result in successful upstream reproduction of lamprey.

Experimental barrier - A barrier design that represents a fundamental change in functional characteristics regarding how a barrier impedes passage of sea lampreys and/or provides passage to non-target fish.

Facilitator - A party to a barrier project whose role is to facilitate the development of barriers for sea lamprey control involving other parties that take a more active role in the planning, construction, operations, and maintenance.

Fish ladder - A channel or physical structure engineered to provide water velocities and/or drops in elevation that enable adult fish to migrate up a river past dams.

Fish lift - Upstream bypass facility that uses an elevator to carry fish from the tailrace to the surface of a reservoir.

Fish passage facilities - Facilities associated with a dam or barrier that enable fish to move around, through, or over the dam or barrier without harm.

Fishway - A term used to describe a variety of methods and facilities to pass fish up and downstream past barriers and dams.

Fixed-crest barrier - A sea lamprey barrier that has a fixed crest, the hydraulic head of which is considered low. A jumping pool may provide non-target jumping fish passage. A metal lip is often used to keep sea lampreys from using their suction cup mouths to climb over the barrier. Passage for non-jumping fish can be made possible with the addition of a variety of fishways. These barriers can be built of a variety of materials – wood timbers, gabion baskets, steel sheet piling, poured concrete, rip rap, armor stone, or a combination of these materials (e.g., gabion baskets and sheet piling).

Flood level - The calculated elevation of the designated flood.

Flood plain - The areas that adjoin a watercourse, which are covered by flood waters during events with recurrence intervals usually between 1 and 100 years.

Gauge - An instrument for measuring the variations in the height of water in a stream. The simplest form is a staff gauge, which is a vertical ruler that measures stream height above a known elevation. Stream height is converted to stream flow (water volume per unit time) by means of a rating curve (calibration), which is unique for each gauge.

Great Lakes Basin - Refers to the "Convention area" for which the GLFC has been charged with certain responsibilities by the United States and Canadian governments. The 1955 Convention on Great Lakes Fisheries between the United States of America and Canada states, "This Convention shall apply to Lake Ontario (including the St. Lawrence River from Lake Ontario to the forty-fifth parallel of latitude, Lake Erie, Lake Huron (including Lake St. Clair), Lake Michigan, Lake Superior and their connecting waters, hereinafter referred to as the Convention area."

Habitat - Canadian Fisheries Act defines this as parts of the environment on which fish depend, directly or indirectly, in order to carry out their life processes.

Hydraulic head - The vertical distance between the surface of the reservoir and the surface of the river immediately downstream from the dam.

Hydrologic and hydraulic analysis - Hydrology looks at the size and frequency of flows in a river. Hydraulics is the study of water flow through/over structures such as dams or through natural channels. Hydrology is studied to determine the frequency and sizes of flow for which the hydraulics of the dam and the channels need to be assessed.

Inflatable barrier (a type of adjustable-crest barrier) - A hybrid sea lamprey barrier and fish passage structure for which the crest height can be readily raised and lowered by automatic controls which control an inflatable airbag which operates a hinged plate. The crest of the barrier is raised at the beginning of the sea lamprey spawning run and then lowered after the spawning run for the remainder of the year to allow fish passage. This is a relatively new concept in sea lamprey barrier design.

Jumping pool - A pool located just downstream of the low crest of a fixed-crest barrier that provides sufficient depth for a fish to accelerate to a speed necessary to jump high enough to clear the barrier crest.

Lamprey spawning-run time - The time period during which adult sea lamprey are known to migrate from the open waters of the Great Lakes upstream to spawn in rivers and streams.

Lamprey trap - A device, generally a box-like structure, which is attached as a permanent or temporary device to a sea lamprey barrier or de facto barrier. Its purpose is to trap adult sea lamprey. Traps may serve a variety of resource management needs such as adult assessment, sterile male release (SMRT), and possibly a control function yet to be defined.

Levelogger - Trademark name of an instrument that is designed to measure water level over time, based on the pressure differential from the bottom of the stream and atmospheric pressure at the site. The instrument has a self-contained data logger.

Liftover - Programs to collect fish manually, by seining, electroshocking, or dipnetting downstream of an instream structure, transporting them upstream of the structure, and releasing them. Also known as trap and haul or trap and truck programs. The lack of a conventional fishway and the cost of installing one are typical reasons for using this method of fish transportation or passage.

Locks and elevators – A type of fish passage device that has not been used at sea lamprey barriers but should be considered an option. Locks and elevators attract fish to a water-filled chamber at the downstream side of the barrier, and they are then transported to the upstream side for release. The advantage of this approach over other fishways is that large numbers of fish can be handled and species that do not move well through fishways can be accommodated.

Mark-recapture (also known as tag and recapture) - A procedure used in assessment biology where specimens are captured and marked with unique tags or radio telemetry devices. Specimens are released back into the environment and recovered at a latter time or followed in the case of radio telemetry.

Mitigation - The steps taken to lessen the predicted effects potentially caused by the project on each resource. They may include reducing the impact or avoiding the effect completely.

Modified barrier - A conventional barrier with a design change that does not change the functional characteristics of barrier operation.

Non-target species - In biological control applications, the species that is not designated for control of its population, but whose presence may concur with that of a target species designated for control of its population.

Permanent trap - A concrete or steel lamprey trap, usually square or rectangular, built into a permanent barrier and/or fishway.

Pool and weir fishways - Are fishways in which pools are arranged in a stepped pattern and are separated by overflow weirs. If barrier height exceeds the jumping capability of target fish, or in the case of an electrical barrier where salmonids are the target fish, jumping fish can be passed and lamprey excluded by provision of a pool and weir fishway designed with a head differential between pools of at least 30.5 cm (12 in.).

Portable trap - Rectangular steel mesh cages hung by chains from a structure in a stream during the lamprey spawning run and removed usually over the winter to prevent damage by ice.

QAS survey - A quantitative assessment survey that uses unbiased techniques to sample larval sea lamprey and their habitat in streams to make estimates of density of the population of larval sea lampreys.

Regional flood - The highest flood or runoff event measured in a geographic region in historic times. It usually has a statistically calculated recurrence period of between 100 and 300 years.

Return period - An annual maximum flow event has a return period (or recurrence interval) of T years if its magnitude is equaled or exceeded once, on the average, every T years, e.g., Q10 is the annual maximum flow which, on average, recurs once every 10 years. That is to say, in any given year, there is a 10% chance of that flow occurring or being exceeded.

Riparian - Generally refers to the rights accruing to the owners of riparian property (i.e., shoreline), such as the following rights, subject to the public trust, i.e., access to navigable waters, dockage to

boatable waters, and use of water for general purposes, such as bathing and domestic use. More specific legal definitions are to be found in the statutes and regulations of governments that have authority over state/provincial lands and water resources.

Riprap - Broken stones put in areas to prevent erosion, especially along river and stream banks. Sized according to water velocity, etc.

Risk assessment - A description of property and land uses that may be affected by flooding and an analysis of the degree of increased risk to life, property, and the environment from flooding.

Rule-curves - Water levels represented graphically as curves that guide dam and barrier operations, such as the insertion and removal of stop logs.

Run-time - A period of time during which a target (lamprey) or non-target organism is considered to undertake a migration in a river or stream.

Semi-permanent trap - A steel mesh cage or steel plate box, usually square or rectangular, held in a fixed position on a structure in a stream by permanent attachments.

Spawner - A term used to characterize a spawning adult lamprey.

Spillway - The intended location where water passes over or through a dam or barrier.

Stock recruitment curve - A prediction of the number of offspring produced by a given number of parents. May be influenced by environmental factors and can change from one location to the next.

Structural height - The difference in elevation in feet or meters between the point of lowest elevation of a dam before over topping and the lowest elevation of the natural stream or lake bed at the downstream toe of the dam. The vertical distance from the natural bed of the stream or watercourse measured at the downstream toe of the control structure or from the lowest elevation of the outside limit of the control structure, if it is not across a stream channel or watercourse, to the maximum storage elevation

Target species - In biological control applications the species that is designated for control of its population.

Trap-and-sort fishway - Not a swim through fishway. Fish are guided into traps and manually transferred to a location upstream of the barrier for release. Lamprey may or may not be trapped with or separately from the fish. These fishways can be used by all species of fish.

Velocity barrier - A hybrid fish passage and adult sea lamprey barrier device which is designed to exploit the differences in swimming abilities between non-target fish species and adult sea lamprey. The design goal is to prevent upstream passage of adult sea lamprey by presenting a stream velocity field that they are unable to pass. This type of barrier design is still experimental.

Velocity chute - A flume designed to feature flow conditions passable to non-target species but impassable for lamprey.

Vertical slot fishway - Is similar in construction to a pool and weir fishway, except water flows through a vertical opening in each weir rather than over the crest. Like the Denil fishway, vertical slot fishways have been successfully deployed to pass a large variety of riverine and anadromous fish. The primary advantage of vertical slot fishways is that they are hydraulically self-regulating through a large range of water levels, hence they are appropriate for streams with large stage variations.

Year-class - A lamprey belonging to a specific year class would be one that hatched from a spawning event that occurred in a known year.

Units of Measurement and Abbreviations

Physical Quantity	**System International (SI)**	**Imperial**
Length	Meter (m)	Feet(ft.)
	Centimeter (cm)	Inches (in.)
Mass	Kilogram (kg)	Pounds (lb.)
Temperature	Degrees Celsius (^{o}C)	Degrees Fahrenheit (^{0}F)
Water Velocity	Meters per second (m/s)	Feet per second (ft/s)
Water Discharge	Cubic meters per second (m^3/s)	Cubic feet per second (cfs)
Time	Second(s)	Second(s)

Measurement Conversions

Feet to meters	1 ft.=0.3048 m
Inches to centimeters	1 in.=2.54 cm
Pounds to kilograms	1 lb.=0.45359 kg
Degrees Fahrenheit to Celsius	(F-32)/180=C/100
Cubic meters per second to cubic feet per second	1 m^3/s=35.315 cfs
Cubic feet per second to cubic meters per second	1 cfs=0.028317 m^3/s
Feet per second to meters per second	1 ft/s=0.3048 m/s

Executive Summary

The first review to specifically examine the organization and work of the Great Lakes Fishery Commission's (GLFC) Sea Lamprey Barrier Program was completed in January 1988. A second strategic business review of this program was requested by the Executive Secretary of the GLFC's Secretariat and was completed in January 1998. The impetus for this second review was to provide oversight by the GLFC on barrier construction and maintenance, the breaching by adult lampreys of several recently constructed barriers, and the perception of a slow rate of new barrier construction, particularly in the United States. It was also decided that the underlying processes and functions of the barrier program needed further definition, refinement, and clarification.

The 1998 review reached the following general conclusions:

1) barriers are generally effective and efficient,
2) barriers equipped with effective fish passage facilities should be used more in order to generate savings in the sea lamprey program and to accelerate the recovery of fishes, and
3) the movement towards increased use of barriers should follow a carefully planned transition from barriers as a developmental approach to barriers as an operational program that provides six or more new barriers each year, as opposed to the present one, two, or three additional barriers per year.

The report concluded with recommendations directed at all aspects of the barrier program. They ranged from proposed roles and responsibilities for all those involved in the program, to suggested policy and guideline changes, to developing a life cycle-based barrier process aimed at moving the program from a developmental phase to a fully operational program.

During the GLFC's annual meeting in June 1998 the Commissioners' accepted in principle the Barrier Review report's recommendations and directed the secretariat and the control agents to prepare for an enhanced barrier program beginning in FY 2000. The Commissioners also directed the secretariat to contract for a "player-coach-manager" to work with the barrier coordinators and a barrier transition team to move the barrier program from its current developmental phase to a fully operational phase, similar to the lampricide treatment program.

The secretariat subsequently issued a request for proposals requesting consultants to detail how they would "facilitate such a transition and work with the barrier coordinators to:

1. develop basinwide engineering protocols and have them peer reviewed,
2. develop protocols for estimating costs (including all phases of their life cycle), potential benefits, and risks of failure for use in selection of barrier projects to undertake as part of the Commission's integrated sea lamprey management program,
3. develop clear and effective protocols for evaluating environmental effects and risks as well as for design and operation of fish passage and other mitigation measures, and
4. provide the barrier coordinators with a life cycle-based barrier process to manage projects."

In addition, the proposal was to "include development of mechanisms for identifying priorities for barrier research, incorporating research results into new barrier designs, identifying new barrier team members and staffing requirements, creating a barrier strategy and implementation plan as well as project schedules, deliverables, and budget".

The goal of the Sea Lamprey Barrier Transition Project (the project) was "to plan the transition of the Sea Lamprey Barrier Program from a developmental program to an enhanced operation program beginning in the year 2000".

Governance for the project was provided by a Project Management Team (PMT) composed of the program managers of the two control agents and the executive secretary and sea lamprey program manager (SLPM) of the GLFC Secretariat. The SLPM was the lead contact for the project. Members of the Sea Lamprey Barrier Transition Team (SLBTT), composed of staff from the two control agents, the secretariat, and other parties as required, worked on tasks as assigned. A core team composed of the two barrier coordinators (Ellie Koon, FWS and Tom McAuley, DFO-SLCC), Andrew Hallett, DFO-SLCC, and Jim Kelley, FWS-Minneapolis lead the SLBTT. The consultants worked with both the PMT and the SLBTT and were part of the core team.

The consultants (Mike Millar, Natural Resource Consultant, Tucson, AZ and Ian Ross, Management and Technology Consultant, Orillia, Ontario) submitted a proposal that was accepted by the secretariat in September 1998. The consultants' first task was to develop a "Sea Lamprey Barrier Transition Team Preliminary Project Workbook" to be used as a basis for planning the project with the core team. The core team met in Sault Ste. Marie, Ontario from September 14 to 18, 1998 to finalize the project workbook. The project was initially divided into 22 tasks – 17 proposed protocols and a budget and cost development task, the provision of a life cycle-based barrier process, a human resources plan, an implementation plan, and the draft and final report consolidation for peer review.

The core team defined the tasks in detail and established schedules and timelines for task teams. These were later fine-tuned with individual task team leaders. Copies of the project workbook were provided in hard copy and electronic form to SLBTT and PMT members. Each task was assigned a team leader who was responsible for the team's deliverables on their assigned task. One of the consultants was also assigned to each task team to coordinate and monitor the team's efforts. In addition, each consultant was assigned tasks to complete on their own. A subsequent contract extension assigned an additional task to each consultant (see below for details).

Task teams met as required and e-mailed and phoned back and forth while working on task assignments. The consultants became involved with the task teams as required and attended task team meetings as needed.

The consultants prepared a "Sea Lamprey Barrier Transition Team Project-Protocol Style and Content Guide", including templates for Microsoft (MS) Word. This was required to permit individual team reports to be presented in a similar manner and incorporated into a uniform MS Word document.

The consultants submitted monthly reports to the PMT outlining project progress, including individual task team efforts.

The consultants also made a progress report to the Commission's interim meeting in Toronto on December 2, 1998 and to the Sea Lamprey Integration Committee (SLIC) at their spring meeting in Detroit on April 22, 1999.

One of the ongoing challenges in the project was determining the right amount of detail required in the protocols to ensure they were operationally useful and not academic treatises likely to be unused by barrier practitioners. The protocols will need to be routinely revised based on knowledge and experience gained through application and as environmental legislation changes. The duties of the barrier coordinators will need to be expanded to include the custodial role for updating and revising protocols.

It was realized during the project that all protocols would not be complete and finalized at the same time. Some protocols will be immediately operational; others will be in an interim condition, i.e., ready to work with but need some refining through application and use; a few will be of a draft nature, i.e.,

an issue may remain unresolved or some additional work may be required before the protocol is fully operational.

It was noted that some protocols might impact on GLFC policy in ways yet to be determined. Policy review, especially of "The Role of Barriers in an Integrated Sea Lamprey Control Program and Guidelines for Sea Lamprey Barrier Program", should be considered by the GLFC Secretariat staff who are familiar with GLFC policy. It should be noted that review and revision of this particular policy was a recommendation of the 1998 Barrier Review.

From September 1998 to January 1999 task teams developed and documented their assigned protocols. The consultants compiled the protocols and a description of the barrier life cycle into one document. The SLBTT and PMT team members released the first draft of the report "Sea Lamprey Barrier Life Cycle and Operational Protocols" on January 25, 1999 for their own review. From February 17 to 19, 1999 task team leaders met with the consultants at the GLFC office in Ann Arbor, Michigan to deal with issues identified during the review of the draft document. Subsequent to this meeting the main body of the report, including the barrier life cycle process description and protocol template, was revised and distributed electronically for another review by the task team leaders.

The second draft of the report, to be used for peer review of the project, was completed at the end of April 1999 and delivered by the consultants to the Sea Lamprey Program Manager (SLPM) for distribution to the peer review panel. The SLPM mailed out copies of the report in May 1999 to the following individuals for peer review:

Jack Hall, Consultant (former Director of Small Craft Harbours for DFO)

Ted Cowan, Consultant, (formerly with DFO)

Les Weigum, U.S. Army Corps of Engineers, Detroit (member of SLBTF) (also reviewed by members of their Regulatory and Hydraulic/Hydrology Branches)

John Schrouder, Michigan Department of Natural Resources, and

Chris Katopodis, Freshwater Institute, DFO, Winnipeg, Manitoba

The titles of the 34 individual protocols in the peer review document were as follows:

Reach Selection

Site Selection

Barrier Annual Work Plan

GLFC Secretariat Administration and Contract Management of Barrier Program

FWS Administration of Barrier Program

DFO-SLCC Administration of Barrier Program

Identification of Barrier Research Needs

Application of New Technology

Hydrology and Hydraulics in Barrier Design

Installation of Water Level Data Loggers

Surveys at Barrier Sites

Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction

Ontario and Canada Environmental Assessments, Permits, and Approvals Required for Barrier Construction

Ohio Environmental Assessments, Permits, and Approvals Required for Barrier Construction

New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction

United States Federal Environmental Assessments, Permits, and Approvals for Barrier Construction

Preliminary Engineering Designs and Plans

Fixed-Crest Barrier Design and Criteria

Design Criteria for Permanent Traps

Design Criteria for Fish Passage

Use Of Consultants by the GLFC

Final Design and Engineering

DFO-SLCC Construction Contracting and Management

FWS Construction Contracting and Management

Operations Procedures for Barriers

Operating Times for Barriers

Maintenance Procedures for Barriers

Operations and Maintenance of Traps

Operations and Maintenance of Fishways

Performance Measures for Traps at Barriers

Performance Measures for Escapement at Barriers

Environmental Effects Evaluation

Remedial Measures for Barrier Escapement

Emergency Measures Advisory Services

Some comments from peer reviewers came back promptly, others were late in coming back (i.e., after November 1999), and two have not yet responded. In most instances the contents of the protocols were aptly described by their titles. One reviewer said the document was too long and some protocols too repetitive but noted that “even the most uninitiated should be able to follow the process from reach selection, to site selection, administration, contract design and management, environmental approvals, and operating procedures”. The report in its present form contains a lot of background material not available in written form anywhere else and serves as documentation and a good introduction to new control agent staff and others unfamiliar with the barrier program. In addition, some protocols contain information found in other protocols as each protocol is meant to stand on its own. Efforts to edit out unnecessary details can be undertaken when the protocols are first revised based on the experience gained during their application and if it is still felt that documentation is excessive.

Comments from the peer review panel were compiled into a common MS Word document which was electronically (E file) distributed in November 1999 to the SLBTT Core Team. Team members responded to those comments that related to their individual contributions to the document. A final version of the document was then created by the consultants and released to the SLPM, Chair SLBTF, and the barrier coordinators in January 2000. The duties of the barrier coordinators are to be amended to include the maintenance of the barrier protocols document.

Supplemental Reports

Project Task 16-"Budget and Costs Development" proved to be a more formidable task than originally anticipated and staff were not able to devote the time required. It was decided to split Task 16 into two parts. The part dealing with the effort required to implement an expanded barrier program was added to Task 21-“Human Resources Planning”. The portion of Task 16 dealing with operating and capital expenditures was added to Task 22-“Implementation Plan”.

In March 1999 the consultants, with the help of the IMSL specialist and the SLPM, developed a set of tables for the purpose of identifying the level of effort (resource requirements) to implement the expanded barrier program starting FY 2000 (original Task 21). These tables were completed by the Sea Lamprey Barrier Task Force Chair (Dennis Lavis, FWS), the barrier coordinators, and Andrew Hallett, DFO-SLCC. In April the consultants facilitated a workshop in Ann Arbor with these same people and the IMSL specialist to review the results of completing the tables. They then prepared new tables representing the level of effort and types of skills required for an expanded barrier program. During the peer review, the SLBTF completed Task 22- "Implementation Plan" that is to cover the first 20 barriers to be constructed in the operational phase of an enhanced barrier program. This task was to update and expand the current Barrier Implementation Strategy. The implementation plan in draft form was presented to the Sea Lamprey Integration Committee's (SLIC) 1999 fall meeting. Either SLIC or the secretariat will determine the date for the final submission of the implementation plan.

The consultants used the resource requirements information from the March workshop in Ann Arbor, along with direction provided by the PMT on a preferred operational program implementation option, to complete a separate confidential report to the PMT on "Human Resources Requirements for an Expanded Barrier Program". The PMT recommended to the GLFC that the expanded barrier program in the United States be delivered by the U.S. Control Agent, the FWS, in a manner similar to how the program is now delivered in Canada by the DFO-SLCC. (For details of this option see page 16 in the separate report "Human Resources Requirements for an Expanded Barrier Program".) A final version of the report was submitted to the PMT at the end of May 1999.

During the project it became apparent that Task 19 needed to be redefined. There were important business needs with systems requirements that went beyond those described in original Task 19, i.e., the requirements for project management software. Project management is an application that supports the management of new projects and deals only with a portion of the barrier life cycle. It was noted that the control agents had already acquired project management software tools (MS Project), but were not using them due to lack of training. There are other aspects of the barrier life cycle that require information systems; namely, the barriers inventory. The consultants were asked to include a requirement analysis for supporting databases that would focus on the information life cycle for the whole barrier program including the barrier inventory. Version 1.0 of a report entitled "Requirements for a Sea Lamprey Barrier Inventory System" was released June 30, 1999 for review by the IMSL Specialist to determine the scope and integration of barriers with IMSL. To date no comments have been received and the report is considered complete. The document is intended for use by data architects and data analysts to develop data models, data standards, and data structures for a relational database used to support the barrier business. It is expected that systems, if developed, will require information management protocols based on an information management life cycle.

In addition to the above supplementary reports, the consultants prepared during the peer review a discussion paper on the subject of partnership agreements (MOA) for barrier development and maintenance. The final report "Suggested Points for Inclusion in Sea Lamprey Barrier Program MOUs and MOAs" was forwarded to members of the PMT on July 22, 1999. The report notes that the FWS already has, under the authority of the Secretary of the Interior, authorization, by sections 757a and b of 16 United States Code, to enter into cooperative agreements with Great Lakes States to

> "construct, install, maintain, and operate devices and structures for the improvement of feeding and spawning conditions, for the protection of fishery resources, and for facilitating the free migration of fish, and for **the control of sea lamprey**".

Under this proposed arrangement most, if not all, barrier agreements would be between the FWS and individual or multiple partners. It was recognized that the FWS would probably require use of their own types of legal agreements with partnering agencies/organizations. However, it was felt necessary to outline the types of statements or details that should also be included or referenced in such documents to ensure the interests and liabilities of the GLFC were protected and the roles and

responsibilities of all those involved with the barrier program were clearly understood. Completion of this task provided a list of points that should be addressed in both memoranda of understanding (MOUs) and memoranda of agreement (MOAs) between the FWS and cooperating agencies/partners in order to try and avoid any misunderstanding.

Acknowledgements

The consultants would like to thank the members of the SLBTT and the secretariat for their willing cooperation in this larger than anticipated and complex project.

Introduction

GLFC Project Directive

The strategic business review, "A Review of the GLFC's Sea Lamprey Barrier Program", was accepted in principle by the Great Lakes Fishery Commission (GLFC) during its annual meeting in June, 1998. The GLFC directed the secretariat and the control agents to prepare for an enhanced barrier program to begin in the year 2OOO. The GLFC also directed the secretariat to contract for a "player-coach-manager" to work with the barrier coordinators and the barrier transition team to facilitate moving the barrier program from its current developmental phase to a fully operational phase, similar to the lampricide treatment program.

Project Management Team (PMT) Response

The secretariat and the control agents responded to the GLFC direction by establishing a Project Management Team (PMT). It is composed of the senior managers of the secretariat and the control agents as well as the sea lamprey program manager of the secretariat (SLPM). Project governance for the project is provided by the PMT. The lead contact for the PMT is the SLPM. Members of the PMT include:

Victor Gillman	Department of Fisheries and Oceans
Chris Goddard	Great Lakes Fishery Commission
Gerald T. Klar	U.S. Fish and Wildlife Service
Rob Young	Great Lakes Fishery Commission

Consultants were called to submit proposals to facilitate the transition and work with the barrier coordinators to:

- Develop basinwide engineering protocols and have them peer reviewed,
- Develop protocols for estimating costs (including all phases of the barrier life cycle), potential benefits, and risks of failure for use in selection of barrier projects to undertake as part of the GLFC's integrated sea lamprey management program,
- Develop clear and effective protocols for evaluating environmental effects and risks as well as for design and operation of fish passage and other mitigation measures, and
- Provide the barrier coordinators with a life cycle-based barrier process to manage projects.

The PMT organized a project team known as the Sea Lamprey Barrier Transition Team (SLBTT). It was composed of staff from the two control agents- United States Fish and Wildlife Service (FWS) and Department of Fisheries and Oceans Canada - Sea Lamprey Control Centre (DFO-SLCC), the GLFC Secretariat, and other parties, as required. The SLBTT was to be led by a core team composed of the two barrier coordinators- Ellie Koon, FWS and Tom McAuley DFO-SLCC, Andrew Hallett DFO-SLCC, and Jim Kelley, FWS-Minneapolis. Consultants were hired to work with both the PMT and SLBTT and be part of the core team.

PROJECT GOALS AND OBJECTIVES

Project Goal

The goal of the project is to plan the transition of the sea lamprey barrier program from a developmental program to an enhanced operational program beginning in the year 2000.

Project Objectives

1. The creation of substance and documentation in the form of protocols describing the work and work processes required to plan, design, construct, operate, and maintain sea lamprey barriers on a full life cycle basis,
2. To have all protocols reviewed by an independent panel of peers, accepted by SLIC, and approved by the GLFC,
3. To develop an implementation plan for the first 20 barriers to be constructed in the operational barrier program to be accepted by SLIC, and approved by the GLFC at the fall 1999 meeting,
4. To determine the resources required for an operational barrier program (human resources, budget, and information management systems), and
5. To develop a life cycle-based barrier process as a management tool.

The SLBTT is responsible for deliverables in this project, namely documentation of the barrier process and protocols on a full life cycle basis. This report covers objective one and a portion of objective five and is directed to the peer review described in objective two.

Acknowledgements

Acknowledgement of the contributions of the following individuals to this project is gratefully extended:

SLBTT Core Team

Andrew Hallett	Department of Fisheries and Oceans
Ellie Koon	U.S. Fish and Wildlife Service
James P. Kelley	U.S. Fish and Wildlife Service
Tom McAuley	Department of Fisheries and Oceans
Mike Millar	Natural Resource Consultant
Ian Ross	A Management and Technology Consultant

SLBTT Team Members

Barb Staples	Great Lakes Fishery Commission
Bill Swink	USGS - Biological Resources Division
Dale Ollila	U.S. Fish and Wildlife Service
Dan Hayes	Michigan State University
David Haight	Department of Fisheries and Oceans
Dennis Lavis	U.S. Fish and Wildlife Service
Doug Cuddy	Department of Fisheries and Oceans
Gavin Christie	Great Lakes Fishery Commission
Greg Klingler	U.S. Fish and Wildlife Service
Jerry Weise	Department of Fisheries and Oceans
John Heinrich	U.S. Fish and Wildlife Service
Kasia Mullett	U.S. Fish and Wildlife Service
Larry Sisk	U.S. Fish and Wildlife Service
Michael Jones	Michigan State University
Mike Fodale	U.S. Fish and Wildlife Service
Randy Eshenroder	Great Lakes Fishery Commission
Rod McDonald	Department of Fisheries and Oceans

PMT

Chris Goddard	Great Lakes Fishery Commission
Gerald T. Klar	U.S. Fish and Wildlife Service
Rob Young	Great Lakes Fishery Commission
Victor Gillman	Department of Fisheries and Oceans

The Barrier Life Cycle Process

A description of the barrier process includes several sub-processes required to plan, design, construct, operate, and maintain barriers over a life cycle of 50 years.

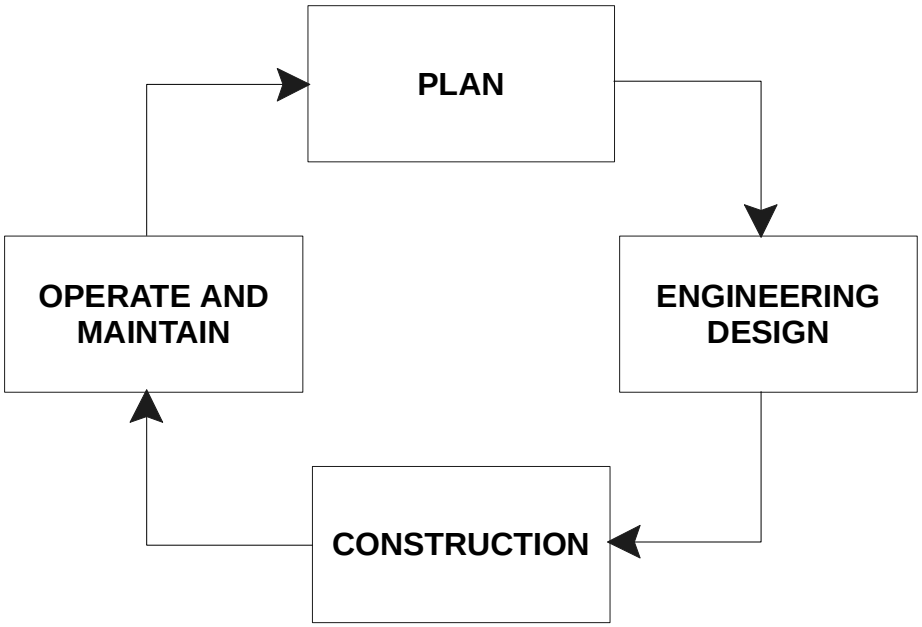


Figure 1 Generalized barrier life cycle

In the following four sections each step of the barrier life cycle (Figure 1) is expanded to a more detailed view with a discussion of components including where and when specific protocols apply (these are noted as underlined text).

Plan

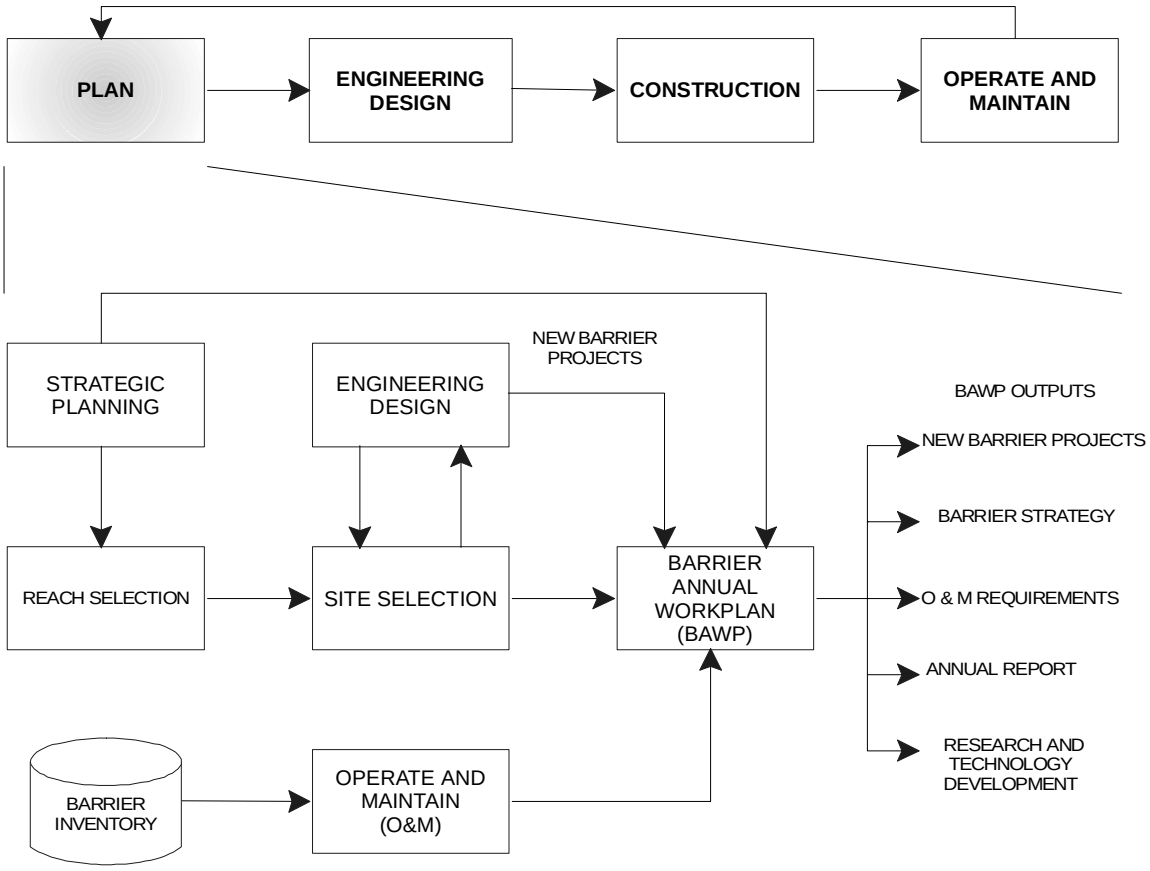


Figure 2 Barrier planning process

The goal of the planning process is to provide for the orderly development of the barrier program as an operational sea lamprey control program. Included in this view of the planning process (Figure 2) are the links to strategic planning, engineering design, and the operation and maintenance of barriers. Five protocols are integrated by the Barrier Annual Work Plan protocol (BAWP). This includes two protocols that address the planning and approval requirements for research and technology development projects. The protocols are provided in the protocol section of this report and include:

- Reach Selection,
- Site Selection,
- Barrier Annual Work Plan (BAWP),
  - Application of New Technology,
  - Mechanism for Development of Barrier Research Needs,
  - GLFC Secretariat Administration and Contract Management of Barrier Program,
  - FWS Administration of Barrier Program, and
  - DFO-SLCC Administration of Barrier Program.

Strategic Planning

The goal of the barrier program is found in the GLFC's vision for its sea lamprey management program. The GLFC's objective for sea lamprey management is to provide an integrated program "that supports the Fish Community Objectives for each of the Great Lakes and that is ecologically and economically sound and socially acceptable" (GLFC 1992 Strategic Vision document). Based on the theory of integrated pest management, sea lamprey will be suppressed to economic-injury-level targets, that is, to the lowest tolerable abundance beyond which further control would cost more that the value of the fishes saved. Further, in recognition of the public concern over chemicals in the environment and the efficiencies of employing alternative methods, the GLFC vision includes a milestone for a 50% reduction of lampricides from the levels before 1989. Thus, sea lamprey barriers will be constructed so as to improve the cost-effectiveness of control so that suppression can be maximized and to reduce the amount of lampricide used to further reduce economic costs. All this must be balanced with the increased environmental costs associated with barrier placement in tributaries to determine the most applicable method of control.

The strategic plan for barrier implementation will result from the evaluation of all individual candidate projects by criteria based on these general objectives. The individual projects are ranked using a combination of their cost effectiveness, their potential to reduce lampricide use, their potential to reduce sea lamprey populations, their effects on stream environments, and their feasibility. The analytical hierarchy process (AHP) has been used as a method for combining these criteria. The first such ranking was completed and adopted by the GLFC in the "Sea Lamprey Barrier Strategy and Implementation Plan" in 1996. Once ranked in this way, the overall role of barriers as a technique in combination with lampricide and other alternative methods will be assessed in the context of the long-term targets for each Great Lake. This integration will be made using the Integrated Management of Sea Lamprey (IMSL) decision support tools to simulate future scenarios and to evaluate outcomes of different levels of investment in sea lamprey barriers. The resulting strategic plan, for construction of the optimal number of barriers from the top of the rank-order list, will include plans for its iterative re-evaluation using new information from the performance evaluation of barriers constructed over time.

The Sea Lamprey Barrier Task Force (SLBTF) is responsible for the strategic planning of the barrier program. The barrier coordinators do the bulk of the actual planning work and prepare and present the plan to the SLBTF. The strategic plan for barriers, including the ranked candidate barrier river list, is being revised as part of this project under Task 22 and will focus on the strategy for an accelerated implementation plan for an operational barrier program.

Reach Selection

Selection of one or more stream reaches, where it is anticipated a site could be located to build a barrier, on a candidate barrier river involves the use of selection criteria. Criteria are based on presence and abundance of larval lamprey, habitat, lampricide treatment frequency, lampricide usage, and other factors as described in the protocol Reach Selection.

Site Selection

The goal of site selection involves reducing the number of choices within a stream reach to one final site at which a barrier can be built. The selection process, described in the Site Selection protocol, utilizes existing information sources to determine if the proposed site can meet engineering, environmental assessment, and regulatory agency permitting requirements. In addition to using scientific and technical information, other agencies and interest groups are consulted.

Barrier Annual Work Plan

The goal of the Barrier Annual Work Plan (BAWP) is to provide budget estimates and program plans for all life cycle elements for the next fiscal year as well as projected program requirements and cost estimates (PR&CE) for the period two years hence. The BAWP protocol integrates several other protocols in an effort to consolidate the planned activities of barrier owners, control agents, and the GLFC for lamprey control using barriers. Cooperative agreements are developed with barrier owners which detail cost sharing arrangements for barrier planning, engineering, construction, operations, and maintenance.

Barrier Program Administration

The sea lamprey management program is implemented by the control agents through an administrative procedure known as a Memorandum of Agreement (MOA). They are developed between the GLFC and the control and research agents and detail the commitments that have been approved and funded by the Commissioners. The United States Army Corps of Engineers (USACE) is also used to administer the barrier program subsequent to strategic planning and stream selection processes. The USACE operates under a variety of congressional authorizations and operating protocols of its own design. In general the USACE protocols mimic what is described within.

The BAWP under the control agent MOA is administered differently in the two countries and by the GLFC Secretariat. The administration of funds is described in the following three agency protocols:

1. GLFC Secretariat Administration and Contract Management of Barrier Program,
2. FWS Administration of Barrier Program, and
3. DFO-SLCC Administration of Barrier Program.

Barrier Research and Technology Development

The barrier program is evolving from an applied developmental program to an operational control program. Its success has been dependent upon access to research and new technology. Investment in research and new technology as a portion of the program's funding needs to be continued and increased. The investment is done in two forms:

1. Operational investments in continuous process improvement (CPI), and
2. Structured investments in research and technology development projects.

CPI is a fundamental component of the engineering design process. It is iterative and involves the incorporation of new knowledge, experience, materials, features, and design concepts in every new barrier project.

Structured investments in the development, testing, and evaluation of unique new concepts for barriers in sea lamprey control (including traps and fish passage) will involve project funding for which two protocols are provided in the protocol section:

1. Application of New Technology, and
2. Identification of Barrier Research Needs.

Research and technology development activities once approved and funded are considered as projects. Project plans define each project's life cycle from start to completion.

Engineering Design

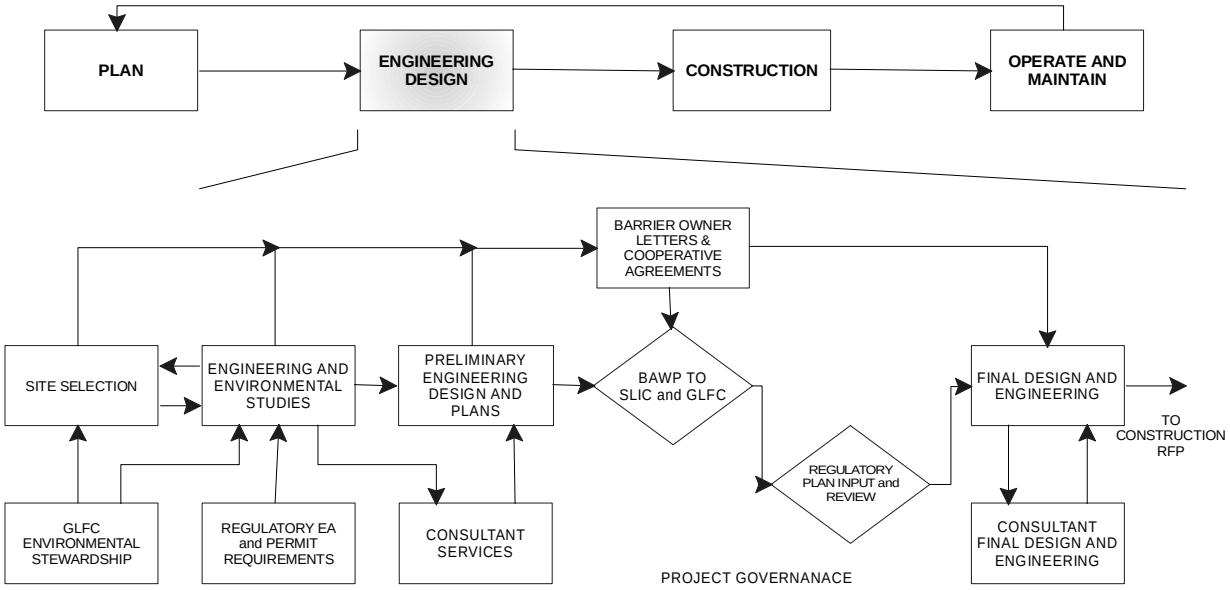


Figure 3 Expanded view of the engineering design process

Leadership and coordination for the engineering design of barriers throughout the Great Lakes Basin is to be provided by the Engineering Unit of the DFO-SLCC. This unit, under the technical leadership of the Canadian Barrier Coordinator, is responsible for maintaining specialized core competency (skills and knowledge) in sea lamprey barrier engineering design. The unit also acts as the repository for all engineering designs in the barrier inventory.

Each new barrier involving capital investment and construction by the GLFC is considered to be a project. Multiple projects may be planned concurrently. The goal of engineering design (Figure 3) is to advance a barrier project from concept to completion of approved, funded, permitted, and partnered plans ready for construction. The engineering design process involves several stages that can span several years from start to completion for an individual project.

Site selection drives the engineering design process for new barriers. It may be iterative.

Engineering design may also be initiated in response to maintenance requirements for major repairs, modifications, and/or decommissioning.

Deliverables from the engineering design process include: technical drawings, plans, specifications, engineering reports, and all required regulatory construction and environmental assessment permits needed for a competitive tender for construction from the private sector.

Engineering and Environmental Studies

The goal of engineering and environmental studies is to obtain site-specific information to support GLFC approval, applications for construction permitting, and to define preliminary engineering designs and alternatives. Once a candidate barrier site has been determined by the Site Selection protocol,

there is a need to determine what additional information will be required to satisfy the following three business needs:

1. Engineering design requirements,
2. Regulatory environmental assessment requirements and other permit requirements, and
3. GLFC environmental stewardship.

Engineering Design Requirements

Engineering design requirements are developed within the barrier program. They are based on experience from the program and engineering practice for hydraulic structures and fish passage in the Great Lakes Basin and internationally. Engineering design requirements for barriers apply basinwide. The information required to support engineering designs of barriers, lamprey traps, and fishways generally exceeds that required for regulatory permits. Site specific engineering studies may be required if existing data is insufficient. Hydrologic studies are the most demanding as several years of representative hydrologic data for a site may be required. Three protocols are described:

1. Hydrology and Hydraulics in Barrier Design,
2. Installation of Water Level Data Loggers, and
3. Surveys at Barrier Sites.

Environmental Assessment (EA) and Other Permit Requirements

Environmental assessments and other permitting requirements are set by the jurisdiction that has authority over the site. There are differences in the administration and authority over natural resources between the U.S. and Canada at the federal level as well as at the state, provincial, tribal/First Nation, and local government level. Under state/provincial laws, authority tends to vest with the government agency or agencies that has/have authority over dam safety, water resources, fisheries, and environmental protection.

The Convention on Great Lakes Fisheries grants the GLFC broad powers to implement the sea lamprey management program throughout the basin. Under the Convention the GLFC is not required to have the approval of local authorities to carry out all activities of the sea lamprey management program. However, it is GLFC policy to negotiate concurrence with regulatory agencies. If concurrence is not reached, the matter is referred to the GLFC Commissioners for direction. The GLFC may then choose whether or not to exercise its authority as a matter of policy.

Regulatory requirements for permitting need to be accounted for in determining information requirements for environmental studies and other permits. Protocols for determining environmental assessment and other permit requirements by jurisdiction are set forth in the following, which also define the permit application and approval process described later in this section (Regulatory Plan Input and Review):

- Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction,
- Ontario and Canada Environmental Assessments, Permits, and Approvals Required for Barrier Construction,
- Ohio Environmental Assessments, Permits, and Approvals Required for Barrier Construction,
- New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction, and

- U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction.

NOTE: Other Great Lake states are not included in this version of protocols as there are no high priority barriers included at this time for those jurisdictions in the Barrier Strategy and Implementation Plan.

This process includes early consultation with natural resource and environmental agencies. It may form the basis for obtaining additional direction in relation to their concerns that could lead to a regulatory EA bump-up. There may be a need for additional site specific environmental and biological surveys beyond the regulated requirements for permit approval, such as:

1. Fish studies,
2. Aquatic habitat assessment, and
3. Other environmental studies.

GLFC Environmental Stewardship

At its discretion, the GLFC may direct additional environmental studies (beyond those suggested by regulatory bodies) of a specified nature prior to its approval for an individual barrier project (non-regulatory EA bump-up). A draft protocol Environmental Effects Evaluation is provided in the protocol section.

General direction by the GLFC in this area is also provided through policy (Strategic Vision). Environmental criteria resulting from policy are used for site selection and the requirements for engineering and environmental studies.

Preliminary Engineering Designs and Plans

The goal of preliminary engineering designs and plans is to define the engineering requirements and budget for a proposed barrier structure including its appurtenant works, i.e., lamprey traps and fishways, that meet a number of design objectives. The design objectives include those purposes and functions that the structure is required to serve, namely:

1. Block upstream migration of spawning sea lamprey,
2. Enable passage of non-target fish species, and
3. Provide a safe environment for staff and the public.

Interim deliverables from the process are engineering plans and budget estimates for projects ready for regulatory approval and construction/decommissioning in the following fiscal year (including projects involving major modifications to existing barriers). These first require submission through the BAWP process for GLFC approval and funding for final engineering and construction prior to submission to regulatory bodies for plan input and review.

Engineered repairs to existing structures are approved by the GLFC as part of operations and maintenance budgets. These may be subject to state/provincial regulatory requirements for permits.

The protocol Preliminary Engineering Designs and Plans integrates several protocols required for preliminary engineering design and plans, namely:

1. Fixed-Crest Barrier Design Criteria,
2. Use of Consultants by the GLFC,
3. Design Criteria for Permanent Traps,

4. Design Criteria for Fish Passage, and
5. The protocol of the applicable jurisdiction for Environmental Assessments, Permits, and Approvals Required for Barrier Construction.

Permit applications may require the provision of engineering plans, drawings, and reports by state/provincial registered professional engineers. If the control agents do not have staff engineers with required registration and licensure, the services of outside consulting engineers may be retained to assure compliance with regulatory requirements. When the control agents do this directly they will use the procurement policies and procedures of their agency. Where it is necessary to retain consulting engineers on behalf of the GLFC direction is provided on the procedure in the protocol Use of Consultants by the GLFC.

A number of barrier designs and construction materials have been used to date, and are suited to barrier construction in most situations. The barrier design options are listed in the Preliminary Engineering Designs and Plans protocol and include variants of the following barrier types:

1. Fixed-crest,
2. Adjustable-crest,
3. Velocity, and
4. Electrical.

Barrier Owner Letters and Cooperating Agreements

The Convention does not prevent the GLFC from directly owning or operating barriers. The current policy of the GLFC is to provide the initiative and implement the barrier program using its control agents and through partnerships with other barrier owners. Barrier projects represent a long-term commitment by the parties (50 years).

The land owner/barrier owner must be involved in the engineering design process when a site has been selected. There is an evolving contractual relationship with the land owner/barrier owner. Initially this would include consent to access property for surveys, exchange of letters of support for project, letters of understanding, and eventually a formal contractual agreement would be negotiated (including leases, purchase, or other realty arrangements).

The roles of the parties participating in any proposed barrier project need to be clearly defined and understood by all participants. This will require written contracts between the parties. At least three parties are involved in any barrier undertaking: facilitator, agent, barrier cooperator, and/or barrier owner (see Glossary).

The parties may partner on a barrier project, in which the same entity may take on more than one role. Examples of the types of relationships currently in place include:

1. In Canada DFO-SLCC is both an agent of the GLFC for barriers as well as a barrier owner. The understanding for the construction, operation and maintenance of barriers is included in the annual MOA between the GLFC and DFO-SLCC. Ontario MNR is a barrier cooperator through a MOU with DFO.
2. In Michigan there are several barriers for which the Department of Natural Resources of the State of Michigan is both a cooperator and a barrier owner. A cooperative agreement between the barrier owner and the GLFC will be in place for cost sharing lamprey control efforts related to barrier operation and maintenance.

Depending on the role of the agent, cooperator, or barrier owner in a project, their own internal procedures (protocols) for realty transactions will be followed in order to secure title for the purchase, lease, and/or easement as required.

Project Governance

Governance for all barrier projects is a two-step process that is initiated through the BAWP, then followed by external plan input and review by the jurisdiction that has authority over the site.

BAWP to GLFC

The BAWP is described in the planning section. All projects must be approved by the GLFC and funded through the GLFC/control agent MOA or the GLFC/barrier owner negotiation process. Project approval and funding involves three project categories in the BAWP:

1. Proposed plans for new barrier projects, or retrofitting de facto barriers, to be constructed two to five years hence require prior budget approval and funding for engineering and environmental studies and preliminary engineering designs and plans,
2. Mature projects with barrier owner letters of understanding and engineering plans, ready for regulatory approval and construction/decommissioning in the following fiscal year, require submission through the BAWP process for GLFC approval and funding for final engineering and construction (includes major modification projects to existing barriers), and
3. Major repairs to a barrier that require engineering design are approved by the GLFC as part of the annual operation and maintenance budget. Emergency repairs are dealt with on an individual case basis. Permits for repairs may be required through state/provincial regulations.

(Projected projects in the program requirements and cost estimates (PR&CE) for the period two years hence are approved by the GLFC and then forwarded to the two respective federal governments for incorporation into their financial planning processes.)

Regulatory Plan Input and Review

The goal for plan input and review is to provide complete applications for construction project concurrence by regulatory bodies. The regulatory bodies take the application through their respective review process which will result in the issuance/denial of permits. Each jurisdiction has processes for public and government review of projects that are described in the five protocols for Environmental Assessments, Permits, and Approvals Required for Barrier Construction.

The deliverables from this process are construction and other required permits from the regulatory bodies. Permits may contain additional terms and conditions to those known and included in the original application.

Project Scheduling

The calendar time for the submission of applications for regulatory plan input and review is critical. Any delays can directly impact on the completion of a project on time within a given year. The time window for construction permits in watercourses is generally restricted to two months of the summer (July-August) during low stream flow to minimize the impact on fish, water quality, and other aquatic organisms. Occasionally fall or winter construction permits are obtained.

It is important that permit applications be complete including additional considerations that may arise from the review (prior consultation with regulatory bodies). Project scheduling is determined by estimating the time requirements for construction tendering, review and contracts, final design and engineering, and plan input and review. The time requirements for these steps is backed off

(calculated backwards in time from start of construction window) to determine the time for submitting applications.

Final Design and Engineering

The goal of final design and engineering is to complete all approved engineering drawings, plans, and technical specifications such that competitive tenders can be called from the construction industry. The protocol describing this is Final Design and Engineering.

The engineering licensure requirements for final plans will be addressed and may necessitate the outsourcing of final plans to qualified consulting engineers.

Project management plans are developed including the considerations for engineering oversight or engineering supervision for multiple projects to be built concurrently. This includes schedules and provisions for regulatory inspections as required by permits.

At this stage operations and maintenance schedules and manuals are developed as well as emergency measures plans if required under regulation. Long-term engineering maintenance requirements are defined for complex barriers and fishways.

Barrier owner contracts and realty title registrations are finalized at this time, including:

1. Cooperative agreement between the GLFC and the barrier owner,
2. Title registration of floodplain easements, and
3. Lease and/or purchase of property and title registrations.

The GLFC does not currently have a realty protocol. The realty protocol of one of the other parties to a barrier project is to be used in accordance with land tenure law for the jurisdiction. The negotiation of long-term leases and perpetual easements registered on title is preferred, as the planned lifetime of barriers is 50 years.

Use of Consultants

The term consultants is defined widely and includes consulting engineers and other consulting firms providing professional services from the applied sciences (engineers, surveyors, and hydrologists) and the environmental sciences (ecologists and biologists). From time to time there is a need for additional engineering, scientific, and technical services in the barrier program beyond those that can be provided by the control agents. This includes engineering and other specialists outside of the core competency of control agent staff and to meet project demands and timelines.

In addition, the control agents do not have staff engineers qualified to practice in all jurisdictions and specialties where barrier projects are proposed. In such circumstances the control agents may retain the services of consulting engineers. When they do this directly they will use the procurement policies and procedures of their agency. The GLFC may also retain the services of consulting engineers in the project jurisdiction to conform to the jurisdiction's regulatory requirements through the protocol Use of Consultants by the GLFC.

Design-Build

A process known as design-build was considered as part of this project (not shown in the life cycle process diagrams). Design-build integrates the processes of engineering design and construction as one contract with a private sector firm that specializes in this form of delivery of capital projects. There are currently no known firms of this type that practice throughout the Great Lakes Basin for the development of hydraulic structures or sea lamprey barriers with the exception of electrical barriers.

At the present time the use of the design-build process by the barrier program, other than the use of design-build for electrical barriers, is considered inappropriate for a variety of reasons.

Construction

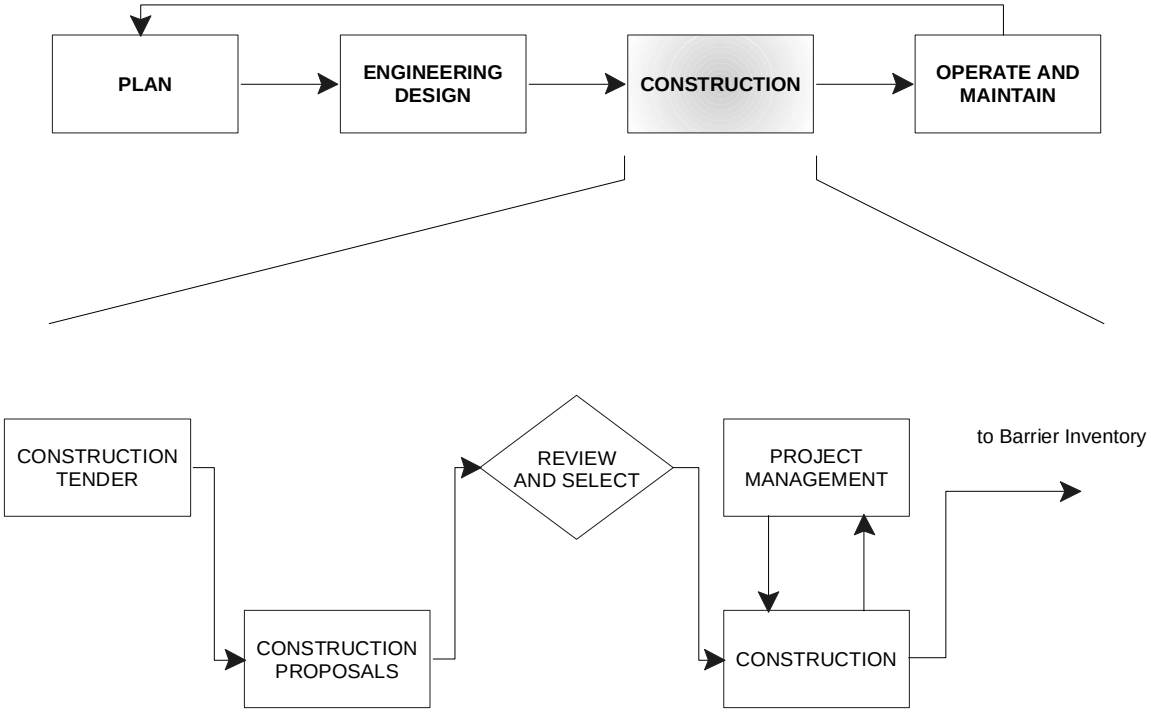


Figure 4 Expanded view of the construction process

The goal of the construction process (Figure 4) is the selection and awarding of a construction contract through a competitive process which results in the successful completion, on time and within budget, of a barrier project in accordance with the approved engineering design.

Construction Tender, Construction Proposals, Review and Select

The cooperative agreement or agent MOA for the barrier project identifies the roles and responsibilities for the parties, including which party is designated as the lead for project construction. The leading party will use their organization's construction procurement process which generally consists of three steps: competitive tendering, an industry response with construction proposals and costs, and the review, selection, and contract award to one company's proposal. Protocols for construction management by the control agents in the protocol section include:

1. DFO-SLCC Construction Contracting and Management, and
2. FWS Construction Contracting and Management.

Contracts will generally include requirements for bonds, liens and holdbacks, inspections, performance evaluation and tests, and final acceptance and signoff.

Construction

Permits generally restrict construction in streams and rivers to a narrow time window of two months (July-August) or occasional fall or winter permits. The terms and conditions of the works are set in the contract between the leading party and the contractor. Engineering designs, plans, and specifications are incorporated into the contract as attached schedules. The leading party has authority over the work.

Successful completion of the barrier results in its addition to the barrier inventory and registration of the barrier and barrier owner on title.

Project Management

Based on terms and conditions in the construction contract, the leading party (or its designate) will provide engineering inspections of the works during construction. Inspections by the regulatory authority may also be required as part of permitting conditions. The objective is to ensure that the works are being constructed as planned. Inspections may be tied to scheduled deliverables and payments for work under the contract. Inspections usually will require a registered professional engineer with authority to signoff under the contract or to make any written amendments to plans.

As part of permitting, some jurisdictions may also require the submission of final as-built plans and drawings at the completion of construction. As-built plans incorporate any variations to the original proposed plans and drawings and are usually the responsibility of the engineer that developed the final engineering drawings.

Projects that are funded in part by the GLFC through the cooperative agreement with a barrier owner, where neither control agent is party to that cooperative agreement, require that the GLFC designate one control agent to act on its behalf to provide engineering oversight. In this case the designate has no authority over the construction contract, the agent provides only engineering oversight to verify that work has been completed to engineering requirements so that payments can be authorized by the GLFC under the cooperative agreement with the barrier owner.

Record Retention

Once a barrier project is completed, copies of all information used in barrier design and construction drawings, including final drawings, is to be retained by the engineering unit responsible for the project and become part of the barrier inventory. Where a barrier owner designs and constructs the barrier (e.g., MDNR, USACE) they may wish to retain this information in their files. In such situations the barrier coordinator must know, and record in the barrier inventory, where this information is located in case of emergency, needed repairs, or where there is a change in barrier ownership.

Operate and Maintain

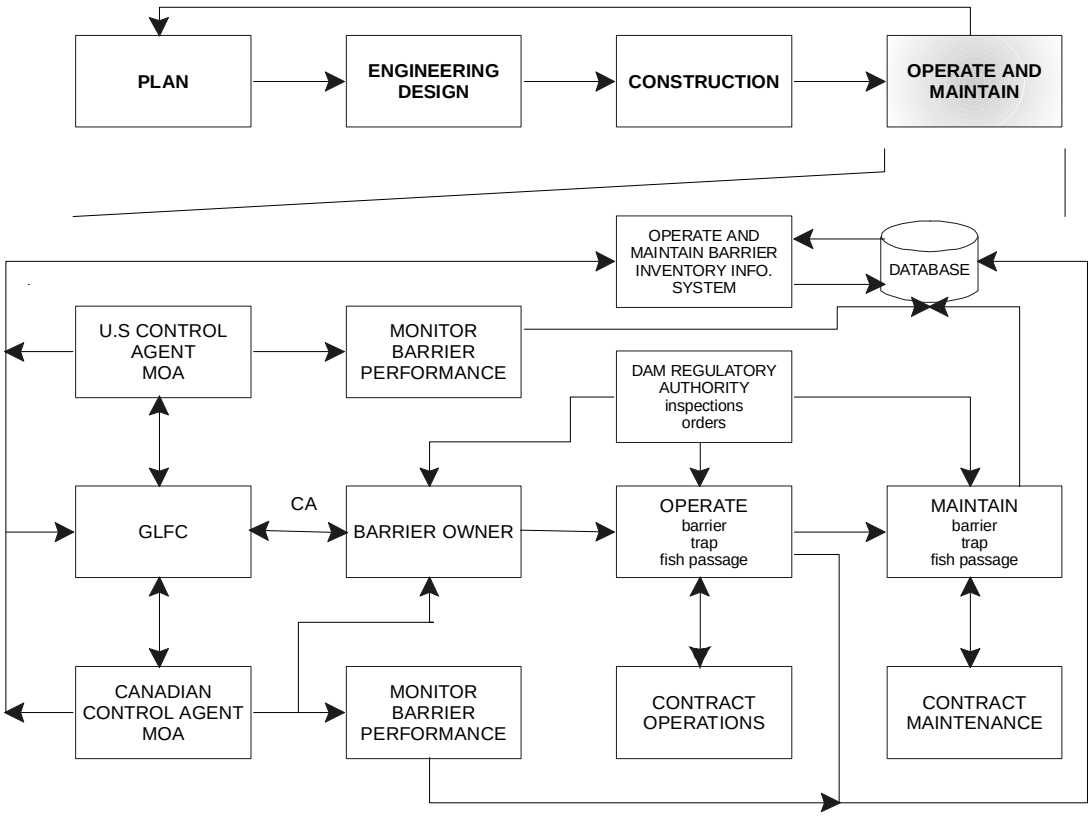


Figure 5 Expanded view of the operations and maintenance process

The goal of barrier operations and maintenance (Figure 5) is to assure, over the long-term (50 years), the proper function of all barriers in the barrier inventory and their appurtenant works, traps and fishways, in accordance with:

1. GLFC barrier program goals and objectives,
2. Any requirements of dam regulatory authorities,
3. Control agent MOAs, and
4. Cooperative agreements (CAs) with barrier owners.

Barrier Agreements

Figure 5 indicates two types of barrier agreements for O&M, MOA with the control agents and cooperative agreements (CAs) with barrier owners. Not shown is the MOA with the research agent for alternative control research.

Barriers are a sea lamprey control alternative that the GLFC funds in partnership with barrier owners. Prior to barrier construction the GLFC enters into a letter of understanding with a potential barrier owner and this is advanced to a cooperative agreement when the barrier is built. Cooperative agreements are long-term commitments negotiated by the GLFC with barrier owners that span the economic life of the structure (50 years).

The O&M requirements of MOA and cooperative agreements for all barriers in the inventory are determined during normal barrier activities undertaken throughout the preceding year and discussion with owners. They are reviewed as part of the BAWP to determine budget requirements for O&M funded by cost-sharing arrangements. The administration of barrier MOA and cooperative agreement funds by the GLFC are described in the protocol GLFC Secretariat Administration and Contract Management of Barrier Program. The cost sharing formulae used in barrier owner cooperative agreements are negotiated between the GLFC and the barrier owner on a case-by-case basis.

Barrier fund administration by the control agents under their MOA with the GLFC is described in the protocols DFO-SLCC Administration of Barrier Program and FWS Administration of Barrier Program. The Canadian control agent program MOA includes the O&M requirements for barriers that are owned and operated by DFO-SLCC.

Monitoring Barrier Performance

The purpose of barriers is to prevent lamprey from reaching spawning habitat upstream, thus eliminating larval lamprey production and the need for lampricide treatments. Lamprey traps provide a means for the retrieval of adult lamprey for adult assessment purposes and live animals for alternative control research (e.g., the sterile male research technique (SMRT) program). Fishways provide for the upstream migration of non-target fish species that the barrier might otherwise impede. The goal of monitoring barrier, lamprey trap, and fish passage device performance is to determine that all barriers in the inventory are meeting control and other resource management objectives and to mitigate performance problems. The control agents play the lead role for monitoring barrier performance throughout the Great Lakes Basin.

The design requirements of barriers, lamprey traps, and fishways are based on control and resource management goals determined during design and refined through external and internal decision making and approval processes prior to construction. As permanent structures they are designed to meet their original purpose for 50 years, unless modified to change purpose or enhance performance. Many fixed-crest barriers constructed early in the program continue to meet their original design objectives and provide cost effective control. Performance evaluations should be consistent with whatever criteria they were originally designed for.

Under IMSL (Integrated Management of Sea Lamprey) barrier performance will be measured on an equivalent basis with lampricide control methods (i.e., the required reduction of residual larval populations upstream after a treatment).

Escapement

The passage of spawning adult lamprey at a barrier site that may result in successful upstream reproduction of lamprey is known as escapement. Known causes of escapement include:

1. Dam leakage such as holes in masonry abutments and dams, rock gabions, and flow through coarse substrate and bedrock fractures,
2. Channels created by burrowing animals,
3. Accidental passage through a fishway or spillage and escapement while collecting samples/fishing traps,
4. Flood events exceeding the designed barrier crest height,
5. Passage through ditches or drains,
6. Vandalism (e.g., people throwing lamprey over the barrier), and

7. Failure to operate temporary barriers early or late enough in the season.

Detection

The principal means of detecting recruitment of larvae upstream of a barrier is larval assessment surveys. The survey procedures are the same as those used for stream surveys for lampricide treatments. Two types of surveys: initial detection (larvae presence/absence) and quantitative larval assessment (QAS) are described in the protocol for Performance Measures for Escapement at Barriers. The protocol describes routine surveys that are conducted on a cycle that is consistent with that rivers lampricide treatment history (in general, once every three to six years) for all barriers in the inventory. Annual surveys are conducted for three consecutive years after the construction of a new barrier. Survey results are reported to barrier coordinators and the data collected recorded in the larval assessment databases of the control agents. Currently the costs associated with larval assessment surveys above and below barriers are not attributed to the life cycle costs of barriers. These costs are accounted for in the control agents' larval assessment budgets.

For new barriers, potential escapement due to flood events exceeding design crest height can be detected (period and magnitude) by means of stream level data loggers. If a flood event coincides with the lamprey run there is possibility of lamprey escapement, and larval detection surveys conducted within the appropriate cycle will determine if lampreys breached the barrier during the event.

Trap Assessment

Lamprey traps require barriers or similar structures in order to be effective. They require routine servicing for the removal of lampreys. Concurrent with these operations procedures, counts of animals are made with the results incorporated into adult assessment databases. Two protocols Performance Measures for Traps at Barriers and Operations and Maintenance of Traps are provided in the protocol section. While trap construction is a barrier cost, the operating costs are not currently associated with traps at barriers and, thus, are not attributed to the life cycle costs of barriers. The adult assessment and the sterile male release technique budgets of the agents account for these costs.

The run-time characteristics for lampreys at barriers are described in the protocol Operating Times for Barriers and provide direction to aid in the scheduling of trap operation.

Other Environmental Surveys

Direction from regulatory permits (EA and other permits), or specific direction from the GLFC under the protocol Environmental Effects Evaluation, may include the requirement for additional environmental surveys before and after a barrier has been built. Such surveys would primarily focus on fish passage and may include fish run surveys, mark-recapture studies, fish community surveys, and other environmental surveys. Such studies are expected to be of a specific nature and applied on a case-by-case basis. Costs associated with them are project related rather than O&M. Studies, such as Noakes et al., provide insight into the general environmental affects of all barriers of similar type (fixed-crest barriers). A protocol for pre and post-construction fish studies may need to be developed under the general direction of the protocol Environmental Effects Evaluation.

Mitigation

There are two resource management actions that occur as a result of lamprey escapement past a barrier:

1. Consideration of the stream for a lampricide treatment, and

2. Determination of the cause(s) for lamprey escapement at the barrier and remedial action(s) taken to mitigate the problem(s).

Lampricide treatment costs are not considered as part of barrier program costs.

For the latter action, the Remedial Measures for Barrier Escapement protocol is provided. It is not possible to describe all remedial responses to all circumstances. Professional judgement of the barrier coordinators is required to evaluate the risk and determine an appropriate response based on specific circumstances. All causes for recurrent escapement at a barrier site will be investigated and determinations made with respect to remedial actions. The barrier coordinators will maintain records of all escapement incidents and their outcomes as part of the barrier inventory. Remedial works for escapements are considered as barrier maintenance.

Barrier Owner

The obligations of the barrier owner with respect to barrier O&M are defined by:

1. The dam regulatory authority for the jurisdiction where the barrier is located, and
2. The terms and conditions of the barrier owner cooperative agreement or agent MOA with the GLFC.

The dam regulatory authority has statutory authority over dams within its jurisdiction, which may include requirements for inspections and maintenance. Requirements are described in laws and regulations that deal primarily with dam safety. The height and impoundment area of barriers generally fall below the limits required for the application of dam safety regulations in most jurisdictions. Barriers generally are of limited risk to public safety and the environment; nonetheless, there are statutory requirements for the inspection and maintenance of the structures over their lifetime of 50 years. From time to time, dam regulatory authorities may inspect barriers and issue remedial maintenance orders as required.

Under the cooperative agreement, O&M requirements are detailed. Guidance for these is provided in the protocols for O&M that follow. The cooperative agreement provides details on what portion of O&M the GLFC will fund. A cooperative agreement is executed when the barrier is near completion and terms have been negotiated with respect to the cost sharing of O&M budgets. The barrier coordinators will consult barrier owners as part of the BAWP to determine planned annual O&M requirements.

Operate

The operation of barriers, traps, and fish passage facilities are described in the following basinwide protocols:

1. Operations Procedures for Barriers,
2. Operating Times for Barriers,
3. Operations and Maintenance of Traps, and
4. Operations and Maintenance of Fishways.

While barrier owners are responsible for barrier operations based on the cooperative agreement with the GLFC, the barrier coordinators will coordinate the process. Barrier owners or the barrier coordinators may contract with third parties to undertake operations on their behalf. The third party contractors may include the control agents. The protocols are to be used as guides to establish contracts with third parties.

Operations manuals, or schedules are usually prepared during the final engineering and design stage and provided to barrier owners as part of the cooperative agreement. Operations manuals may be

combined with maintenance manuals. Manuals are to be incorporated into the barrier inventory and subject to revision as required. There may also be regulatory requirements for an emergency measures plan for the site.

Barriers are routinely visited by a variety of people throughout the year including personnel responsible for barrier operations. Scheduled inspections by engineers are normally carried out as part of maintenance; however, it is useful that other non-engineering personnel visually check a barrier site when they are there and report any suspect conditions to the barrier coordinators and barrier owners. An inspection form is included in the appendix attached to the protocol for Maintenance Procedures for Barriers.

Maintain

The maintenance of barriers, traps, and fishways are described in three protocols:

1. Maintenance Procedures for Barriers,
2. Operations and Maintenance of Traps, and
3. Operations and Maintenance of Fishways.

While barrier owners are responsible for barrier maintenance according to the terms of their cooperative agreement with the GLFC, the barrier coordinators will coordinate the process. Barrier owners or the barrier coordinators may contract with third parties to undertake maintenance on their behalf. The third party contractors may include the control agents. The protocols are to be used as guides to establish contracts with third parties.

Scheduled inspections by engineers are normally carried out as part of maintenance. Scheduled inspections and reporting by engineers to dam regulatory agencies may also be required.

The structural failure of most barriers represents limited risks to life, property, and the environment. Barrier owners should have emergency action plans where required by regulation. In the event that natural or man-made disasters affect the integrity of barriers, the protocol Emergency Measures Advisory Services will provide technical advice to barrier owners and emergency measures agencies.

Routine maintenance requirements are identified and planned through the BAWP and funding provided through the control agents' MOAs and cooperative agreements with barrier owners. From time to time major unanticipated repairs to barriers may be required. Major repairs are those that require engineering design and regulatory approval.

Operate And Maintain Barrier Inventory

The following two tables show current barrier owners. Not all structures in the U.S. were built originally for lamprey control (de facto barriers).

Michigan Department of Natural Resources	11 sites
Wisconsin Department of Natural Resources	3 sites
Tribes/First Nations	1 site
Private owners	6 sites
Local governments	2 sites
U.S. Army Corps of Engineers	1 site
TOTALS	24 sites

Table 1 Current barrier owners in the U.S.

Department of Fisheries and Oceans	25 sites
Ontario Ministry of Natural Resources	5 sites
Ontario Ministry of Transportation	1 site
Private owners	2 sites
Municipality	1 site
Grand River Conservation Authority	2 sites
Metro Toronto and Region Conservation Authority	2 sites
TOTALS	38 sites

Table 2 Current barrier owners in Canada

There are currently 62 operational barriers and 87 traps in the program. The revised Barrier Strategy and Implementation Plan will identify the next 20 barrier projects to be constructed at an accelerated rate of five new barriers per year. Information systems need to be developed to support the management of the barrier program based on the business life cycle described herein. An assessment of the data elements for information systems to support the program is described as a separate deliverable under this project. The eventual development of systems to support the barrier program will necessitate the development of new information management protocols.

Basin	Portable Traps	Semi-permanent Traps	Permanent Traps
Lake Superior	8		8
Lake Michigan	19	1	
Lake Huron	8	8	9
Lake Erie	4		4
Lake Ontario	7		11
Total as of Feb.1999	46	9	32

Table 3 Trap inventory by basin and type as of February 1999

INTRODUCTION TO PROTOCOLS

Protocol Meaning

The scope of the barrier process, a full life cycle basis from planning to decommissioning, is very broad and covers many areas of scientific and technical interest as well as public administration. This requires considerable detail in some areas much like a manual of practice.

Due to jurisdictional differences, it is not be possible to establish a single common procedure or practice in many areas such as administration. Despite any differences it is important to document where common elements can apply throughout the Great Lakes Basin.

The protocols are iterative. They need to be routinely revised based on knowledge and experience gained through application. The barrier coordinators have the custodial role for the update and revision of the protocols.

Purpose of Protocols

The purpose of a protocol is to instruct others in the manner by which an activity in the barrier life cycle (e.g., operating an adjustable-crest barrier or servicing a lamprey trap) is to be delivered under a wide range of situations found across the Great Lakes Basin. Protocols are intended for use in real situations.

Protocol Content

The following section provides the template used for protocol development. Each protocol stands alone and can be extracted from this report and used independently.

BARRIER PROTOCOL TEMPLATE

1. Protocol Title: Brief Descriptive Title for the Protocol

2. Protocol Business Need

Description of the business need(s) for the protocol (why) and whether the protocol is required to satisfy business requirements within the barrier program (internal) or those required to satisfy external business requirements (i.e., regulatory requirements).

3. Protocol Deliverables

Describes the protocol's intended outcome and frequency of use.

4. Target Audience

Defines the intended target audience who will implement the protocol.

5. The Jurisdiction for Protocol Use

The direction of the barrier program is to plan, develop, operate, and maintain barriers throughout the Great Lakes Basin on a border-blind basis (basinwide). This direction may not always be met or need to be met with all protocols. In this section the area(s) of jurisdiction to which the protocol is to apply is identified. The hierarchy of jurisdiction for protocol use includes:

1. Basinwide without jurisdictional requirements,
2. Basinwide with jurisdictional requirements, and/or
3. Protocols by jurisdiction.

Some protocols will have general application across the Great Lakes Basin. Others have general application across the basin but some actions vary because of jurisdictional requirements (e.g., labor codes, workers' health and safety, etc.).

In other instances separate protocols will have to be written for each jurisdiction where the particular action is to be implemented. The decision on which variant to select may be based on how extensive the jurisdictional requirements are relative to the balance of the protocol (i.e., greater than 50%). Other distinctions may be appropriate (i.e., the protocol may be intended solely for use within the control agent organization due to government policy and procedure requirements).

6. Procedures

The sequence of actions required to implement the protocol is described. Actions are listed in logical and common sense order.

6.1. Skills Required

The technical and professional skill level and certification required to carry out the various steps in the protocol is described here.

6.2. Level of Effort

The level of effort required for each action within the protocol (i.e., days, weeks, and/or months). The number of people required (i.e., two people required for health and safety) and their roles (e.g., two people required for site survey protocol, one for operating rod and the other for operating transit).

6.3. Definitions

Terms, concepts, or acronyms unique to the description of protocol actions.

7. Tools Required

Specialized tools and other resources that are required to implement the protocol (e.g., backpack electrofishing gear for larval assessment surveys).

8. Information Requirements

Describe the data/information required by or used by the protocol and their information management requirements.

9. Contract Requirements

Identify what, if any, contract requirements may be needed to implement the protocol.

10. References

Cite any references used in the protocol. Citations for paper sources should be based upon the Canadian Journal of Fisheries and Aquatic Sciences, which can be obtained at http://www.cisti.nrc.ca/cisti/journals/efisauth.html.

Citations from electronic sources should be based on International Standard ISO 690-2 (Information and documentation - Bibliographic references - Part 2: Electronic documents or parts thereof). An abridged version of this standard is available at http://www.nlc-bnc.ca/iso/tc46sc9/standard/690-2e.htm.

11. Use of Other Protocols

Citations of any other control and assessment protocols that are used. If other protocols are used directly they are cited under Section 6 where and when used.

12. Protocol Authority

Defines the appropriate level of approval authority for amendments to the protocol for version control. A body of experts may be defined to supervise the implementation of protocol.

12.1 Allowance for Variations from Protocol

Recommendations to authorize barrier practitioners to deviate from their protocols after involving consultation with appropriate experts if required.

12.2 Protocol Status and Revision

How frequently should the protocol be reviewed for currency and relevance?

12.3 Author and Date

The name of the original author and the date of the protocols release.

1. Protocol Title: Reach Selection

2. Protocol Business Need

The goal of the site selection process is to locate a sea lamprey barrier on a stream or river where it will be most efficient and cost-effective. A barrier is cost-effective when the cost of its construction, operation, and maintenance is offset by savings achieved by eliminated or reduced lampricide treatments and fishery savings (e.g., less fish stocking) attributable to improved lamprey control. Implicit in this definition is the objective of effectively blocking as much lamprey spawning and larval habitat as possible, and building the least costly structure that will accomplish that objective. The site selection planning process can be described as having three steps:

1. Identifying those streams that are suitable candidates,
2. Specifying an optimum reach within which a barrier may be located (described herein), and
3. Identifying a construction site with appropriate geotechnical, topographic, access, land ownership, and other characteristics (Site Selection protocol).

This process is an internal business requirement of the barrier program.

3. Protocol Deliverables

The outcome of this protocol is selection of a stream reach within which a barrier can be constructed on each candidate river. Ideally, identification of a suitable stream reach will need to be completed only once for each stream; however, if the first reach selected proves to be unworkable, the protocol can be re-applied using much of the same information. Outputs will be documented as periodic revisions to the GLFC Barrier Strategy and Implementation Plan.

4. Target Audience

The barrier coordinators and supporting staff of the two control agents.

5. The Jurisdiction for Protocol Use

The protocol is applicable within all jurisdictions of the Great Lakes Basin.

6. Procedures

6.1. Strategic Planning

Selection of a suitable stream reach and a specific site within that reach for barrier construction is preceded by identification of the stream as an appropriate candidate for a barrier project through the Barrier Strategy and Implementation Plan. This involves examining the Great Lakes tributaries that are regularly treated with lampricides to determine if they are suitable for alternative control using barriers. A basinwide inventory of all potential barrier projects and data characterizing each project is assembled. A variety of technical, biological, and administrative criteria are evaluated for each potential project. In order to estimate and compile data related to criteria on which streams are ranked, it is necessary to make a preliminary judgment as to the existence of an appropriate site within a certain stream reach, the process described in detail herein.

Preliminary construction cost projections are based on regressions derived from a database of previous projects. Cost-effectiveness of a proposed barrier is evaluated by comparing all treatment and barrier costs in pre- and post-barrier scenarios. Barrier costs include planning/design, construction, operation, maintenance, and decommissioning or

recommissioning. All costs are amortized over a 50-year barrier life cycle and converted to net present values, except in the case of timber structures, which are amortized over a 25-year period. Planning and capital construction costs are lump sums; operating and maintenance and treatment costs are annualized according to occurrence cycles.

The list of candidate streams is then ranked using an analytic hierarchy model (AHP), in which weights for each criterion are used to order the individual projects. Single criteria, such as cost-effectiveness or lampricide savings, can also be used to prioritize projects. This process leads to a preliminary judgment of whether a barrier or continued lampricide treatments will be the preferred method of lamprey control in each stream.

In the future, the Barrier Strategy and Implementation Plan will be integrated with the IMSL model so that barrier selection can be fully incorporated with proposed lampricide treatments when methods of control are recommended within a lakewide and basinwide framework. When barriers are integrated within IMSL, barrier strategic planning will become an iterative process incorporating new knowledge of barrier life cycle costs as well as lampricide treatment costs. This will involve reprioritization of barrier projects on a regular basis.

Once an optimum reach is located, barrier coordinators are able to compare the potential project with other high-ranked projects and can then advance a preliminary project proposal to the SLIC and GLFC for approval to proceed. What follows is the process for locating an optimum reach within a barrier candidate stream.

6.2. Lamprey Distribution and Habitat Availability

The objective of barrier construction is to eliminate or reduce lampricide treatments by blocking off suitable habitat. Selection of a suitable stream reach (within which there can be expected to be a site to achieve this goal) requires information on past and present lamprey distribution and the location of spawning and larval habitat. The best source of this information is the staff of the control agents' larval assessment units and their databases. Additionally, consultation with local sport anglers and state/provincial agency biologists is an excellent source for this type of data.

It should be noted that habitat-based predictions of a barrier's likelihood to end treatments are imprecise and are a source of significant uncertainty in benefit/cost calculations. While we can usually observe the presence or absence of suitable-sized spawning gravel, we do not have a complete understanding of other factors necessary for lamprey reproduction and survival, such as temperature regimes and dissolved oxygen cycles. In fact, some Canadian barriers with identified spawning habitat downstream do not support lamprey reproduction in those downstream reaches. It is recommended that most judgements of whether treatment will continue post-barrier be made conservatively so as not to overestimate benefits, that is, the usual procedure is to assume that lampreys will continue to reproduce below the barrier if spawning habitat is present.

A factor also complicating the issue of whether treatments will continue post-barrier is the procedure currently used to select streams for lampricide treatment. Quantitative larval population estimates are made for all streams that are proposed for treatment in the following year (Fodale, et al. 1998 a & b), and a cost per transformer is calculated, such that the greatest number of potential transformers can be removed using the resources available in that year. This procedure makes it more unlikely than in the past that short reaches below barriers will be treated-- although treatment costs are likely to be significantly less, the amount of habitat (hence the number of larvae) being much smaller, reducing the treatment benefit proportionately more than the treatment cost. In

this scenario, continued treatments below the barrier treatment would not be cost-effective and the benefit/cost (B/C) ratio for a barrier would be increased.

This suggests that even if there is some sea lamprey reproduction below barriers, treatments may still be eliminated, but with a trade-off in transformers allowed to escape to the lakes. However, this may result in a smaller impact than the non-barrier scenario, which includes escapement in the order of 3 to 5% of a larger number of larvae as residuals from treatment.

In summary, if larval densities are low in downstream reaches, spawning gravel is absent or scarce, or other evidence suggests that lamprey reproduction will be minimal post-barrier, it can be postulated for B/C calculations that treatment below the barrier site will be unnecessary. Otherwise, it should be assumed that treatment would continue.

The following questions should be answered in order to select the optimum reach within which to site a barrier:

- Is there a downstream limit to spawning habitat?
- Is there a downstream limit to larval habitat?
- Is there in fact a typical downstream limit to larval lamprey distribution, or are they usually found at the mouth? If found near the mouth, at what densities do they occur? In general, the closer a barrier is located to the mouth of a stream, the more likely it is to eliminate treatments, but at the same time it is more likely to require passage of non-jumping fish.
- Is there reason to believe that water quality (high temperature, low dissolved oxygen, contaminants or pollutants) will limit or preclude lamprey reproduction in downstream reaches, even if habitat is available? Does the present species assemblage (fish, plants, insects, etc.) suggest that habitat or water quality is poorer downstream?

6.3. Lampricide Treatment Strategies

Strategies for treatment of infested tributaries will affect initial barrier site selection. It is advantageous to locate a barrier downstream of the lowermost significantly large infested tributary if it is likely that treatments could be completely eliminated by doing so. In this situation, a barrier located upstream of the infested tributary may not be cost-effective; the site selection process should then demand that the barrier be located downstream of the tributary, or the stream downgraded in the priority list. If a barrier below a major infested tributary is not feasible, cost-effectiveness must be recalculated. On the other hand, if it is unlikely that treatment could be eliminated on the main stream (i.e., any site would still result in significant reproduction), then a barrier site located upstream of an infested tributary might still be considered. Two barriers can also be considered-- one on the tributary and another on the main stream, although this scenario may not be cost-effective in some cases.

If an infested tributary below the barrier candidate reach is relatively small, it may not diminish cost effectiveness significantly to locate a barrier upstream of the tributary. Similarly, if treatment of the lower main stream is likely to be required post-barrier in any case, locating the barrier upstream of an infested tributary is unlikely to reduce cost-effectiveness significantly. If an infested tributary is located near the mouth of a main stream, below spawning habitat on the main stream, and is usually treated separately (e.g., the White River, tributary to the Bad River, Ashland County, Wisconsin), it can still be cost-effective to consider a barrier on the main stream only.

6.4. Preliminary Hydrology

Detailed hydrology data collection and analysis is needed when barriers are designed (protocols Hydrology and Hydraulics in Barrier Design and Preliminary Engineering Designs and Plans), but an examination of existing information during the site selection process can help to choose a reach and guide selection of barrier type.

The objective of fixed-crest type barriers is to maintain at least a 30.5 cm (12 in.) vertical drop during periods of lamprey migration. If stream flow during lamprey migration is very stable, and shows little variation in water level, then a low crest will suffice. If stream flow is very unstable, or "flashy", water levels will show large variations during the lamprey migration, and a relatively high crest will be required to maintain the necessary drop. Hydrology/hydraulics and soils may determine the barrier type necessitated for a specific reach (i.e., electrical or fixed-crest) or they may indicate the need to focus on a different reach with wider banks or a steeper gradient, or to remove the stream from consideration. In the case of unstable streams; adjustable-crest barriers might not be able to ensure a minimum drop any more than a fixed-crest barrier, but they have the major advantage that they can be lowered in extreme flood conditions, minimizing upstream backwater impacts.

Without a detailed, site specific analysis of hydrology, comparative hydrology can be approximated using published records of the USGS and Environment Canada. This can help determine whether a barrier will be feasible in a particular stream or reach. All available data needs to be analyzed, evaluated, and compared. A few high-priority barrier candidate streams have permanent water level gauges for which many years of data are available. In these cases, published data include descriptions of mean annual flow, mean annual flow by month, exceedence flows for specific periods, etc. Most candidate barrier streams do not have permanent gauges, but flow regimes within a region are similar, and some information can be inferred from gauges on nearby streams using comparative hydrology. Water level data compiled by barrier staff using automatic water level recorders will also be useful in understanding hydrology of nearby streams.

In the case of ungauged streams, it is necessary to determine whether there are water control structures upstream, such as hydroelectric dams or lake level controls that will alter the natural flow regime during the period of lamprey or fish migrations. For example, stop logs are sometimes removed all at once from lake level control structures, producing unnatural floods that cannot be predicted by the known hydrology of the stream. Many streams are regulated by control structures used for hydroelectric power generation and/or flood control. Access to the flow control plans for these existing structures are required, including if any are scheduled for decommissioning. It is also recommended that downstream channel reaches be examined for water control structures that can effect the elevation of the barrier tail water, i.e., beaver dams, log jams, rock dams, or restricted bridge openings. If site specific water levelogger data is available, this should reflect the existence of such controls unless the obstructions have recently developed.

In most instances, for the final barrier location and design fairly specific hydrology/hydraulics work for that area of the stream will be required (engineering and environmental studies).

6.5. Preliminary Fish Data

In order to determine fish passage needs and fulfill requirements of required environmental permitting, it is necessary to have detailed information about the fish species present in each stream. Prior to formal preparation of environmental documents

and actual design of fishways, however, it is useful to gather preliminary information about fish and their habitat use in order to evaluate the feasibility of establishing a lamprey barrier in a particular reach.

Of primary importance is establishing the presence and relative importance of fish runs that coincide or overlap with lamprey spawning runs, for example, lake sturgeon (see also Section 6.8, Endangered Species in this protocol), walleye, steelhead, and smallmouth bass. For most of these species, spawning habitat requirements are similar to those of lamprey, and a fixed-crest barrier that will block lamprey will also isolate spawning habitat for non-jumping fish. Jumping fish can usually navigate a fixed-crest barrier provided that there is an adequate jumping pool at the foot of the structure. An electrical barrier will require a separate structure to pass even jumping fish if such is deemed necessary. An initial determination of fish species present will aid in estimating fish passage costs and will, therefore, result in a more accurate estimate of barrier cost-effectiveness.

The primary source of this information should be the state/provincial natural resource management agencies and local fisheries management plans established by the agencies; the secondary source is the assessment and control databases maintained by the control agents. If little data is available it is possible to glean a great deal of such information from local sport anglers and landowners.

6.6. Topography and Preliminary Soils Evaluation

An initial inspection of topographic and soil maps can determine whether barrier construction may be feasible in a stream reach identified as desirable by other criteria. It is best to visit the area for a visual inspection if possible, or to consult with control agent field personnel familiar with the area.

An ideal reach for any type of fixed-crest barrier has a good gradient and a well-contained channel to limit impoundment size. A straight section of river is preferred to minimize erosive scour downstream. Sound bedrock is an ideal substrate type except when it needs to be blasted. Most valley alluvial materials (from boulders to fine sand) as well as lacustrine clays and tills can be accommodated in the design process. Soil type may dictate the design type and construction method for barriers, for example, sheet piling can be driven easily in sand or clay but not as easily in soils containing large boulders. Organics (peat or muck) need to be excavated out and, depending on deposit depth can be very expensive to remove. If a potential site is a wide, low wetland with muck soil, for example, it would be advisable to consider other sites. If no other sites are available, it may be possible to consider an electrical barrier, depending on a detailed analysis of hydrology.

6.7. Special Legislative Designations

It is important to identify special designations of certain streams or stream reaches early in the site selection process. While many special designations will not inhibit barrier construction, some almost completely preclude projects that will modify flow. Examples of known special legislative designations are:

6.7.1. U.S. National Wild and Scenic River Act and the Michigan Scenic Rivers Act

In the U.S., several barrier candidate streams or portions thereof were designated National Wild and Scenic Rivers in 1968, including the Pere Marquette, Ontonagon, Whitefish, and Carp Rivers, and Bear Creek (Manistee River). Several streams in Michigan were proposed for designation (so-called “Congressional study streams”) by the

Michigan Scenic Rivers Act of 1991 (P.L. 102-49), including sections of the White River and the Little Manistee River and additional sections of the Ontonagon, Whitefish, and Carp Rivers. Within this federal designation are three subcategories: wild, scenic, and recreational. Although the law contains specific language allowing sea lamprey barriers under certain conditions, barrier construction in reaches designated wild or scenic is likely to be very difficult. It should be possible in reaches designated recreational, but this has not been tested for a permanent barrier. A temporary electrical barrier was operated in a recreational reach of the Carp River (Mackinac County, MI) for three years to collect males for SMRT under a permit from the U.S. Forest Service. An electrical barrier was constructed on a scenic reach of the Pere Marquette River by an act of Congress (public law 98-444 approved Oct. 4, 1984).

6.7.2. Michigan Natural Rivers Act (State Act 231 of 1970)

The objective of the Michigan Natural Rivers Program is primarily to work with local units of government to protect designated rivers via zoning laws. It is oriented toward private lands and concerned with zoning issues such as building setbacks, sediment control, and aesthetics. It is not considered an impediment to the barrier program. Barriers on Michigan Natural Rivers include the Jordan River electrical weir, Homestead Dam on the Betsie River, and Hesperia Dam on the White River. Designated rivers that are ranked high for barrier projects are the Boardman River (Kids Creek) and the Two Hearted River. Rivers designated both as National Wild and Scenic Rivers and Michigan Natural Rivers are managed cooperatively by the state and federal governments.

6.7.3. Ontario Lands for Life

In 1997, the Ontario Ministry of Natural Resources announced Lands for Life, a comprehensive program for planning all aspects of the future use of Ontario's Crown land and resources. Crown land accounts for 87% of Ontario's territory. The Minister decided that the first phase of Lands for Life should be to develop regional land use strategies for the almost half of Ontario's Crown land on which most resource and recreational demands are made. The initial report is currently in the process of public review. The complete text can be found on the World Wide Web at "http://www.mnr.on.ca/MNR/lfl". It proposes to classify all crown land under seven designations with varying levels of protection, including: Heritage Waterways and Great Lakes Heritage Coastlines (Recommendation 150); and that OMNR, with appropriate partners, should ensure that fish populations and habitat are protected by, among other actions, using and improving planning legislation, policies, standards, and guidelines to protect fish habitat; ensuring that they protect the habitat of rare species and unique populations; rehabilitating degraded habitat of rare species and unique populations, where this may allow population restoration; and maintaining species at risk and unique populations (Recommendation 221). According to OMNR officials, Lands for Life has the potential to affect the barrier program (Peter Burtch, OMNR District Office, 875 Queen St., Sault Ste. Marie Ontario, Canada P6A 6W4, personal communication). Lands for life may require consideration in the environmental assessment process.

6.7.4. Canadian Heritage Rivers System

The Canadian Heritage Rivers System (CHRS) is a cooperative program developed and run by the federal, provincial, and territorial governments to recognize Canadian rivers and to ensure protection of their natural and cultural heritage features and recreational values. In Ontario designated rivers include the French, Mattawa, and Grand Rivers. Under consideration for designation are the Missinaibi, Bloodvein, St. Marys, Thames, and Humber Rivers. There are currently no proposed barrier projects on these rivers.

6.7.5. Wisconsin Northern Rivers Initiative

This is a preliminary effort by the Wisconsin Department of Natural Resources which is currently soliciting public opinion on rivers that should be protected and appropriate methods of doing so. The only barrier candidate stream proposed so far is the Bad River system.

6.7.6. Ohio State Scenic Rivers Program

Ohio has 11 river systems designated for special protection as wild, scenic, or recreational. The only barrier candidate stream so protected is the Grand River. The proposed barrier site is just downstream of the designated reach so would not fall under the authority of the State Scenic Rivers Program. Conneaut Creek, another barrier candidate stream, has been proposed for designation by the program.

6.7.7 New York Wild, Scenic, and Recreational Rivers Act

New York has many rivers designated by the state as wild, scenic, or recreational most of which are in Adirondack Park. No barrier candidate streams are included.

6.8. Endangered Species

It should be determined early in the reach selection process whether any species in categories afforded special protection are present in the candidate stream or adjoining shorelands. The presence of endangered, threatened, or otherwise protected species does not preclude barrier construction, and in fact, may favor barriers over lampricides as a method of control in some instances. However, the presence of endangered species will require additional consultation with federal, state, and provincial agencies, and additional permits will likely be needed (see protocols by jurisdiction for Environmental Assessments, Permits, and Approvals Required for Barrier Construction).

This initial examination of endangered species should probably be limited to fish, mollusks, and other aquatic species, the distributions of which are readily available from each jurisdiction. The presence of endangered terrestrial plant and animal species may become a concern during barrier construction and is to be addressed in the protocol entitled Site Selection. Permit and environmental assessment-related endangered species issues are addressed in protocols by jurisdiction for Environmental Assessments, Permits, and Approvals Required for Barrier Construction.

Mitigation requirements for lake sturgeon (Acipenser fulvescens) will likely include passage of sturgeon to upstream spawning areas in designated streams, unless it can be demonstrated that spawning occurs primarily below the proposed barrier site. At this time sturgeon passage technology is not well developed and passage cannot be guaranteed. Until methods of sturgeon passage are better researched and tested, barriers on known sturgeon spawning streams, or candidate sturgeon restoration streams, will be unlikely to be approved by permitting agencies. Michigan has designated several barrier candidate streams as top-priority sturgeon restoration streams (Hay-Chmielewski, 1997). The Wisconsin Department of Natural Resources has a sturgeon management plan currently in draft form (Wisconsin DNR, 1997). The GLFC sponsored Lake Superior Technical Committee is also drafting a lake sturgeon rehabilitation plan that designates important habitats and restoration goals (Auer, 1999).

6.9. Skills required

Preliminary reach selections should be carried out by a fishery biologist who consults liberally with staff in the assessment and control units of the agents. A professional engineer with barrier dam experience should be consulted for the preliminary hydrology and topography and soils determinations and work with the biologist locating the site in the reach.

6.10. Level of effort

Task	Staff hours
Lamprey Distribution and Habitat Availability	20
Lampricide Treatment Strategies	4
Preliminary Hydrology	24
Preliminary Fish Data	16
Topography and Soils	16
Special Legislative Designations	4
Endangered Species	4

Components requiring fieldwork will vary as a function of the level of detail required and transportation times.

6.11. Definitions

AHP Model- Analytic hierarchy process model- a process model that permits numerical expressions of various factors and their weighting such that one or more preferred options can be selected from a multitude of options and alternatives. This model is one of the methods used to rank barriers in the GLFC Barrier Strategy and Implementation Plan.

IMSL-Integrated Management of Sea Lamprey-the principles of integrated pest management applied to sea lamprey control.

7. Tools Required

Aerial photos, topographic maps, soil maps, USGS, USACE and Environment Canada hydrology records, endangered species lists, suitable vehicle for rugged field travel, canoe, kayak, or other small boat.

8. Information Requirements

Topographic maps and aerial photography are available from the USGS, Natural Resources Canada, OMNR, MDNR, and many other state, provincial, federal, and commercial sources.

Endangered species lists available from agencies in each jurisdiction.

Control agents' larval assessment databases and stream habitat information.

State/provincial fisheries data, e.g., creel surveys, mark-recapture surveys, stream water quality, and aquatic habitat surveys.

9. Contract Requirements

None normally required unless private contractors are hired to collect unavailable data, e.g., fish surveys, hydrological data, etc. FWS, DFO-SLCC, or GLFC contracts would be used.

10. References

Fodale, M., M. Twohey, G. Barner et al. 1998(a.). Larval assessment sampling protocol using the AbP-2 backpack electrofisher in Great Lakes streams. Sea Lamprey Management Program. 13 pp.

Fodale, M., M. Twohey, G. Barner et al. 1998(b.). Larval assessment sampling protocol for non-wadable waters of the Great Lakes and its [sic] tributaries. Sea Lamprey Management Program. 13 pp.

Hay-Chmielewski, Liz and Gary Whelan, eds. 1997. Lake Sturgeon Rehabilitation Strategy, Michigan Dept. of Natural Resources Fisheries Division, Fisheries Special Report 18. 52pp.

Auer, Nancy A., 1998. Lake Sturgeon Rehabilitation Strategy for Lake Superior (draft), Great Lakes Fishery Commission, Lake Superior Technical Committee. 24pp.

Wild and Scenic Rivers Act (16 U.S.C. 1271)

Wisconsin Department of Natural Resources, Bureau of Fisheries Management and Habitat Protection, 1997. Wisconsin's Sturgeon Management Plan (draft). 14pp.

11. Use of other protocols

Site Selection
Barrier Annual Work Plan
Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction
Ontario and Canada Environmental Assessments, Permits, and Approvals Required for Barrier Construction
U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction
Ohio Environmental Assessments, Permits, and Approvals Required for Barrier Construction
New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction
Hydrology and Hydraulics in Barrier Design
Design Criteria for Permanent Traps
Design Criteria for Fish Passage
Preliminary Engineering Designs and Plans

12. Protocol Authority

The technical experts for this protocol are the barrier program staff of the control agents.

12.1. Allowance for Variations from Protocol

There is some latitude in variation from the protocol particularly as it applies to access and completeness of existing data from natural resource agencies. Approval for minor variations from the protocol should be in writing as a consensus opinion from the barrier coordinators.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3. Author and Date

Ellie Koon, March 1999

SITE SELECTION

1. Protocol Title: Site Selection

2. Protocol Business Need

The purpose of this protocol is to select a construction site with appropriate geotechnical, topographic, access, land ownership, and other characteristics. Final site selection presumes that:

1. The stream has been determined to be a suitable candidate in the GLFC Barrier Strategy and Implementation Plan;
2. That an appropriate reach has already been identified according to the Reach Selection protocol; and
3. That approval for planning studies and preliminary engineering design of the project has been obtained under the BAWP and funding is approved or assured from the GLFC.

This process is an internal business requirement of the barrier program.

3. Protocol Deliverables

The outcome of the protocol is to select an optimum barrier site within a pre-identified reach on each stream. Ideally, it will need to be completed only once for each stream; however, if the first site selected proves to be unworkable, the protocol can be reapplied. Once the optimum site has been selected on a reach, budgets for detailed site studies are developed and submitted under the Barrier Annual Work Plan for input to SLIC and the GLFC for approval and funding.

4. Target Audience

Barrier coordinators and support staff from the control agents, barrier cooperators, cooperators, and partners.

5. The Jurisdiction for Protocol Use

The protocol should be applicable within all jurisdictions of the Great Lakes Basin with some differences in procedures as described below.

6. Procedures

6.1. Technical Requirements for Barriers

Soil borings and detailed hydrology analysis will be required later as part of engineering and environmental studies (Surveys at Barrier Sites and Hydrology and Hydraulics in Barrier Design protocols); however, the following generalizations can be made in regard to final site selection:

1. Except for deep highly organic soils, a barrier can be constructed on virtually any soil type, but the soil at a particular site may limit potential barrier designs and construction methods as discussed in the Reach Selection protocol.
2. The hydrological characteristics of a stream may limit site selection and barrier design choices. Virtually all fixed-crest barriers built for sea lamprey control have a head of less than 1.5 m (5 ft) and most are less than 1 m (3 ft). If the hydrology of a stream dictates that the head must be higher, or if a higher head will cause unacceptable upstream flooding, then another site or another design should be considered. Adjustable-crest barriers have virtually the same limitations, except that they can minimize upstream flooding effects at high water if programmed to drop the crest when water level exceeds a certain height. If proper sites on a stream are very limited and the stream is hydrologically unstable, a gradient-field electrical barrier may be the only barrier technology possible. Gradient-field electrical barriers are

effective to a maximum water depth of about 4 m (12 ft) (Jeff Smith, Smith-Root, Inc., personal communication).

6.2. Determine Availability of Access

While lack of established access would not preclude a barrier site from consideration, it is preferable to select a site with existing access to lessen costs. Existing roads can be located using maps from state, provinces, counties, hunting, and fishing clubs, etc. Control agent lampricide treatment and larval assessment records are particularly useful in locating roads and trails. Access on private roads will require permission from the landowner and possible easements at a later date if construction is to proceed using the access road.

If a site without nearby access is deemed favorable as a result of other factors, it can be cost effective to construct an access road. In the absence of existing roads, topographic maps and air photos can reveal opportunities for access, such as abandoned railroad grades, ridges, and old roads. Topographic and other maps can also indicate areas where roads should not be considered, for example, long distances across wetlands. The estimated cost of road construction must be considered as part of the barrier construction cost and factored back into the B/C analysis in the Barrier Strategy and Implementation Plan. If access road construction reduces the cost-effectiveness of the project, another site may be considered if possible or the stream should be downgraded in the Barrier Strategy and Implementation Plan.

If a potential site is close to an existing bridge, the barrier normally should be located upstream of the bridge in order to minimize saturation of soils and an increase in flood levels at the existing structure. Exceptions depend on barrier and soil types, gradients, and design of the bridge. Hydraulic analysis of the headwater influence of the dam is relied on in the industry to predict upstream water levels and extents of flooding caused by dams. The bridge owner for acceptability could review these modeling results. This will vary on a case-by-case basis. Some bridges have more vertical clearance for flood flows than necessary, just because of the shape of the valley being crossed. Building barriers near bridges may improve access, which is desirable. When building dams upstream of bridges – some additional erosion protection may be required depending on erosive potential of tailwater. Rather than limiting where barriers are built with respect to bridges, identify that when bridges are within the area of hydraulic influence of the dam, the bridge owner should be consulted, and permits / agreements obtained as necessary e.g., the McIntyre barrier was built just below a bridge.

Suitability of potential access options must be verified by a site visit.

6.3. Verification of Habitat Availability

Before final designation of a construction site, the assessment unit of the control agent should verify the distribution, amount and quality of spawning gravel and/or larval habitat below the site if the B/C calculation is based on a prediction that the barrier will eliminate treatments. Floating the stream in a boat or canoe or walking in chest waders at low water is the most reliable means of doing so.

6.4. Land Ownership and Easements

Determination of land ownership and arrangement of easements (if necessary) must precede final selection of a barrier site, including flooding or flowage easements extending upstream. Easements need not be secured at the time of final site selection, but the willingness of the landowner(s) must be reasonably well established. It is best to

have a written commitment from the jurisdictional agency, if public land, or a letter of support from the landowner if private. It should be remembered that the proposed structural life expectancy of a barrier is 50 years, thus perpetual or long-term leases are preferable to shorter-term arrangements.

6.4.1 United States Procedures

In the U.S., the states and not the FWS or GLFC have purchased or leased barrier sites. The capability exists for the FWS to obtain easements, as was done for the AC (alternating current) electrical weirs in the 1950s and 1960s. Although this has not been used in recent times for barrier work, the potential still exists but has implications on the application of federal laws and regulations. Remedial works projects (to lamprey proof a structure) have been conducted on dams owned by private or corporate entities in the U.S. In these cases, ownership of the structure and the land have remained private, with the GLFC usually directly contracting the remedial construction.

6.4.1.1. Michigan

For barriers in Michigan the state is the owner of all existing structures other than remedial works projects. If a barrier site and any predicted flooding effects are confined to state land, barrier construction can proceed without further arrangements once agreement is reached with appropriate state authorities. If private land, the state has either acquired the land or obtained a perpetual easement, with the GLFC reimbursing the state for any costs. The Real Estate Division of the MDNR handles land purchases and easements. If a barrier site is located on federal land, the GLFC and state of Michigan may construct barriers under a cooperative agreement or permit with the agency that has jurisdiction. For example, the Miners River barrier was constructed by the state under an informal agreement with the National Park Service. Abutments for the Carp River temporary sterile male collection barrier were constructed under a direct contract with the GLFC Secretariat according to a special use permit from the U.S. Forest Service. The abutments may remain in place as long as the permit is renewed.

6.4.1.2. Wisconsin

The two existing barriers in Wisconsin (Middle and Brule Rivers) were constructed on land owned by the state of Wisconsin under a program similar to that in Michigan, in which the state became the owner of the structures. The proposed site for the single high priority barrier candidate stream in Wisconsin, the Bad River, is located on land belonging to the Bad River Band of Lake Superior Chippewas. No U.S. precedent exists for barrier construction on tribal land. However, there may be non-barrier precedents which may be useful examples.

6.4.1.3. Other States

No dedicated "from scratch" barriers have been constructed in other U.S. states. It is hoped that procedures modeled after those used in Michigan and Wisconsin can be used.

6.4.2. Canadian Procedures

Since the Canadian barrier program is conducted entirely within the province of Ontario, there is only one provincial jurisdiction to deal with if the site falls on provincial Crown land. The OMNR and DFO process the transfer of land to DFO. The province stipulates that the land returns to the province if DFO no longer has an interest in it. If the site is on private land, the SLCC administrator leases it in the name of DFO.

There is one precedent for barrier construction on First Nation land in Ontario, that of the Salmon River fixed-crest barrier on the Tyendinaga Reserve. The barrier is seen as a partnership, with no formal agreement regarding ownership or lease; the understanding is that DFO built it and thus maintains it and the Tyendinaga Reserve operates the lamprey trap on a contract basis.

6.5. Availability of Electrical Power and Telecommunications

Depending on the barrier technology planned for a site, it may be necessary to have electrical power available. Fixed-crest barriers do not require electricity, but it may be preferable if fish traps are to be operated at night. For gradient-field electrical barriers and computer-controlled adjustable-crest barriers, line electrical supply to the site is mandatory. As with road access, the estimated cost of bringing power to a site must be considered as part of the barrier construction cost and factored back into the B/C analysis in the Barrier Strategy and Implementation Plan.

Computer-controlled adjustable-crest barriers and gradient-field electrical barriers require a telecommunications connection in the form of a telephone line for modems used for remote control of the barrier control system.

6.6 Historical/Archaeological Consultation

Some jurisdictions will require consultations (this always needs to be done for USACE projects) to verify that barrier construction will not disturb historical or archeological sites, depending on the proponent of the project and the source of funding (see protocols by jurisdiction for Environmental Assessments, Permits, and Approvals Required for Barrier Construction). This can usually be done by correspondence. On First Nation/Reservation lands the location of burial and ceremonial sites should be verified with tribal representatives.

6.7. Skills Required

Persons using this protocol should be familiar with lamprey control and assessment procedures, preferably with some dam construction knowledge. A professional engineer with dam construction experience should be consulted for the soil evaluation and design possibilities for final site locations.

6.8. Level of Effort

Task	Staff hours
Technical Requirements for Barriers	8
Determine Availability of Access	24
Verification of Habitat Availability	16
Land Ownership and Easements	24
Availability of Electric Power	4
Historical/Archaeological Consultation	8

7. Tools Required

Aerial photos, topographic maps, soil maps, USGS, USACE and Environment Canada hydrology records, suitable vehicle for possibly rugged field travel, canoe or small boat.

8. Information Requirements

Topographic maps and aerial photography are available from the USGS, Natural Resources Canada, OMNR, MDNR, and many other state, provincial, federal, and commercial sources.

Public records regarding land ownership.

Control agents' larval assessment databases and stream habitat information.

State/provincial fisheries data for access, barrier site, and flooding data, e.g., creel surveys, mark-recapture surveys, stream water quality, and aquatic habitat surveys.

9. Contract Requirements

Easements for access, barrier site, and flooding may need to be contracted with private landowners or other agencies.

10. References

11. Use of Other Protocols

Reach Selection
Barrier Annual Work Plan
Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction
Ontario and Canada Environmental Assessments, Permits, and Approvals Required for Barrier Construction
U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction
Ohio Environmental Assessments, Permits, and Approvals Required for Barrier Construction
New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction
Hydrology and Hydraulics in Barrier Design
Surveys at Barrier Sites
Design Criteria for Permanent Traps
Design Criteria for Fish Passage

12. Protocol Authority

This protocol is generally applicable across the Great Lakes Basin with jurisdictional variations in land ownership procedures. The technical experts for this protocol are the barrier coordinators and administrative staff of the control agents, cooperators, and barrier cooperators for realty arrangements.

12.1 Allowance for Variations from Protocol

There is some latitude in variation from the protocol particularly as it applies to access and completeness of existing data from natural resource agencies. Approval for minor variations from the protocol should be in writing as a consensus opinion from the barrier coordinators.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3. Author and Date

Ellie Koon, March 1999

BARRIER ANNUAL WORK PLAN

1. Protocol Title: Barrier Annual Work Plan

2. Protocol Business Need

This protocol describes the business process for the development of the barrier annual work plan (BAWP). It includes projects involving the construction of barriers (both new barriers and the retrofitting of existing barriers) and annual barrier operation and maintenance. Barrier research and technology development is part of the research budget submission and is included as part of the GLFC annual work planning process.

Prior to 1998, the barrier program was considered developmental. The program will now be considered operational and will be managed on a full life cycle basis from commissioning to de-commissioning.

Barriers are one component of the overall GLFC sea lamprey control program. Other program elements include larval assessment, lampricide control, the sterile male release technique (SMRT), and alternative control research. This protocol deals only with the BAWP.

The protocol is required to satisfy the program/budget planning requirements of the GLFC and the control agents as well as public and private barrier owners.

3. Protocol Deliverables

The key deliverable of this protocol is the BAWP, which is prepared and submitted for approval for the current fiscal year and includes, as a separate submission, the projected program requirements and cost estimates (PR&CE) for the fiscal year two years hence. Annual work plans should be focussed on clear objectives.

4. Target Audience

The SLBTF is responsible for the development of the BAWP. The barrier coordinators are responsible for preparing most of the budget estimates and plans. Operational and construction budget estimates are provided by the SLBTF to the Program Integration Working Group (PIWG). The SLBTF recommends barrier research and technology development plans and budgets to the Research Priorities Working Group (RPWG) which submits its plans independently to PIWG.

PIWG integrates the BAWP budget with all other sea lamprey control activity plans and makes program recommendations to the Sea Lamprey Integration Committee (SLIC) for consideration and eventual recommendation to the GLFC for approval as the work planned for the next fiscal year. GLFC Secretariat staff is also involved in the preparation of budgets, including the SLPM and the IMSL Specialist.

5. The Jurisdiction for Protocol Use

The barrier program is to plan, develop, operate, and maintain barriers throughout the Great Lakes Basin on a basinwide and border-blind basis. This protocol includes the integration of elements involving basinwide barrier planning including requirements by jurisdiction and barrier ownership.

6. Procedures

6.1. GLFC Budget Process

The BAWP is part of a larger GLFC budgetary process, which is described here for context. The GLFC annual budget process involves other elements beyond the scope of this protocol. The process includes annual budget submissions of the entire GLFC

program (including the sea lamprey control program) for the current fiscal year and the one two years hence. These two budgets are forwarded to the GLFC Commissioners for their approval at their fall interim meeting. After GLFC approval, a description of the approved program for two years hence is included in the GLFC Program Requirements and Cost Estimates (PR&CE) documentation provided to both the U.S. and Canadian federal governments for incorporation into their respective budget appropriation processes.

The BAWP under the control agent MOA is administered differently in the two countries and by the GLFC Secretariat. The administration of funds is described in the following three agency protocols:

1. GLFC Secretariat Administration and Contract Management of Barrier Program,
2. FWS Administration of Barrier Program, and
3. DFO-SLCC Administration of Barrier Program.

Cooperative agreements (CAs) with barrier owners deal with new barriers and routine operations and maintenance requirements including access to repair funds that are retained by the GLFC.

Currently under the U.S. agent MOA, funds for trap operations are not covered under the barrier program. They are funded under the assessment and SMRT programs. The lamprey traps used in the U.S. are mostly portable.

In Canada trap operations are funded under the assessment program while the construction and maintenance of permanent traps are funded under the barrier program. Similarly, funds for the monitoring of barrier performance by larval assessment surveys are from the assessment programs of both control agents.

The evolution of the barrier program from developmental to operational requires its integration with other lamprey control and assessment programs on a life cycle basis.

6.2. Schedule

Activity by the barrier coordinators for planning and implementing the BAWP is conducted throughout the year. Final development and completion of the draft BAWP budget estimates by the SLBTF takes place in September prior to the SLIC fall meeting that occurs in October. The meeting of the GLFC Commissioners for annual program and budget approval normally occurs in early December.

6.3. BAWP Development and Content

An annual progress report of barrier activities for the current fiscal year, including barrier performance, is to be based on deliverables from the protocols used in the barrier program (see **11. Use of Other Protocols**). Where applicable, statistical information on the number of lamprey trapped and fishes passed should also be included. This is a new activity and the report compiled by the SLBTF is to be included in the annual control agent report to the GLFC Commissioners each spring.

The BAWP is developed for the fall budget meeting of the GLFC Commissioners. Budget estimates are made for the following life cycle elements:

1. Based on the revised Barrier Strategy and Implementation Plan a list of strategic barrier construction priorities is developed for three to five years out,

2. Based on the protocols Reach Selection and Site Selection, project plans and cost estimates are made for preliminary engineering and environmental studies for priority barrier sites over the next fiscal year and the one two years hence,
3. Based on the protocols Preliminary Engineering Designs and Plans and Final Design and Engineering project plans, construction and life cycle cost estimates are made for the barriers to be constructed (including modifications to existing barriers and barrier decommissioning, if any) during the next fiscal year,
4. Based on the protocols Operations Procedures for Barriers, Maintenance Procedures for Barriers, Operations and Maintenance of Traps, and Operations and Maintenance of Fishways budget estimates for operation and maintenance for the entire inventory of existing barriers, including repair fund requirements, are made for the next fiscal year,
5. Based on protocols for Performance Measures for Escapement at Barriers and Performance Measures for Traps at Barriers budget requirements for the next fiscal year for control agent performance monitoring for the entire barrier inventory are made and incorporated into the budget plans of the assessment programs of the control agents, and
6. Based on the protocols Application of New technology and Identification of Barrier Research Needs develop barrier research and technology development plans and budgets for submission to RPWG.

Final plans and budgets are completed in committee by the SLBTF, which meets as required to complete annual submissions. The separate submission for the projected PR&CE for two years hence normally contains less detail. The barrier coordinators compile much of the necessary information. Project planning involves considerable detail, which needs to be condensed into summaries for budget submissions to PIWG, RPWG, and SLIC.

Proposals for new barrier construction are summarized using a standard format and must identify the barrier owner, how funds are to be dispersed (i.e., grant application, direct contract, etc.), and the status, terms, and conditions of the operation and maintenance CA with the barrier owner. The details of CAs and MOA for all existing barriers need to be determined through discussion with barrier owners.

6.4. BAWP Implementation

The approved and funded BAWP is implemented through MOA with each control agent. Annual control agent MOA are initiated by the control agents and reviewed and executed by the parties at the beginning of the new fiscal year. The administration of funds by the control agents is done according to the following two agent protocols:

- FWS Administration of Barrier Program, and
- DFO-SLCC Administration of Barrier Program.

The barrier coordinators are responsible for implementing the BAWP. The terms of the work plan are set forth in the control agent MOA, which may differ from the draft BAWP submitted earlier to SLIC. The Canadian agent MOA notes that the DFO-SLCC is also a barrier owner.

Maintenance agreements with barrier owners (other than DFO-SLCC) are developed as long-term CAs. The barrier coordinators, in conjunction with GLFC Secretariat administrative staff, administer funds with barrier owner CAs in accordance with the GLFC Secretariat Administration and Contract Management of Barrier Program protocol.

Funds are generally distributed by the GLFC on receipt of invoices for work completed by the barrier owner or their contractors. The barrier coordinator verifies that the work has been completed including the provision of engineering oversight if required. Subject to written agreement with a barrier owner, the GLFC may directly contract for repairs to a barrier.

Guidance to barrier owners under the CA for operations and maintenance of barriers and their attached works is provided in protocols for:

- Operations Procedures for Barriers,
- Maintenance Procedures for Barriers,
- Operations and Maintenance of Traps, and
- Operations and Maintenance of Fishways.

6.5. Skills Required

Participants need to be familiar with and possess a detailed working knowledge of the entire barrier program. The work involves significant team effort involving engineering and biological science skills and the ability to communicate effectively in oral and written form. The protocol requires the use of numerical tools such as spreadsheets, finance, and statistics. The ability to negotiate partnerships with partners on new barriers is valued.

6.6. Level of Effort

The two barrier coordinators and the Chair, SLBTF would be expected to each commit at least one to two person months each per year to this activity, the bulk of which is program planning.

6.7. Definitions

BAWP- Barrier Annual Work Plan, a yearly plan for planning, constructing, operating, and maintaining sea lamprey barriers (complete life cycle) for the current fiscal year and the one two years hence.

PIWG – Program Integration Working Group, a working group that integrates individual program budgets into overall sea lamprey control program

RPWG- Research Priorities Working Group

7. Tools Required

General office equipment with access to desktop productivity tools including personal computers with networked capabilities for electronic mail, word processing, spreadsheets, statistics, and financial planning.

8. Information Requirements

Access to information in the form of a data base inventory of existing barriers and their operations and maintenance status. Updated spreadsheets of estimated and actual expenditures for barrier construction, operations, and maintenance used for cost estimation. Access to the numeric data supporting the Barrier Strategy and Implementation Plan.

9. Contract Requirements

MOA with the two control and research agents
CAs with barrier owners
Barrier cooperator MOU

10. References

11. Use of Other Protocols

Application of New Technology

Identification of Barrier Research Needs

Operations Procedures for Barriers

Maintenance Procedures for Barriers

Operations and Maintenance of Traps

Operations and Maintenance of Fishways

FWS Administration of Barrier Program

DFO-SLCC Administration of Barrier Program

GLFC Secretariat Administration and Contract Management of Barrier Program

Performance Measures for Escapement at Barriers

Performance Measures for Traps at Barriers

Preliminary Engineering Designs and Plans

Final Design and Engineering

Reach Selection

Site Selection

12. Protocol Authority

This protocol is dependent upon the SLIC/GLFC budget planning process. Changes to that process may necessitate changes to this protocol.

12.1. Allowance for Variations from Protocol

SLIC and/or the GLFC provide general guidance and direction for the preparation of the BAWP. Additional guidance can be sought directly from the GLFC Secretariat and SLIC.

Specific fast track approval procedures may need to be identified or developed to address contingency funding requirements in the event that acts of nature cause the need for significant repairs to barriers beyond the approved budget for repairs.

12.2. Protocol Status and Revision

This protocol follows existing practice and has been amended to include barrier program planning and budgeting, other than the use of design-build for electrical barriers, on a full life cycle basis.

12.3. Author and Date

I. Ross, March 199

FWS ADMINISTRATION OF BARRIER PROGRAM

1. Protocol Title: GLFC Secretariat Administration and Contract Management of Barrier Program

2. Protocol Business Need

This protocol summarizes current procedures used to address business requirements of the GLFC Secretariat in administration and contract management of the GLFC's sea lamprey barrier program. The program is based on GLFC's policy statement, The Role of Barriers in an Integrated Sea Lamprey Control Program and Guidelines for Sea Lamprey Barrier Program (barrier policy statement). The business requirements are driven by an annual program approved by the GLFC, which is the secretariat's responsibility to manage. This includes, but is not limited to, the use of Memoranda of Agreement (MOA) with the FWS and DFO-SLCC; barrier agreements and partnership agreements with cooperating agencies; contracts with engineering and construction firms; research contracts; and the direct payment of expenses initiated by FWS and DFO barrier coordinators for items not covered in their MOA.

3. Protocol Deliverables

The GLFC approves a barrier program for the current fiscal year and the one two years hence for formal submission to the governments of Canada and the United States as part of the GLFC's Program Requirements and Cost Estimates (PR&CE) document. The GLFC also approves final plans for a barrier program for the current fiscal year, based on actual funding available. The GLFC Secretariat is responsible for ensuring the program is executed in the most efficient manner, i.e., research undertaken; specific barriers planned, designed, constructed, and maintained; and barriers, traps, and fishways operated. Work to be accomplished is included in contracts or agreements as mentioned above. The duration of these agreements may extend beyond the fiscal year in which they were initiated, except for the MOA between the GLFC and the control agents, which cover one fiscal year at a time. Funds are placed in project-designated accounts. Invoices and charges against these accounts are paid based on the terms of the particular agreement. Financial status of the individual barrier projects and MOA is reported to the GLFC twice yearly and is available to others on request.

4. Target Audience

This protocol applies to all barrier designers, engineers, and FWS and DFO-SLCC field personnel who are involved in the coordination and final placement of these barriers in the Great Lakes. The GLFC Secretariat, the FWS Sea Lamprey Coordinator, the DFO Area Manager - Ontario, and the DFO-SLCC Property and Contract Manager provide oversight of the administrative processes.

5. The Jurisdiction for Protocol Use

This protocol is designed for use within the Great Lakes Basin (i.e., the Convention area as defined in the Convention on Great Lakes Fisheries).

6. Procedures

The GLFC operates on a fiscal year, which begins on October 1 and ends on September 30. The FWS shares the same fiscal year, while DFO-SLCC operates on a fiscal year beginning 1 April. Annual MOA with these agencies are written on the GLFC fiscal year basis. Unexpended MOA funds not required for ongoing barrier projects are returned/released to the GLFC on 30 September. The GLFC's financial regulations afford some flexibility in planning and executing contracts and otherwise managing an international field program: 1) GLFC funds may be carried over from one fiscal year to the next to satisfy approved obligations (including barrier projects), and 2) GLFC maintains bank accounts in both Canada and the United States. This flexibility allows returned/released MOA barrier funds to be included in subsequent year's MOA to complete barrier projects.

FWS ADMINISTRATION OF BARRIER PROGRAM

6.1. Fiscal Year plus Two Years Hence Program

6.1.1. Present a proposal to the GLFC, at its interim meeting in December, for an annual barrier program for the current fiscal year plus the one two years hence, including forecasts of construction, maintenance, operations, and support needs. The proposal estimates a program with a base level of effort plus inflation and one with an enhanced program that fully meets the GLFC mandate to control sea lamprey. The proposal is based on the advice and recommendations of the SLIC and its SLBTF and is reviewed for consistency with the GLFC barrier policy statement.

6.1.2. Obtain approval from the GLFC for the barrier program.

6.1.3. Incorporate a description of the approved program in the GLFC Program Requirements and Cost Estimates (PR&CE) document. The PR&CE includes descriptions of all GLFC program elements and explains how each element advances the achievement of the GLFC Strategic Vision and fulfills the mandate set forth in the Convention on Great Lakes Fisheries.

6.1.4. Communicate program requirements and cost estimates through the formal submission of the PR&CE document to the Governments of Canada and the United States and following up with briefings and supplemental information as needed.

6.2. Current Fiscal Year Program

6.2.1. Present a proposal to the GLFC, at its interim meeting in December, for the annual barrier program, including details of all construction projects and major planning initiatives. The proposal is based on the advice and recommendations of the SLIC and its SLBTF and is reviewed for consistency with the GLFC's barrier policy statement.

6.2.2. Obtain approval from the GLFC for the individual construction projects and planning initiatives that make up the annual program.

6.2.3. Communicate approved plans to FWS and DFO and other committees and cooperators as appropriate.

6.2.4. Consult and negotiate with cooperating agencies, researchers, and, in some instances, contractors to reach agreement on the appropriate contractual arrangements and schedules (e.g., contract for Pere Marquette River barrier between GLFC and Smith-Root, Inc.).

6.2.5. Set up GLFC budget and accounting codes for individual construction or planning projects to track financial progress. Barrier coordinators and the SLPM track project progress.

6.2.6. Execute MOA with FWS and DFO for barrier work to be conducted within their agencies. It is the responsibility of the FWS and DFO to ensure that work carried out under the MOA complies with their own agency standards, applicable regulations, and legal requirements. Due to the ongoing relationship enjoyed among parties, the annual MOA have somewhat standard and broadly worded language. Since MOA are normally developed and in place before the barrier program for the next field season is approved by the GLFC, it may be necessary to amend an approved MOA if there are significant barrier program changes from what was originally anticipated at the time of the MOA preparation.

6.2.7. Retain funds at the GLFC for work conducted under the supervision of DFO-SLCC, to expedite the contracting process. Expenditures may be made in either Canadian or U.S. currency. Funds for salaries and support of barrier program

staff are included in the MOA. The DFO-SLCC initiates contracts and orders and forwards invoices to the GLFC Secretariat with an approval and request for payment. DFO is responsible for assuring all such work meets with their agency standards, applicable regulations, and legal requirements.

6.2.8. Retain funds at the GLFC for work conducted at the direction of the U.S. barrier coordinator. U.S. barrier funds for salaries and support are included in the FWS MOA, while all other U.S. operations funds are retained by the GLFC. In the absence of grant agreements with state natural resource agencies (see 6.2.9.1.), the U.S. barrier coordinator facilitates the solicitation of bids or otherwise initiates agreements for orders, supplies, or services and forwards the information to the secretariat thereon. The secretariat prepares/executes contracts and other formal agreements as needed. The U.S. Barrier Coordinator, acting as agent for the GLFC, approves invoices for payment after ensuring vendors have delivered on their commitments under GLFC contracts. The FWS is responsible for assuring all work paid for with FWS funds (under the MOA) meets with their agency standards, applicable regulations, and legal requirements.

6.2.9. Execute contracts or partnership agreements with a variety of partner agencies, universities, and consultants, necessary to carry out barrier program work that is not included in the MOA between GLFC and its control agents. Where necessary, contracts can be between the GLFC and an agency or a construction firm. The U.S. and/or Canadian Barrier Coordinators and/or engineers have responsibility for project oversight and management in all of these cases, including approval of bid specifications, change orders, and all stages of construction. Barrier coordinators/engineers are encouraged to maintain communication with contractors to enhance prospects for project success and control costs.

6.2.9.1. **States:** A standard barrier application and agreement are available for use with states when they are performing the work. (See Section F of GLFC Guidelines for Sea lamprey Barrier Program)

6.2.9.2. **Other agencies:** e.g., United States Army Corps of Engineers (USACE): Some cooperating agencies require the use of their own contract documents. For instance, on a recent partnership with one federal agency, the agency required the use of their contract documents, which required the GLFC to provide certain assurances and assume liabilities usually not encountered. In such cases, the secretariat works to ensure the GLFC's interests are protected and place trust in cooperators that they share, as well, an overriding interest in the welfare of the Great Lakes fishery.

6.2.9.3. **Researchers:** A standard GLFC research contract is used for research needs (universities, consultants, etc.).

6.2.9.4. **Builders/Engineers:** Construction contracts directly with builders and engineering firms require more customization due to project specifics and performance and liability issues. The secretariat maintains a relationship with a local attorney with expertise in contracts, and secures advice on specific aspects of construction contracts and partnership agreements when needed. A document has recently been developed that may serve as a standard for future needs. In Canada, for conventional barrier projects, the DFO-SLCC prepares and uses their own form of construction contract. The DFO-SLCC engineering unit may be requested to undertake engineering work in the U.S.

6.2.10. Process invoices according to terms of the above mentioned agreements. Invoices are first reviewed and approved by the appropriate barrier coordinator

and the secretariat's SLPM to ensure that project work has been performed satisfactorily. The GLFC Secretariat Administrative Officer (AO) then reviews and approves based on financial commitments in the contracts/agreements.

6.2.11. Report financial status of project to the GLFC and to others on request.

6.1. Skills Required

Generally, skills will vary depending on the individual's level of involvement. The SLPM must possess skill in communicating with the SLBTF, the U.S. and Canadian barrier coordinators, agency partners, and researchers on plans to most efficiently execute the approved annual program. The secretariat's AO practices oversight on contractual and financial requirements of the program, seeking legal advice when necessary. The bookkeeper has knowledge of the accounting program sufficient to pay invoices and report financial status. The GLFC's Executive Secretary (ES) reviews and signs formal agreements and contracts on behalf of the GLFC, and intercedes when internal/external factors delay or prevent progress.

6.2. Level of Effort

The level of effort varies depending on the complexity of the specific annual program, i.e., communication/negotiation requirements, number of projects, whether standard contracts can be employed, or new or customized contracts must be developed.

6.3 Definitions

Current fiscal year plus the one two years hence - The fiscal year which is two years in the future, e.g., if the current fiscal year is 1999, the fiscal year two years hence is 2001.

7. Tools Required

The financial status of individual barrier projects and MOA is tracked using three software packages: Solomon IV for Windows, F9, and MS Excel. F9 provides a hotlinks between Solomon and MS Excel to create financial reports.

8. Information Requirements

If the GLFC Secretariat uses the current administrative and financial systems, no additional data needs are identified. If more detailed financial tracking and reporting is desired (e.g., planning, land acquisition, engineering, construction and contracting, operating, maintenance, and decommissioning), the current systems are capable of doing so.

9. Contract Requirements

Examples of contracts and agreements used by the secretariat and its control agents to deliver all aspects of the barrier program are on file with the secretariat and the control agents. They are modified as required to address particular situations or circumstances.

New agreements may be needed for use with state agencies (barrier cooperators). The GLFC's standard application and agreement are applicable for situations in which a state agency directs the work. In cases where the GLFC directs the work, a new partnership agreement covering the barrier program as a whole and/or agreements for specific barrier projects may be useful to ensure it is clear who owns, accepts liability for, operates and maintains, and pays for certain costs. Canada's federal-provincial barrier agreement could be used as a starting point with input/customization from the barrier coordinators, secretariat, GLFC attorney, state representatives (perhaps starting with Michigan) and then review by all.

Liability and insurance issues need to be reviewed in all contractual agreements, which have not recently undergone a legal review and are being used by the GLFC and its agents. The review should consider insurance coverage that should be carried by others when participating in the barrier program (construction, servicing traps, etc.) to protect the control agents and the GLFC from being sued by them or the public. A legal opinion from both governments on the GLFC's current protections is pending.

10. References

The following administrative file references are available at the GLFC Secretariat: Excerpts from FWS and DFO--GLFC MOA that pertain to the barrier program, GLFC barrier application and agreement for use with states, GLFC research contract, and GLFC construction contract.

11. Use of Other Protocols

This protocol will be used to track and monitor expenditures for activities in most protocols in the barrier program.

12. Protocol Authority

The secretariat has the authority to execute GLFC decisions on the barrier program. Contractual arrangements between the GLFC and a government agency or contractor require review by the secretariat's AO and SLPM before approval by the ES. If proposed changes in projects exceed spending authority or otherwise vary from approved program or policy direction, the GLFC or its executive will be consulted for a decision.

12.1. Allowance for Variations from Protocol

If variances require a change in a contract, an amendment must be developed and signed by the secretariat and the appropriate contractor representative. In some instances an amendment may require GLFC approval.

12.2. Protocol Status and Revision

The protocol should be reviewed, as needed, based on mutual agreement of the participants. Review when GLFC barrier policy and guidelines are rewritten.

12.3. Author and Date

B. Staples, April 1999

FWS ADMINISTRATION OF BARRIER PROGRAM

1. Protocol Title: FWS Administration of Barrier Program

2. Protocol Business Need

This protocol summarizes current procedures used to address the financial requirements of the FWS regulations, as required by law, in administering its participation in the GLFC's sea lamprey barrier program. These procedures are externally driven in terms of compliance. The internal tracking system of the FWS must be activated through the use of the current MOA between the FWS and the GLFC, which spells out the use of funds and establishes the tracking for reporting. Oversight of key decisions on costs and locations.

3. Protocol Deliverables

The MOA will outline the barrier program for a particular fiscal year. Work to be accomplished through the FWS will be placed in the MOA for the fiscal year in which it is to occur. Invoices and charges against funding in the MOA will be billed to the GLFC and reported using the current reporting format by specified project codes to be identified. It should be noted that some of the U.S. barrier program is achieved outside of the MOA using cooperators (e.g., state natural resource agencies) and private contractors. Funds for this work are retained at the GLFC but the work is coordinated and monitored by the U.S. Barrier Coordinator.

4. Target Audience

This protocol applies to all barrier designers, engineers, and FWS field personnel who are involved in the coordination and final placement of these barriers in the U.S. portion of the Great Lakes. The GLFC Secretariat and the FWS Sea Lamprey Coordinator (SLC) will provide oversight of the administrative process.

5. The Jurisdiction for Protocol Use

This protocol is designed for use in the United States. Due to the variances in law, contracting procedures, and financial and accounting procedures, this limitation must apply. Under the MOA, all activities occurring in the U.S. by the GLFC are considered as activities of a federal agency. If the FWS is involved all applicable U.S. laws and regulations apply.

6. Procedures

The FWS operates on a fiscal year basis that begins on October 1 and ends on September 30 of the next year. To initiate the administrative and financial process requires the completion of a preliminary MOA as soon as possible in October since the FWS cannot legally charge for services rendered until a formal mechanism has been established. An amended MOA is filed once final plans are in place and budgets and programs for the year are known and approved by the GLFC. Therefore the following is recommended:

6.1. Initiate MOA

By October 1, the MOA for the new fiscal year should be signed for activating the Denver Finance Center's system for tracking expenditures. These expenditures are tracked and management reports are issued to the SLC quarterly. These same reports are available to the Marquette office for use by the field staff for tracking purposes. In compliance with the MOA, quarterly expenditure reports and invoices requesting reimbursement are sent to the GLFC.

6.2. Project Codes

The FWS can establish separate project codes for barrier planning, land acquisition, engineering, construction and contracting, operating and maintenance, and decommissioning. These costs can be tracked depending on the level of reporting desired. These same project codes will be on the quarterly reports to the GLFC.

6.3. Quarterly Reports

Reports are issued on a quarterly basis by the SLC, Twin Cities, Minnesota for projects incorporated into the MOA. All accounts remain open as long as obligations are not cleared. The MOA and financial records may take several years to reconcile.

6.4. Project Charges

Projects constructed under contract with the FWS would be obligated on the Denver Finance Center (DFC) system and remain obligated until final invoices and the FWS's engineers approve charges. Each project would have it's own project code established by the administrative officer in Engineering. Fund targets from the SLC would be issued to Engineering based on the total amounts in the MOA allocated for barrier work requiring engineering assistance. Overhead charges for engineering and contracting services would have to be negotiated between the FWS and the GLFC depending on project and level of involvement.

6.5 Legal Review

The MOA, all contracts, and any participation by the FWS that involves realty, construction, or significant changes to current arrangements would require legal review by the Department of Interior Solicitor. Section V of the MOA covers the liability and insurance issues. With respect to liability and insurance issues, both FWS and GLFC activities performed in the United States are covered by the Federal Tort Claims Act, 28 U.S.C. 2671, et seq. Volunteers used by the FWS in support of GLFC work sign a form that covers them under the same Tort Claims Act.

6.6. Skills Required

Generally, skills will vary depending on the individual's level of involvement. The FWS-SLC practices oversight over all administrative and safety requirements of the program. Administrative technicians and administrative officers at the regional and field levels input obligations into the Denver system. Knowledge of budgetary and financial procedures in the FWS is required, as well as special training in accessing the automated remote data entry system. Personnel specialists are employed for all actions involving use of volunteers, seasonal hires, and payroll problems.

6.7. Level of Effort

The level of effort required here is based on the implementation of a new program above and beyond the current administrative burden in the current MOA. These costs are covered under the design and engineering protocols and contract management protocols.

7. Tools Required

8. Information Requirements

The current administrative and financial systems used by the FWS are satisfactory. No additional data needs are identified except the need to establish project codes as part of normal procedure. The use of additional project codes will provide more accurate and detailed program and project costs.

9. Contract Requirements

See protocol FWS Construction Contracting and Management

10. References

Federal Acquisition Regulations (FAR)

11. Use of Other Protocols

This protocol will be used to track expenditure for FWS activities in most protocols.

12. Protocol Authority

All changes to the MOA or specific contractual arrangements or realty issues would require review by the Department of Interior Solicitor, Twin Cities, MN before approval of the Geographic Assistant Regional Director, Geographic Area 1 is received.

12.1. Allowance for Variations from Protocol

If circumstances dictate the need for a change in the MOA an amendment must be developed and signed by the GLFC and the FWS. Should there be a need to deviate from this protocol the FWS-SLC will be contacted for approval and will determine if a higher level of approval is required.

12.2. Protocol Status and Revision

As needed based on mutual agreement of the participants

12.3. Author and Date

Larry W. Sisk, February 1999

DFO-SLCC ADMINISTRATION OF BARRIER PROGRAM

1. Protocol Title: DFO-SLCC Administration of Barrier Program

2. Protocol Business Need

This protocol summarizes current procedures consistent with Canadian government regulations as required by law in administering DFO-SLCC participation in the GLFC sea lamprey barrier program. These procedures are externally driven in terms of compliance. The internal tracking system of the DFO must be activated through the MOA, which details the use of funds and establishes the tracking for reporting purposes. Oversight of decisions needs to be clearly established so the duties of the barrier coordinator in regards to operations, maintenance, emergency measures, etc. can be carried out expediently.

3. Protocol Deliverables

- Tendering documents and construction contracts for new barriers,
- Payment documents for construction contracts,
- Trap contracts,
- Title searches and land leases, and
- Maintenance requirements and schedules.

4. Target Audience

This protocol applies to DFO-SLCC administrative staff, particularly the Property and Contract Manager (PCM), the DFO-SLCC Program Manager, the barrier coordinator with barrier program staff, and the adult assessment biologist.

5. The Jurisdiction for Protocol Use

This protocol will apply to the administration of the barrier program in Ontario.

6. Procedures

The DFO-SLCC operates on two fiscal years. The Canadian fiscal year runs from April 1 to March 31 for purposes of Canadian federal government accounting and reporting requirements. The GLFC fiscal year runs from October 01 to September 30 for MOA program delivery, accounting, and reporting requirements.

The following procedures are instituted to deliver the barrier functions of the MOA:

6.1. Payment of Existing Leases

The PCM arranges through the SLCC finance section for payment of existing agreements for barrier sites, some with private landowners, others with the provincial government, municipalities, companies, and/or other agencies. The PCM is responsible for annually reviewing lease agreements and negotiating the renewal of lease agreements that are due to expire.

6.2. Barrier Fishway and Trap Operations Contracts

The PCM arranges to make SLCC staff available for annual maintenance to barriers. Work to be carried out is compiled by barrier program staff and the adult assessment biologist following inspections and field visits to the barrier network. The scheduling of trips are planned by the PCM and barrier coordinator with confirmation by the SLCC

Program Manager. Remedial and other work involving major barrier and stream-bank changes, and/or contractor backhoe and crane work will normally be planned and overseen with expedient scheduling by the barrier coordinator (engineer) and barrier staff.

6.3. Barrier Maintenance

The PCM arranges for payment and maintains budgets and cost summaries for all barrier maintenance activities. The PCM consults with the barrier engineering and adult assessment staff following the annual spring spawning migration to develop barrier and trap maintenance requirements. This should be a continuous year-round consultation, not a once a year activity. Maintenance is required year-round and not just during the fall.

The PCM is also responsible for scheduling annual maintenance requirements. The engineering unit and the PCM decide together whether SLCC has the staff resources/ equipment/expertise to carry out the proposed work. It in some cases, it may be more appropriate to hire a private/general contractor than use SLCC staff and equipment. At the discretion of the barrier coordinator or delegate, some maintenance activities will require technical supervision by barrier engineering staff, while the shop foreman may supervise others. Technical supervision of maintenance activities may be needed on or off site. Work is carried out throughout the year with the majority of work conducted in the fall of each year by DFO-SLCC maintenance staff or private contractors.

6.4. Land Leases and Land Title Searches

The PCM arranges for land title searches and negotiates land lease agreements with private land owners, private companies as well as municipal and provincial governments for new barrier construction projects identified in the MOA. Land lease agreements should be negotiated for the life of the barrier operations (see DFO-SLCC Construction Contracting and Management).

6.5. Tendering Documents for New Barrier Construction and Remedial Works

The PCM together with the barrier coordinator and staff prepare standard tendering documents for barriers to be built or projects requiring major modifications. The prepared tender packages are submitted to local area construction associations, consistent with DSS and Department of Public Works (DPW) procedures. Construction associations should be contacted prior to setting the closing date/time so as to avoid scheduling of closing on a day when other projects may be closing. A contractor typically receives bids from their subcontractors and trades the day of closing and only hours before closing time. Careful scheduling of closing times will allow the contractors time to assemble a proper bid, and will help attract them to bid on barrier projects. Contractors know instream work is risky, and if faced with a choice between bidding an easier job on land and one instream, they will chose the former.

Further details on the tendering process are found in DFO-SLCC Construction Contracting and Management.

6.6. Contracting Procedures for New Barrier Construction and Remedial Works

The PCM, in consultation with the barrier staff, prepares the standard construction contract (consistent with DPW procedures) for the successful bidder and arranges for all proper signing approval. The contract includes details of materials, construction procedures, scheduling, and inspection. The PCM arranges for payment of construction

contract invoices following written authorization from the engineering staff. Following approvals from the PCM and engineering staff, requests for payments are submitted to the GLFC administrative officer for payment.

6.7. Contracting Procedures for Engineering Support

The barrier program anticipates demands for additional or specialty engineering services. Private engineering firms can be engaged by DFO-SLCC when required by the engineering workload. The PCM is responsible for procuring the services through DSS or equivalent procurement procedures. The barrier coordinator engineer will identify the need for consultants, draw up the scope of work to be carried out, and direct and review the consultant engineering firm's work.

6.8. Skills Required

Knowledge, by the DFO-SLCC Administrative Officer and PCM, of budgetary, financial, purchasing and contracting procedures of the DFO-SLCC, GLFC, DSS, and DPW for financial tracking, contract payments, and equipment purchases. Other essential skills in the process include professional engineering license and judgement and knowledge of the construction, tendering, operations and maintenance needs of existing and planned barrier dams, fishways, and traps.

6.2. Level of Effort

The level of effort will be proportional to the GLFC barrier construction program in Ontario.

7. Tools Required

Existing administration and financial systems are adequate at this time. However, should the barrier program be expanded this area will have to be reexamined.

8. Information Requirements

If the DFO-SLCC uses the current administrative and financial systems no additional data needs are identified at this time. The use of additional cost codes will provide more accurate and detailed program and project costs.

9. Contract Requirements

See protocol DFO-SLCC Construction Contracting and Management

10. References

The following documents are on file with the DFO-SLCC and the GLFC Secretariat:

Private Property Lease Agreement,

Property Agreement with a municipality,

Property Agreement with the provincial government (OMNR),

Property Agreement with a private company,

Service Contract to Fish a Trap at a Barrier Site,

Annual Barrier Maintenance Schedule,

Tendering and Specification Documents for construction of a new barrier,

Construction Contract Agreement, and

Federal / Provincial Agreement on Sea Lamprey Barrier Dams.

11. Use of Other Protocols

This protocol will be used to track expenditures for activities in those barrier protocols involving the Canadian Control Agent.

DFO-SLCC Construction Contracting and Management

12. Protocol Authority

12.1. Allowance for Variations from Protocol

If circumstances dictate the need for a change in the MOA, an amendment must be developed and signed by the GLFC and the DFO. Should there be a need to deviate from this protocol, the PCM will decide if approval of the DFO Area Manager-Ontario is required.

12.2. Protocol Status and Revision

As needed based on mutual agreement of the participants.

12.3. Author and Date

Dave Haight, April 1999

IDENTIFICATION OF BARRIER RESEARCH NEEDS

1. Protocol Title: Identification of Barrier Research Needs

2. Protocol Business Need

This protocol describes the internal business processes that drive the identification, prioritization, funding, and decision making regarding sea lamprey barrier research for internal (e.g., HBBS, PERM, Upper Mississippi Science Center) and external researchers, both public (e.g., academia) and private (e.g., commercial).

3. Protocol Deliverables

The SLBTF will use this protocol annually as part of the Barrier Annual Work Plan to recommend to the RPWG barrier research projects that should be undertaken in future years. The recommendations will be submitted to SLIC for further consideration and recommendation to the GLFC for approval.

4. Target Audience

The intended audience for implementation of this protocol is members of SLBTF, RPWG, PIWG, SLIC, and the GLFC. This protocol will also be useful to researchers who wish to learn of GLFC processes to fund sea lamprey barrier research.

5. The Jurisdiction for Protocol Use

Basinwide without jurisdictional requirements

6. Procedures

6.1. Identification and Prioritization of Research Needs

The Sea Lamprey Barrier Research Strategy adopted by the GLFC in June, 1994 outlines barrier research needs. General guidance is found in the GLFC Sea Lamprey Research Strategy (Revised March 1995). Copies of these documents are available from the GLFC Secretariat and the SLBTF.

Each fall, the SLBTF reviews these strategic documents for current applicability, solicits input from commissioners, advisors, researchers, partners, and users, and recommends to the RPWG priority areas of research and technical assistance that should be investigated over the next two to three years. The SLBTF also suggests to the RPWG the process by which specific priority research projects should be investigated.

1) **Internal** – studies conducted by staff at HBBS, the Upper Mississippi Science Center, PERM, or control agents in collaboration with any of the foregoing.

2) **Solicited research** – studies usually conducted by scientists at outside institutions, although internal researchers are encouraged to submit proposals as well. Solicitations are of three types:

   - An open “Request For Proposals” (RFP) where all proposals that meet the broad subject area are accepted and considered for funding,
   - A “Focused RFP” where specific scientists with expertise in a more focused subject area are identified and asked to submit proposals, and
   - A “Solicitation for Bids” where a very specific research question is presented and a solicitation is sent to one or more parties thought to be qualified to conduct the research.

3) **Managed research** – more long-term in nature, the secretariat works closely with appropriate scientists and engineers to guide the development of proposals that meet specific research needs. Either external or internal investigators could conduct managed research.

6.2. Types of Research

The SLBTF recommends to the GLFC Secretariat Senior Scientist whether investigations, in the view of the task force, could be classified as research or technical assistance; the final decision, however, rests with the senior scientist.

Technical assistance projects do not require full peer review of proposals (GLFC Sea Lamprey Research Strategy) and are often conducted by GLFC researchers or its control agents. Decisions to conduct the work are based upon proposals that are judged scientifically meritorious by the GLFC Secretariat with direct and immediate results applicable to the barrier program. Studies that deal with alterations/modifications to further refine or enhance the effectiveness or efficiency of existing barriers, traps, or fishways are considered technical assistance.

Research is often (but not always), conducted by external researchers whose proposals have undergone an extensive peer review process by the Board of Technical Experts (BOTE); research contracts are awarded on a competitive basis. The scientific review of research proposals are accomplished by members of the BOTE or other recognized experts in the area proposed for investigation, e.g., hydraulics if there is no qualified BOTE member. As defined by the GLFC Sea Lamprey Research Strategy, investigations into new barrier designs would be considered research, as would studies involving sea lamprey behavior.

6.3. Funding of Research

Sea lamprey research requirements are projected as budget line items in the Program Requirements and Cost Estimates (PR&CE) submitted by the GLFC to the governments of Canada and the United States. Approval of current fiscal year funding for the research program occurs at the GLFC interim meeting and is reflected as line items in that current year. Research is broken down into three categories: lampricide, alternative control, and ecology and integrated management. The majority of barrier research in the future will be funded under the Alternative Control category. The GLFC actively seeks higher funding levels for this category in its annual submission of PR&CE to governments; to date, about $435,000 has been dedicated each year to Alternative Control Research.

Technical assistance proposals are funded on a project by project basis as ideas and need is identified. Funding for this work comes from the barrier program operational budget, the internal research line item category, or a combination of both. Funding allocation recommendations by the SLBTF are made on a case-by-case basis and depend upon the nature of the project and who is doing the work. In most cases, specific "add-on" funds are requested through the budgetary process to conduct technical assistance projects. The recommendations are provided to the SLIC for consideration.

6.4. Timing of submissions for proposed research

Each year, the RPWG holds a research workshop early in the calendar year. This provides SLIC task force chairs the opportunity to review the progress of current GLFC sponsored research of both internal and external researchers. It also affords the opportunity for researchers with new or novel ideas to present their concept prior to

entering a competitive request for proposals. The SLBTF can recommend invitations to this meeting be extended to promising researchers based on discussions at the SLBTF annual fall (generally September) meeting. The SLBTF benefits from the presentation of proposals prior to the SLBTF spring (generally March) meeting where recommendations on research proposals, to be forwarded to RPWG, are formulated.

The schedule for delivery of **internal research** and **technical assistance** proposals is established along a three-year cycle as follows:

1. Two fiscal years out; study concept proposals (pre-proposals) required,
2. One fiscal year out; nothing additional required if above are accepted, and
3. Current fiscal year; full study proposals required for peer review (projects will begin the following fiscal year).

These deadlines come in July each year and are based on recommendations from the SLBTF at its spring meeting. For those topics considered research, peer reviews of the proposals are conducted through the BOTE. The GLFC Secretariat reviews technical assistance proposals. The RPWG collects all reviews and forwards them to the SLBTF in time for its fall meeting. The SLBTF reviews the proposed three-year study plan for relevance to its research priorities and forwards recommendations for funding back to the RPWG for presentation to SLIC in October. The BOTE forwards comments on the scientific merit of the research proposals to the SLIC. The SLIC, in turn, provides recommendations to the GLFC in December of each year. Approved studies begin January 1.

Solicited and/or **managed research** follows much of the same time line except that these types of research are dealt with on an annual basis. Following recommendations from the SLBTF in the spring, requests for proposals are let in April with a July deadline for submission. The proposals undergo peer review through the BOTE process. At its fall meeting, the SLBTF reviews proposals for relevance to its research priorities (in most cases, this is unnecessary as the solicitation results from recommendations made earlier by the SLBTF) and makes recommendations to RPWG. The RPWG based upon these and comments on the scientific merit of the proposals from BOTE, recommends research for funding to the SLIC in October. The SLIC makes recommendations to the GLFC in December for decision. Approved studies begin January 1.

6.5. Skills Required

Ability to critically examine research concepts and make determinations if studies as proposed will contribute significantly to the advancement of desired barrier information or design processes as established in strategic research documents or through discussion by the SLBTF. An understanding of engineering design will be required for some investigations.

6.6. Level of Effort

The level of effort necessary to conduct this procedure requires members of the SLBTF (12 persons) for two meetings (only a small portion of each meeting is devoted to research discussions). The SLBTF Chair devotes effort to four additional meetings (research workshop, RPWG, PIWG, and the SLIC meetings). The estimated person day effort to implement this protocol annually is eight. The amount of time required of the secretariat senior scientist and BOTE to review research and technical assistance proposals is dependent on the number and degree of complexity of the proposals and is thus extremely variable and would be an addition to the above estimate.

6.7. Definitions

Barrier research/barrier technical assistance - refer to Appendix 1 of the GLFC Sea Lamprey Research Strategy

BOTE – Board of Technical Experts

PERM – Partnership in Environmental Research and Management

PIWG – Program Integration Working Group

PRCE- Program Requirements and Cost Estimates

RPWG – Research Priorities Working Group

7. Tools Required

8. Information Requirements

This protocol will generate study proposals by researchers. These proposals are considered proprietary original thoughts and must be treated with a degree of confidentiality.

9. Contract Requirements

Upon successful completion of the competitive process and approval by the GLFC, a research grant is awarded to external researchers. The secretariat prepares a performance contract specifying deliverables and reporting requirements.

Internal research is conducted under an annual Memorandum of Agreement between the GLFC and the USGS, Biological Resources Division.

10. References

Sea Lamprey Barrier Research Strategy, June 1994
GLFC Sea Lamprey Research Strategy (Revised March 1995)

11. Use of Other Protocols

Barrier Annual Work Plan
Application of New Technology

12. Protocol Authority

The appropriate level of approval authority for amendments to the protocol for version control would lie with the GLFC. Recommendation for amendments would be proffered through the SLIC task force structure and reviewed by the same. Responsibility for implementation of the protocol can rest with the senior scientist of the GLFC Secretariat.

12.1. Allowance for Variations from Protocol

The senior scientist of the GLFC Secretariat can deviate from this protocol by polling the GLFC for approval (after BOTE review process) outside the specified time frames should encouraging research be proposed directly to the GLFC. The GLFC Secretariat can also amend technical assistance projects as required and provide the necessary “fast-track” to answer immediate concerns. Recommendation for change in technical assistance can originate within the SLIC task force structure.

12.2. Protocol Status and Revision

This protocol is based upon existing operations. The protocol should be reviewed every two years for currency and relevance. The research strategy documents referenced by this protocol undergo periodic revision by the task groups (SLBTF and RPWG) charged with their maintenance.

12.3 Author and Date

D. Lavis, March 1999

APPLICATION OF NEW TECHNOLOGY

1. Protocol Title: Application of New Technology

2. Protocol Business Need

The purpose of this protocol is to describe the process and decision rules relating to modifications of both conventional and experimental sea lamprey barriers and to deployment of experimental barriers.

3. Protocol Deliverables

This protocol will be used as required by the SLBTF as part of the Barrier Annual Work Plan to guide implementation of new technologies.

4. Target Audience

The principals involved in this protocol are SLBTF, SLIC, the control agents, and GLFC including the secretariat.

5. The Jurisdiction for Protocol Use

Basinwide without jurisdictional requirements.

6. Procedures

6.1. Modifications to Conventional and Experimental Barriers

Modifications to both conventional and experimental barriers are innovations that do not fundamentally change the functional characteristics of the design. These characteristics pertain to the methods used to constrain passage of sea lampreys and/or to provide passage of non-target fish. The adjustable-crest associated with an inflatable barrier is an example of a functional change in design that fundamentally changes a barrier's operational characteristics as compared to a conventional fixed-crest barrier. In contrast, changing the lip configuration on a fixed-crest barrier does not represent a fundamental change in how a conventional barrier operates. A design change that fundamentally changes a barrier's operational characteristics cannot be considered a modification, and its use requires procedures associated with deployment of a new experimental barrier.

Deployment of modifications to conventional and experimental barriers should parallel procedures already used in the stream-treatment program where the lampricide task force makes decisions regarding changes in treatment methodology. In similar fashion, the SLBTF will be responsible for approving modifications to existing conventional or experimental barriers. The chairperson of the SLBTF is expected to establish working arrangements with barrier coordinators to allow action on minor problems that require a rapid response. All modifications, including the design objective and the evidence for cost-effectiveness, will be reported to SLIC on a routine basis.

Performance of a modified barrier that, as compared to its original design, increases the cost-effectiveness of suppression and/or diminishes environmental damage on two or more barriers for at least three years requires no special reporting. This determination will be made by the SLBTF and reported to SLIC.

6.2. Deployment of Experimental Barriers

Entirely new barrier designs may materialize from within the GLFC's research program or from adaptations of applications developed elsewhere for species other than the sea lamprey. Designs from either source that have been shown in research trials to meet their respective design objectives may be considered for deployment on an experimental basis. Such new designs will be considered experimental until two operational

deployments have been shown to provide improved cost-effective suppression or diminished environmental damage for at least three years by any of the following criteria in comparison to conventional barriers:

1. lower cost by 15% or more,
2. provide significant safety or ecological benefits at a reasonable cost,
3. provide at reasonable cost, a research platform for observing or monitoring something of interest, or
4. entails no new or increased risk to people or the environment.

The SLBTF will be responsible for documenting the suitability of previously researched designs. Monitoring will be part of the deployment including the evaluation of data collected by the proponent. Documentation will consist of relevant research/technical reports, two reviews by outside experts, and a summary and recommendation from the task force. The SLBTF will be responsible for recommending operational deployments of experimental barriers to SLIC who will recommend them to the GLFC. All barriers recommended for deployment by SLIC will be classified as conventional or experimental.

6.3. Skills Required

Professional training and experience in stream-fish biology, hydrology, and barrier design and construction are needed on the SLBTF, which is the group most concerned with the implementation of this protocol.

6.4. Level of Effort

Two meetings of the SLBTF (or as needed) per year should be adequate.

6.5.Definitions

Conventional barrier-design that met program requirements at two or more sites for three or more years.

Experimental barrier-a design that represents a fundamental change in functional characteristics regarding how a barrier impedes passage of sea lampreys and/or provides passage to non-target fish (see Sec. 6 for examples).

Modified barrier-a conventional barrier with a design change that does not change the functional characteristics of barrier operation.

7. Tools Required

8. Information Requirements

9. Contract Requirements

10. References

11. Use of Other Protocols

Barrier Annual Work Plan
Identification of Barrier Research Needs

12. Protocol Authority

Revisions to this protocol should be approved by SLIC.

12.1. Allowance for Variations from Protocol

Deviation from this protocol can be granted from SLIC.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevance after two years of use.

12.3 Author and Date

R.L. Eshenroder, March 1999

HYDROLOGY AND HYDRAULICS IN BARRIER DESIGN

1. Protocol Title: Hydrology and Hydraulics in Barrier Design

2. Protocol Business Need

Hydrology and hydraulics (H&H) contribute to the design of a barrier crest, an internal program requirement, and to compliance with regulatory legislation, an external program requirement.

Hydrology is undertaken to evaluate the variation and recurrence periods of flow conditions under which a barrier and fish passage device (if required) must function. These flow conditions are subsequently applied in hydraulics analyses, of which one of the results is a river-rating curve. The rating curve is typically composed of several relationships between water surface elevation and discharge, compounded over the range of design flow conditions. Headwater and tail water rating curves are applied in the design and evaluation of barrier crests in the context of such design criteria as crest height (a measure of escapement risk) and minimizing impoundment size (optimizing the geometry of the spillway crest). Velocities calculated from the rating curve have application in design for erosion protection.

Regulatory agencies are interested in flood flow conditions, and may require that certain models or relationships be applied to satisfy their analysis requirements. All barrier projects will be subject to regulatory legislation requiring some hydrology study . The analysis techniques and detail required varies between jurisdictions and with project size. These methods may not always be the best tools available to the engineer for barrier design, because the barrier engineer often requires greater resolution at the lower-than-flood flows typical of the sea lamprey spawning run. The engineer must usually undertake a number of parallel hydrology and hydraulics exercises, those for design and those to satisfy regulatory agencies.

3. Protocol Deliverables

Some hydrology and hydraulics must be carried out for all barrier construction projects. Existing structures being modified may require similar studies in varying levels of detail depending on the existing knowledge of the system and on the nature of the work. The decision on the level of detail of analysis required rests with the licensed professional engineer. Undertaking the design is a function of permitting requirements, site location (urban/remote), and the size and complexity of the river system. Analysis techniques may vary depending on the level of detail required. This protocol outlines the hydrology, hydraulics, and related regulatory requirements needed in the barrier design process in Ontario. Corresponding requirements in the United States will be somewhat different, and may vary from one state to the next. The goal of these requirements remains the same: protection of nearby riparian owners' rights in regard to property damage due to flooding.

4. Target Audience

Qualified individuals under the technical supervision of licensed engineers must undertake hydrology and hydraulics contributing to barrier design. These people may be control agent staff or consultants and will be the principal users of this protocol.

5. Jurisdiction for Protocol Use

This protocol is intended for basinwide application, with the following caveat. Within the practice of hydro-technical engineering, analysis techniques vary depending on geographic location and on relationships developed based on geophysical and climatic similarities between river systems. Climate and geographic location greatly influence river morphology and hydrology. Consequently, design factors and analytical formulae do not have consistent potential for application throughout the Great Lakes Basin where fixed-crest barriers are built. In addition, varying jurisdictional requirements between regulatory agencies in Great Lakes states and the province of Ontario specify different

methods of analysis. Selection of analysis techniques suited to a given barrier project is at the discretion of the engineer.

6. Procedures

The Fixed-Crest Barrier Design Criteria protocol relates a minimum acceptable level of control to a minimum return period for which a barrier must block the passage of sea lamprey. Design crest elevations are evaluated by applying this frequency of return criteria to hydrology studies. The result is a design crest elevation with a predetermined level of performance. This process is outlined in Figure 1.

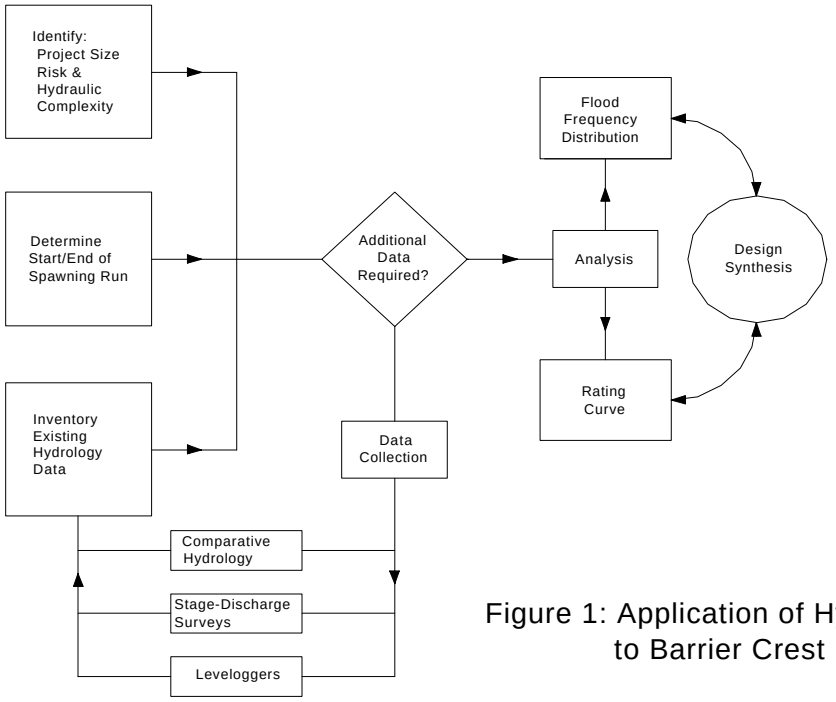


Figure 1: Application of Hydrology to Barrier Crest Design

6.1. Hydrology for Barrier Design

The selection of an analysis technique to evaluate the hydrology of a river depends on the availability of historical flow data, the ability to collect additional data, and on the intended application of hydrologic calculations. The project size and level of risk present will also influence the engineer's decision on the level of detail and confidence required in the predictions required. Risk factors are centered on the riparian owner's identity and land use. Undeveloped, agricultural, and municipal lands have different risks associated with low-head barrier construction.

Historical flow data, preferably from near the site on the candidate stream, is required to evaluate the crest in terms of frequency or return of flood events. The frequency of flows exceeding the barrier criteria may be evaluated, and the predicted level of performance of the barrier may be expressed in terms of higher than crest flow time during the spawning run.

Flood flow predictions based on frequency analysis of historical data are generally not undertaken on less than ten years of data because typical flood planning is done for 25, 50, and 100-year flood events. In most cases, flood flow calculations are based on

extrapolations of historical data. More confidence may be placed in the frequency analysis, as more historical data becomes available. These calculations typically take advantage of Log-Normal and Log-Pearson distributions. When only 10 to 15 years of historical data are available, flood flow predictions should be compared to results from other techniques to confirm their applicability. Results have application in design for erosion protection and in structural design. They are not appropriate for analysis of small flows during the lamprey run, because they are not supported by data in low flows.

When historic hydrology data are not available at a candidate site, comparative hydrology techniques are the next best alternative. Comparative hydrology techniques will require that data from streams of similar morphology and climate are available. The engineer must be aware of the potential of assumptions inherent in comparative hydrology to influence the reliability of the model.

6.2. Hydraulics

Rating curves must be developed for both headwater and tail water. These are largely site and reach specific. Rating curves are developed using a number of tools selected on a project by project basis by the engineer. Results from models such as HEC-RAS, weir equations, and Manning's equation require calibration using site surveys and stage-discharge measurements. Calibration exercises must be undertaken over a range of design flows, and cannot be accomplished in one site visit.

The rating curve for the headwater elevation is related to the geometry of the spillway crest. Over a narrow range of flow magnitudes, the stage-discharge relationship for the crest may be represented using the discharge over a weir equation:

$$Q=CL_eH_e^{3/2}$$

Where Q = discharge
L_e = effective length of crest
H_e = effective total head on crest including velocity of approach
C = discharge coefficient

The discharge coefficient is representative of energy loss resulting from changes to flow vectors as water flows past the dam. The discharge coefficient is not a constant. It is specific only to a given crest geometry, at a specific flow. Relationships have been developed between discharge coefficient and ratios of H_e/P and L_e/b where P is the wetted perimeter of the crest and b is the channel width. The discharge coefficient also changes when the barrier crest is inundated. Selection of one or several discharge coefficients and any assumptions made to simplify these calculations are done on a case-by-case basis and are at the discretion of the engineer. Results may be presented graphically, or with a chart.

Tail water-rating curves are also developed by compounding stage-discharge relationships representing narrow ranges of flow magnitude. Rates of energy loss in open channel flow vary as water level and flow magnitude changes. As with discharge coefficients at weirs, coefficients representing these energy losses are applicable only over narrow ranges of flow. Consequently, calibration through field surveys and discharge measurements are necessary over the range of design flows, regardless of the modeling techniques used.

6.3. Hydrology and Hydraulics for Regulatory Agencies

Regulatory agencies are typically concerned with effects of flood flow, and may stipulate the techniques to be used in the hydrology and hydraulics evaluations undertaken to satisfy their information requirements. These information requirements typically vary between projects. Between jurisdictions there may also be variation in prescribed techniques. The information requirements listed below are from the OMNR document Guidelines and Criteria for Approvals Under the Lakes and Rivers Improvement Act, and are representative of information requirements of most agencies.

6.3.1. Calculation of Design Flood

The OMNR document Guidelines for Approvals under the Lakes and Rivers Improvement Act lists the following methods for determining design floods in order of preference:

1. Frequency Analysis – statistical analysis of stream gauge data,
2. Log-Pearson III analysis is more commonly used in the U.S., whereas the log-normal distribution is more commonly applied in Canada,
3. Regional extrapolation – using frequency analysis data from other parts of the watershed or similar watersheds with similar basin characteristics,
4. Region analysis methods – using regional equations and index methods,
5. The Flood-Ontario index software package Department of the Environment has been used successfully on Canadian Great Lakes tributaries,
6. Hydrograph simulation – can be used on watersheds where no stream gauges are available or where regional analysis are unsuitable, and
7. Rational Method – suitable for small watersheds under 25 square kilometers.

6.3.2. Survey-based Plans of Reservoir for Normal and Design Flood Water Levels

Backwater effects from fixed- and adjustable-crest sea lamprey barriers are small. Modeling using Manning's equation and the crest-rating curve subject to calibration with field observations is generally sufficient to establish levels of reservoir under normal and flood flow conditions. Computer software such as HEC-II or HEC-RAS should be available when more rigorous examination of hydraulics is required. This may be necessitated by a regulatory agency or at the engineer's discretion.

Results are generally presented in an engineering drawing with plan and elevation views. Topography may come from existing mapping or from site surveys.

6.3.3. Stage vs. Storage Calculation Curves for Normal Flow and Design Flood

The volume of the reservoir is calculated at normal flow conditions as well as at the design flood using the discharge over a weir equation:

$$Q=CL_eH_e^{3/2}$$

Where Q = discharge
L_e = effective length of crest

H_e = effective total head on crest including velocity of approach
C = discharge coefficient

This equation is discussed earlier in this protocol.

6.3.4. Channel Velocity Calculations under Normal and Design Flood Conditions

Channel velocity may be calculated from Manning's equation. Velocities may also be determined in HEC or similar hydraulic modeling software. Where possible, velocities should be verified against measurements. The extent of calibration required is at the discretion of the engineer.

6.3.5. Flood Routing Calculations According to Ministry of Transportation Ontario Flood Formulae

Refer to procedures outlined in the Ontario Ministry of Transportation Drainage Manual.

6.4. Skills Required

In the province of Ontario, the engineering profession is governed by provincial legislation. The Professional Engineers Act R.S.O. 1990, Chapter P.28 governs "any act of designing, composing, evaluating, advising, reporting, directing or supervising that involves third-party concerns related to life, health, property, and the public welfare (including the environment), and that requires the application of engineering principles". In addition, a Certificate of Authorization is required to offer consulting engineering services to the public. Therefore, to carry out engineering in the province of Ontario, employees of the sea lamprey control program must be licensed professional engineers, and any consultant offering engineering services to the sea lamprey control program must work under a Certificate of Authorization. The FWS would typically require licensure of engineers engaged in barrier design in the United States.

The engineer will likely require support staff to provide assistance with related tasks such as surveying. The engineers and their support staff will be able to work most effectively if they are familiar with candidate streams, barrier dam design issues and criteria, as well as applicable regulations. When outsourcing, efforts should me made to sole-source a small number of consultants to prevent delays or misunderstandings resulting from a considerable learning curve for each project.

6.5. Level of Effort

Task	Description	No. Staff	Time
6.0	Crest Design Hydrology & Hydraulics		
	Research - The ease of calculation depends on the availability of existing data, and how much additional survey work is required. Data is not always available via internet, and due to scheduling conflicts, etc. data obtained from other agencies may take over a month to arrive.	1 +	1-3 weeks
	Survey (incl. travel time)	Min-2	1-2 weeks
	Site visits for calibration (min. 3 visits per year. Travel incl.)	Min-2	3+ weeks
	Analysis		
	Preparation of survey drawings, slope, and x-section data	1 +	1-2 weeks
	Application of Manning's frequency modeling, weir discharge	1 +	1-2 weeks
6.3.1.	Calculation of Design Flood Flow Times will vary depending on methods used, which is a function of information availability.	1 +	1-2 weeks
6.3.2.	Survey-Based Plans of Reservoir – Normal & Flood Flow	1 +	.5 weeks
6.3.3.	Stage-Storage Calculations – Normal & Flood Flow	1 +	.2 weeks
6.3.4.	Channel-Velocity Calculations – Normal & Flood Flow	1 +	.5 weeks
6.3.5.	Flood Routing under MTO formulae	1 +	n.a.

7. Tools Required

Specific brand names for required tools have not been identified. Specific brand and product names are not constant and cannot be expected to continue to be state of the art. Furthermore, government agencies must not be seen to show favor to certain companies. When materials are purchased, it is assumed that the engineer will have sufficient understanding of the task at hand to select an appropriate tool.

Computer-Related Tools - Departmental standards may require certain software and prohibit others. In general, the following is required: computer-aided design program, hydraulics modeling software, hydrology and frequency modeling software, stream-gauge data acquisition software, spreadsheet, and word processor and computer workstation capable of supporting these applications with output capability sufficient to create construction drawings. Costs for these are subject to change and are not provided.

Hydrology-Hydraulics Tools - Flow meters, water level meters, and data loggers.

Survey Tools - Total Station, level or transit with tripod, 7 meter survey rod, various measuring devices both electronic and manual, axes, stakes, steel bar, paint, calculator, survey logbook.

Safety Equipment-Life jackets, hip and chest waders, safety harnesses and line, and may include 4-wheel drive vehicle suitable for off-road use, small boat or canoe,

8. Information Requirements

Cross section data is required – see protocol Surveys at Barrier Sites,
Historical flow data from USGS, Environment Canada, and control agent monitoring,

Slope and manning roughness – established and calibrated by the engineer,
Topographic Survey – see Surveys at Barrier Sites, and
Flow records – from government agency or barrier program.

All computer files containing hydrologic, hydrology information, drawings, and correspondence required by the barrier program are stored on the network file-server in Sault Ste. Marie, Ontario. This storage device is maintained by Informatics, Department of Fisheries and Oceans. Informatics maintains an archive of weekly back-ups of this server. Any hydrology information, data, etc. compiled by DFO-SLCC for U.S. barrier projects will be provided to FWS on request.

9. Contract Requirements

The GLFC currently has the resources to implement this protocol throughout the Great Lakes Basin using the engineering unit at the Sea Lamprey Control Centre in Sault Ste. Marie, Ontario. If, as a result of workload, outsourcing of engineering work is needed, procedures and deliverables are described in the Use of Consultants by the GLFC protocol.

10. References

Professional Engineers Ontario, 1998, Professional Practice Guideline, Association of Professional Engineers of Ontario, North York, Ontario. http://www.peo.on.ca

OMNR, 1997. Ontario Ministry of Natural Resources Guidelines and Criteria for Approvals under the Lakes and Rivers Improvement Act.

United States Army Corps of Engineers, Design of Small Dams.

11. Use of Other Protocols

Fixed-Crest Barrier Design Criteria

Preliminary Engineering Design and Plans

Installation of Water Level Data Loggers

Use of Consultants by the GLFC

Surveys at Barrier Sites

12. Protocol Authority

12.1. Allowance for Variations from Protocol

No set of protocols will give the correct instructions for every situation barrier engineers will encounter. The activity of balancing project size, complexity, and risk with the level of study undertaken requires sound engineering judgement. The professional engineer requires the discretionary authority to modify this protocol as circumstances require.

With respect to Section 3.0 and the assumptions made regarding start and end times of lamprey runs, this protocol represents the current state of the art. New developments in research areas need to be applied to this criterion to refine them and ensure that the state of the art is maintained.

12.2. Protocol Status and Revision

Periodic review should occur every five to ten years to ensure that methods used are up to date with current engineering practice. The GLFC should also be able to initiate a review of this protocol.

12.3. Protocol Author and Date

A. Hallett, March 1999

INSTALLATION OF WATER LEVEL DATA LOGGERS

1. Protocol Title: Installation of Water Level Data Loggers

2. Protocol Business Need

Hydrology and hydraulic characteristics of rivers change from one location to another. The barrier engineer requires a good deal of site specific information under a range of flow conditions to optimize the design of a fixed-crest barrier to conditions unique to specific sites. The presence of existing gauging stations on candidate rivers could negate the need for levelogger installation. The number of hydrologic studies to be undertaken at once and budget constraints will influence the total number of devices deployed.

There is opportunity for only two to three site visits per year. Given careful timing of these visits a rating curve can be prepared after about two years. Sufficient data for frequency analysis would only become available with more frequent site visits and more years of study. Water level data loggers are used to economically and accurately collect historic flow data so that the barrier engineer may learn about the hydrologic and hydraulic behavior of rivers without requiring weekly or even daily site visits which would be impossible to schedule. If the level-recorders are in place long enough (more than 10 years), they may provide useful information for flood studies.

This protocol may also be applicable for monitoring of existing barrier sites to detect flood events above crest height that may result in the escapement of spawning adult lamprey during the lamprey run. Related protocols are those dealing with the monitoring of barrier performance.

3. Protocol Deliverables

Several types of water level recording equipment are used to provide water level data for the barrier program. River gauging stations operated by the USGS in the U.S, and by the Water Resources Branch of the Department of Environment in Canada, have been in use for some time in the barrier program. Where such high quality data is already available at a candidate barrier location, additional water level recording equipment may be redundant. However, if an existing gauge is some distance from the candidate site, on-site water level recording can help produce an accurate rating curve for the river at the candidate site. Where no gauging information is available, and comparative hydrology is applied to similar watersheds, water level recording at the candidate site can be an essential calibration tool.

The extent of water level recording data required and the location of the levelogger rests with the professional engineer who is responsible for the design and operation of the barrier. In the interest of reducing travel costs and redundant visits at remote sites, these gauges are best located and installed initially by an engineer and second person (possibly technician, biologist or student). Subsequent routine visits to check the gauge could then be undertaken by the technician.

Frequently, the barrier program will have to undertake water level monitoring of its own to achieve sufficient site specific data as may be required for analysis. This protocol is focused on gauging equipment installed and operated in support of the barrier program, with a goal of achieving consistent and valid water level data for application in barrier design.

4. Target Audience

Barrier program engineers and technicians.

5. Jurisdiction for Protocol Use

This protocol is suited for use on candidate barrier streams throughout the Great Lakes Basin where flow records are insufficient for use in barrier design.

6. Procedures

Presently, the water level recording equipment in use by the barrier program is the Levelogger™. This device is available through Solinst Canada, a geo-technical and hydro-geological instrumentation company, based in Georgetown, Ontario. The Levelogger™ was selected from a number of similar devices currently on the market. The principal advantages of the Levelogger™ are:

- Compact size – approx. 22 cm X 2.3 cm (8.7 in X 0.9 in),
- Rugged – self-contained in stainless steel case,
- Battery operated – no electrical connection is required – suitable for remote sites,
- Data download to spreadsheet eliminates transcription error,
- Quick and easy download of data in field,
- Simultaneous collection of temperature data,
- Battery life of approximately eight to ten years, which is equal to typical data collection period required, and
- Approximate cost: $2,000 CDN each.

The principal drawback of the Levelogger™ is that, due to the fact that no electrical cable is used and the water-depth sensor cannot be ventilated to the atmosphere, changes in barometric pressure result in the introduction of error into the recorded water level record. A second Levelogger™ is synchronized with the first and is used to record atmospheric pressure. Atmospheric pressure influences are then subtracted from the water level data to produce a water level record accurate to within millimeters. Each installation of two Leveloggers™ will involve a one time capital cost on the order of $5,000-$6,000 CDN.

Programming and set up for the Levelogger™ are clearly explained in the Levelogger™ Operating Manual (Solinst 1998). Specific settings used by the barrier program include regular water level sampling every six hours. This provides enough resolution of data to capture peak and minimum flow events, and provides a realistic mean daily flow.

Based on the outcome of the site selection protocol, a location for the water level recording instrument will be selected with sensitivity to river hydraulics and proximity to the candidate barrier location to provide applicable data. Because these instruments are expensive, it is worth spending the time to install them in a lockable 5.1-cm (2-in.) diameter steel caisson to prevent loss or theft. The caisson may be driven into soft substrates or may be secured to permanent features such as bridge abutments. The barrier engineer will use their best judgement to find a location free of influence from channel velocity, in a stable condition, and with sufficient depth as to allow level recording year-round. The second instrument, for collecting atmospheric pressure, must be mounted at a sufficient elevation to ensure it will not be submerged and in such a way as to prevent theft.

To protect against instrument and/or data loss, calibration visits to download data and repair caisson installations should be undertaken at a minimum of semi-annually. The Levelogger™ Instruction Manual recommends quarterly inspection/calibration. For the purposes of the barrier program, a typical inspection would consist of downloading data from the water level recorder, measuring river stage and recorder elevation relative to benchmark, measuring stream discharge, and a cross-section survey.

6.1. Skills Required

Because the barrier engineer is legally accountable for the design produced from this data, the engineer has a duty to ensure the quality of the data collected by gauge installations is sufficient for the purpose for which it is to be applied. Water level data collection is carried out under the technical supervision of a barrier engineer. The engineer selects the location for the gauge based on results of the site selection. The engineer will typically require the assistance of a barrier technician to facilitate installation of water level recording equipment. A barrier technician can carry out routine checks, discharge measurements, and replacement and removal of the leveloggers. A minimum of two people is required to install these gauges. It is preferable that one person have shop skills and access to tools to best assist with caisson assembly and installation. For safety, both persons should also have basic rescue skills.

6.2. Level of Effort

Description	No. Staff	Time
Off-site programming of Levelogger™	1	1/2 hour
Purchase / Fabrication of caisson	1	1/2 day
Installation of Levelogger™ (not including travel time)	2+	1/2 day
Semi-Annual Inspection, Calibration and On-Site Data-Transfer to Laptop Computer(not including travel time)	2	1/2 day/visit
Atmospheric Pressure Correction	1	1/2 day

6.3. Definitions

A **barrier engineer** has responsibility for one or more functions of a sea lamprey barrier during its lifetime from the time of initial design to decommissioning. In Ontario this person must be a licensed professional engineer.

A barrier technician will have either, but preferably both, a college education as a construction or civil engineering technologist (CET) and experience in the construction industry.

In the U.S., if under the employ of the federal government, these persons are not required by law to be licensed. Licensure may be required in some states where plans are submitted for permitting under dam safety statutes and when work is outsourced to consulting engineers.

7. Tools Required

Generally, the following equipment will be required:

- Water level recorder* and related computer interface software and hardware,
- Portable computer, supporting Windows 95 ™ or higher,
- Access to tools required for fabricating caissons/protective housings,
- Access to tools/equipment for on-site installation,
- Survey equipment – level/transit, 7 m rod, 50 m tape, flow velocity meter,
- Capability to procure (purchase/rent) related hardware/tools/equipment in field,
- Safety equipment – life jacket, chest waters, dry-suit, safety harnesses and line,
- Boat or canoe may be necessary in some cases, and

- 4-wheel drive vehicle for transportation to sites, possibly an ATV.

* Level-recording instruments need not be limited to the Levelogger™, as other equipment may become available over time and may be more effective.

8. Information Requirements

This protocol will generate several spreadsheet data files, hardcopy and digital drawings for each site. Hydrology data collected for preliminary engineering design of barriers generally has a one-time use in the design process and will be archived as part of the design files on completion of the construction project. All computer files containing hydrologic, hydrology information, drawings, and correspondence required by the barrier program are stored on the DFO-SLCC network file-server in Sault Ste. Marie, Ontario or by the FWS. The files are considered to be part of the barrier program inventory. Any hydrology information, data, etc. collected or compiled by DFO-SLCC for U.S. barrier projects will be provided to FWS on request.

When flow data are acquired for the purpose of monitoring barrier performance, the data are to be retained as part of the records in the barrier inventory and used for decision support for the initiation of larval detection surveys (see Performance Measures for Escapement at Barriers protocol).

9. Contract Requirements

The GLFC currently has the resources to implement this protocol through the agent DFO-SLCC (Engineering Unit, Sault Ste. Marie, Ontario). If outsourcing of engineering work is to be done, contracts outlining procedures and deliverables will be required for Michigan, New York, Wisconsin, and Ontario.

10. References

Professional Engineers Ontario, 1998. Professional Practice Guideline, Association of Professional Engineers of Ontario, North York, Ontario. http://www.peo.on.ca

Solinst, 1998. Levelogger™ Instruction Manual. Solinst Canada. 35 Todd Rd. Georgetown, Ontario

11. Use of Other Protocols

Surveys at Barrier Sites

Preliminary Engineering Designs and Plans

Performance Measures for Escapement at Barriers

Hydrology and Hydraulics in Barrier Design

12. Protocol Authority

Protocols will be peer reviewed and final approval will rest with the barrier engineers and the SLBTF. The engineer may require discretionary authority to amend the protocol from time to time.

12.1. Allowance for Variations from Protocol

The activity of balancing project size, complexity, and risk with the level of study undertaken requires sound engineering judgement. The professional engineer requires the discretionary authority to modify this protocol, as circumstance requires, and to accommodate differences in jurisdictional requirements.

12.2. Protocol Status and Revision

Periodic review should occur every three to five years to ensure that methods used are up-to-date with current engineering practice.

12.3. Protocol Author and Date

A.G. Hallett, March 1999

SURVEYS AT BARRIER SITES

1. Protocol Title: Surveys (geo-technical, hydrologic, legal, and mapping) at Barrier Sites

2. Protocol Business Need

The size of candidate barrier streams varies by orders of magnitude and, as a result, the complexity and level of detail of supporting survey requirements is also highly variable. In the barrier program surveys are undertaken to satisfy internal, design-related requirements, and external jurisdictional or legal requirements. Geo-technical, hydrologic, legal, and topographic mapping surveys are undertaken to satisfy these requirements in varying levels of detail at the discretion of the barrier engineer, and as required for compliance with regulatory requirements. Compliance with regulatory requirements may require professional licensure for engineers and surveyors in each jurisdiction.

Depending upon site conditions and the type of barrier under consideration, additional specialized surveys may be required for engineering design purposes. These will be determined on a case-by-case basis by the project engineer.

3. Deliverables

This protocol identifies typical survey information required to support engineering planning and design of barriers. The protocol also identifies the survey information needed to support legal and land title registration requirements, and survey information typically needed to support technical reports in accordance with jurisdictional requirements for construction permits. Additional engineering plans, surveys, and reports may be required for special circumstances.

4. Target Audience

Depending on the application and on licensure requirements, site surveys may be carried out by appropriate, qualified agent staff, or appropriately qualified/licensed consulting engineers/surveyors. All site surveys require the technical supervision of the control agent's barrier project engineer. For safety reasons, and to facilitate operation of survey equipment, the individual undertaking the survey will typically require the assistance of one additional person. Survey skills would be an asset for this assistant, but are not crucial.

5. Jurisdiction for Protocol Use

This is a generalized protocol intended for basinwide application. Professional judgement of the barrier project engineer is required to assure that specific jurisdictional requirements are met as well as those required for design purposes. Large barriers and barriers built in urban areas require greater study than smaller sites, and will require greater supporting information.

6. Procedures

6.1. Geo-technical Surveys

The purpose of geo-technical surveys at candidate sites is to guide decisions on design, construction materials, and construction techniques, and may also be jurisdictional requirements. These surveys will assess such soil conditions as erodibility, penetrability, permeability, consolidation, and bearing capacity to the extent required by the barrier engineer. Geo-technical surveys for candidate barrier sites can vary greatly in level of detail. The barrier engineer must assess the size and complexity of both the proposed structure and of the candidate site to arrive at this level of detail. For example, brief examination of the candidate site for a small barrier may show a homogeneous bedrock substrate. From here the engineer may justifiably reach conclusions as to construction materials and methods, without going to the cost of highly detailed surveys. In contrast, first inspection of a candidate site for a larger barrier, may reveal a mixed substrate in an

area where geological maps indicate a variety of sub-surface conditions may leave the engineer with no alternative but to contract soil boring or test pitting studies. Elevations should be referenced to a benchmark on site.

6.2. Topographic Surveys for Hydraulic Design

One purpose of topographic surveys at candidate barrier sites is to contribute to hydraulic and hydrologic (H&H) design. Some jurisdictions may provide direction on their preferred choice of analytical methods to be used for H&H design. A number of analytical methods (HEC-II, HEC-RAS, Manning) may be used to assess hydraulics under a range of hydrological conditions. Typically, these methods rely on several cross sections of the river and flood plain, measurements of river slope upstream and downstream from the site, and some assessment of the roughness of the channel substrate and banks. Survey detail must accommodate the requirements of the model or models being used. Recently, considerable advances have been made in the field of natural channel design. A number of principles espoused therein are also applicable to survey design for H&H studies, and are gaining favor of some regulatory agencies.

6.3. Flood Plans

Most, if not all barrier projects are likely to encounter legislation requiring that the extent of the head pond be delineated in plan, under a variety of flow conditions. This should be done as a matter of course. The purpose for requiring flood plans is to protect the interests of adjacent riparian owners. This is achieved by undertaking legal surveys and registering easements on land titles from effected owners. Channel diversion increases the real estate and permitting required, especially on small dams with low heads. See Hydrology and Hydraulics in Barrier Design protocol for more details.

Surveys must extend far enough upstream to delineate the head pond. This will vary from one stream to the next due to variations in river slope. Sound engineering judgement is required to delineate the scope of the survey area. Elevations should be referenced to a benchmark on site.

6.4. For Tender and Construction

The engineer will find it useful to have a detailed site survey with cross sections of the river and banks to assist with calculations for volumes of excavation and fill/armoring required for tender purposes.

6.5. Skills Required

Procedures in this protocol fall under the disciplines of engineering and surveying, and should be carried out by persons skilled accordingly. Skills include land surveying, geo-technical and hydrological engineering. Experience in natural channel design concepts, hydraulic analysis of structures in rivers, and in hydrology is essential in planning these surveys. Work may be contracted out to licensed surveyors or carried out by technical staff at the discretion of the barrier engineer.

Work carried out in the U.S. by FWS personnel should be carried out/supervised by an engineer or hydrologist, though no formal certification is required by law. For consultants to perform this work, whether in Canada or in the U.S., licensure as a professional engineer is required by law. The engineer will require the support of a second person when on site. For safety, both persons should also have basic rescue skills.

6.6. Level of Effort

The amount of survey information required to support barrier design depends on the size of the barrier project. The level of detail, and effort spent acquiring survey-related information, is at the discretion of the professional engineer.

6.7. Definitions

7. Tools Required

Generally, the following equipment will be required:

1. Survey equipment – level/transit, 7 m rod, 50 m tape, flow velocity meter *,
2. Capability to procure (purchase/rent) related hardware/tools/equipment in field,
3. Safety equipment – life jacket, chest waters, dry-suit, safety harnesses and line for each person,
4. Boat or canoe may be necessary in some cases, and
5. 4- wheel drive vehicle for transportation to sites, possibly ATV.

* Level-recording instruments may also be installed at the time of survey. Refer to protocol for Installation of Water Level Data Loggers.

8. Information Requirements

This protocol will generate several spreadsheet data files and digital drawings for each site. All computer files containing hydrologic, hydrology information, drawings, and correspondence required by the barrier program are stored on the network file-server in Sault Ste. Marie, Ontario. Informatics, Department of Fisheries and Oceans maintain this storage device and an archive of weekly back-ups of this server. For U.S. barrier projects the FWS will ensure all survey data is retained in the barrier inventory

9. Contract Requirements

The agents currently have the resources to implement this protocol internally through the engineering unit at the DFO-SLCC. A protocol or similar document outlining procedures and deliverables will be required for Michigan, New York, Ohio, Wisconsin, and Ontario if outsourcing of engineering work is to be done.

10. References

11. Use of Other Protocols

Installation of Water Level Data Loggers

Preliminary Engineering Designs and Plans

Hydrology and Hydraulics in Barrier Design

Use of Consultants by the GLFC

12. Protocol Authority

Protocols will be peer reviewed and final approval will rest with the barrier engineers and the SLBTF. The engineer may require discretionary authority to amend the protocol from time to time.

12.1. Allowance for Variations from Protocol

No set of protocols will give the correct instructions for every situation barrier engineers will encounter. The activity of balancing project size, complexity, and risk with the level of study undertaken requires sound engineering judgement. The professional engineer requires the discretionary authority to modify this protocol, as circumstance requires, partly accommodating interpretations of changes between jurisdictional regulations.

12.2. Protocol Status and Revision

Periodic review should occur every five to ten years to ensure that methods used are up-to-date with current engineering practice.

12.3. Protocol Author and Date

A.G. Hallett, March 1999

MICHIGAN ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS REQUIRED FOR BARRIER CONSTRUCTION

1. Protocol Title: Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction

2. Protocol Business Need

This protocol addresses Michigan's regulatory and permit requirements governing barrier construction and modification in the state of Michigan.

3. Protocol Deliverables

This protocol provides a checklist of environmental documents, permits, and approvals required before lamprey barriers can be constructed or significantly modified. The intended outcome is that barrier practitioners will be familiar with the requirements in all jurisdictions such that barrier projects will receive the required appropriate environmental reviews and obtain the necessary permits and approvals in a timely manner. Assuming it is successful, this protocol will be used once per proposed project.

4. Target Audience

Barrier engineers, practitioners, and administrative staff.

5. The Jurisdiction for Protocol Use

This protocol applies only in Michigan. It primarily includes procedures for compliance with state laws and regulations. Refer also to the protocol U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction.

6. Procedures

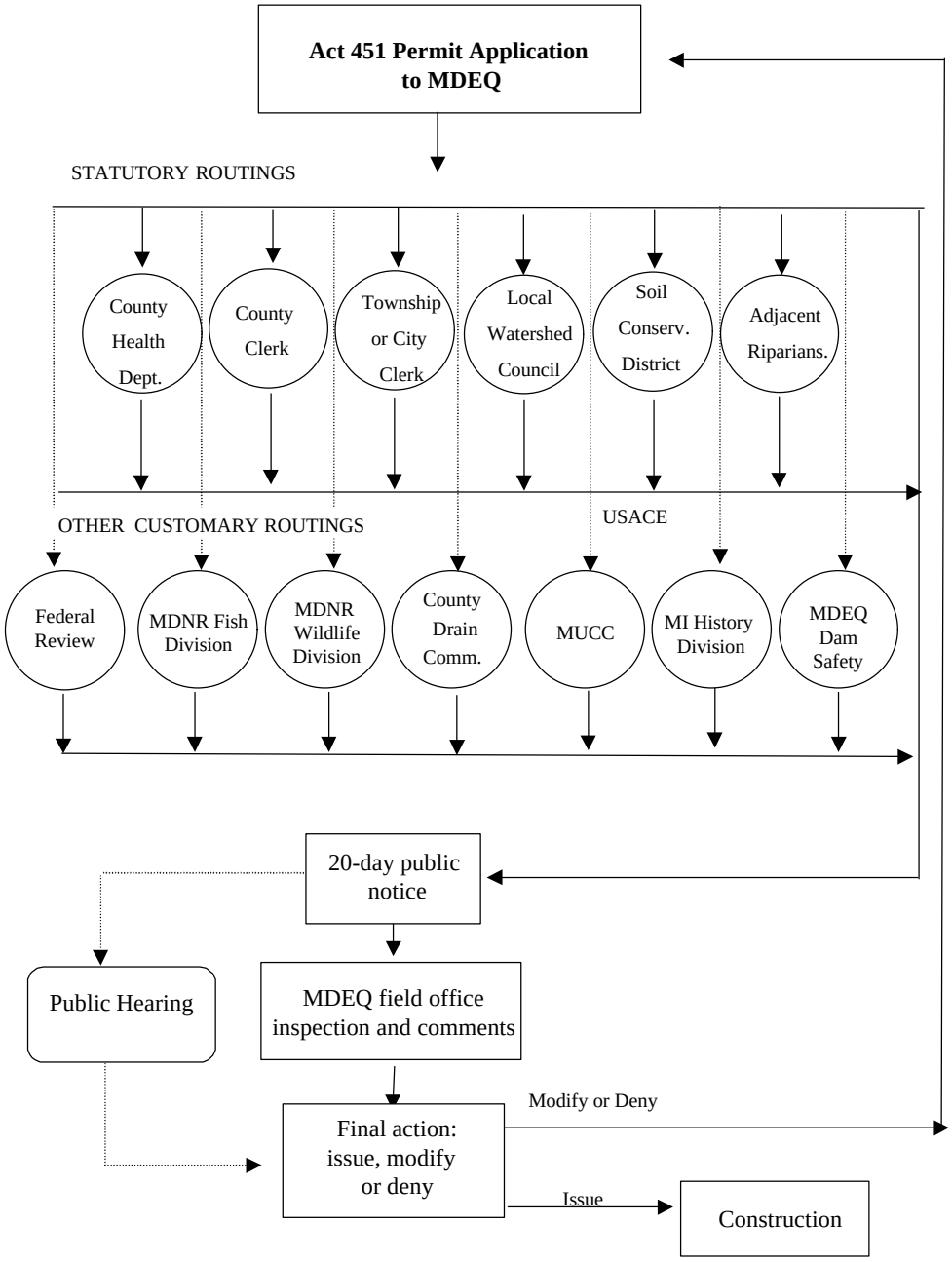
Various parts of the Michigan Natural Resources and Environmental Protection Act (NREPA), Act 451 of 1994 comprise the primary legislation governing Michigan barrier projects. These include Part 31 (Floodplain and Water Resources Protection), Part 301 (Inland Lakes and Streams), Part 303 (Wetlands Protection), and Part 315 (Dam Safety). The Michigan Department of Environmental Quality (MDEQ), Land and Water Management Division (LWMD) administers the law. A single consolidated permit application review process encompasses these provisions.

Michigan is one of only two states that have been delegated program authority pursuant to Section 404 of the Clean Water Act. As part of the Michigan permitting process, the United States Army Corps of Engineers (USACE) receives a copy of the application when both state and federal jurisdictions are applicable, but a separate Section 404 permit is not issued. The USACE retains jurisdiction in navigable waters under Section 10, as well as in wetlands adjacent to navigable waters under Section 404 of the Clean Water Act. These may or may not apply to barrier projects (see protocol for U.S. Federal environmental assessment requirements).

Michigan has no comprehensive environmental assessment statute. However, an administrative rule (R 281.814), pertinent to Part 301, establishes that- "in each application for a permit, all existing and potential adverse environmental effects shall be determined"; that a permit shall not be issued until the department determines that effects will be mitigated as well as possible; the resource is not rare; and that there are no feasible and prudent alternatives. Michigan administrative rule (R 281.812) states that "after receipt of an otherwise complete application, the department may request such additional information, environmental assessments, waterway design calculations, records, or documents as are determined to be necessary to make a decision to grant or deny a permit". Review of the application may require public notice and will involve coordination and consultation with other state agencies as determined necessary.

MICHIGAN ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS REQUIRED FOR BARRIER CONSTRUCTION

The LWMD permit review process for Parts 31,301,303 and 315, as it is applied to the barrier program, is outlined by the following flow chart:



MICHIGAN ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS REQUIRED FOR BARRIER CONSTRUCTION

Not shown in the flow chart are the GLFC protocols for site selection, engineering and environmental studies, and preliminary engineering designs and plans that must be completed in order to prepare the application. The elements of the flow chart are summarized as follows:

6.1. Permit Application

The permit application requires a description of the project, a justification, description of alternatives, and drawings showing cross-sections, site plan, dimensions, and elevations. A hydraulic engineering report prepared by a registered professional engineer showing the impact of the proposal on flood stages or discharge characteristics, may be requested, depending on the scope of the project.

Contact: Permit Consolidation Unit
Land & Water Management Division
Michigan Department of Environmental Quality
P.O. Box 30204
Lansing, MI 48909-7704

6.2. Statutory Routings

The applicable parts of Act 451 have public notification requirements that require routing to certain agencies and persons as described in the first tier of the flow chart. These entities then have 20 days to respond to the application with comments.

6.3. Other Customary Routings

Land and Water Management Division has a great deal of flexibility in regard to routing the permit application to other reviewers. When the application is logged into the Permit Consolidation Unit database, the database will identify potential areas of concern, for example, it will alert the user to the presence of an endangered species in or near the township, range, and section of the proposed project. This process will help define which agencies receive copies of the application for comment. The flow chart shows recipients of applications for barrier construction (Les Thomas, MDEQ-LWMD, personal communication). Note that with proper coordination between the barrier program and other agencies during development of a project, such review should be a formality at this point in the process.

1. Under a MOA between the MDEQ and the United States Environmental Protection Agency (EPA), major permit applications are sent to EPA and other federal resource agencies for review and comment. Major applications include projects that result in placement of more than 10,000 cubic yards of fill; that potentially impact federally listed threatened or endangered species; that impact national parks, federally listed historic or archaeological sites, and similar sensitive locations; have interstate pacts; or involve the discharge of toxic materials.
2. MDNR Fish Division reviews applications for impacts to fish populations and habitats. Fish Division determines which fish species, if any, must be passed at a barrier and approves fish passage designs. MDNR can dictate fish passage installation under Part 483 of Act 451, Passage of Fish Over Dams (formerly the Michigan Free Fish Passage Act of 1929), which gives that authority to the director of the department.
3. MDNR Wildlife Division reviews impacts to wildlife and carries responsibility for enforcing Michigan's endangered species law, Part 365 of Act 451. If the project is perceived to be deleterious to an endangered species, recommendations necessary to assure appropriate protection of the species are provided to LWMD staff.

4. The County Drain Commissioner administers state law and county ordinances pertaining to construction and maintenance of drains, water management districts, and court ordered inland lake level controls. In the case of a barrier project on a state-designated drain (which includes many streams), a letter of approval from the County Drain Commissioner would be needed.
5. Michigan United Conservation Clubs (MUCC) is a large nonprofit organization with a membership of more than 120,000 individual members and 470 affiliated clubs with a goal of the protection and enhancement of Michigan's natural resources.
6. The State Historic Preservation Office (SHPO), a sub-unit of the Department of State, reviews all federal undertakings for impacts on historic properties under the National Historic Preservation Act of 1966. The Office of the State Archaeologist, part of the same administrative unit, also reviews projects to determine their potential impact on Michigan's archaeological resources.
7. Although exemption under dam safety regulations for new barrier projects is to be expected, coordination is still required by the state to confirm this determination. Michigan dam safety regulations apply only to structures that have or will have six feet or more of height and have or will have an impoundment capacity at design flood elevation of five or more surface acres. No dedicated U.S. lamprey barriers currently meet these criteria, so this protocol will not discuss dam safety laws and regulations. Two remedial works projects have been undertaken on dams where review and approval by Michigan Dam Safety engineers were a requirement (Trout River, Presque Isle Co. and White River, Oceana Co.). After repairs the dams remained the property of the owners who retained responsibility for dam safety inspections and reporting.

6.4. MDEQ Review

The appropriate MDEQ field office collects reviews and comments. If a pubic hearing is requested, it may be held at the discretion of the MDEQ staff if objections are judged to be substantive and relevant to the resource.

6.5. Issuance of Permits

MDEQ then either issues the permit, suggests that the project be modified, or denies the permit. The usual time from receipt of an application that is administratively complete to issuance of the permit is 60 to 90 days.

6.6. Skills Required

Knowledge of environmental assessment and other regulatory permit applications, and technical writing and interpersonal skills involving scientific and technical subject matter dealing with environmental, engineering, and fisheries biology. If a hydraulic engineering report is required, the author must be a registered professional engineer.

6.7. Level of Effort

Assemble information and fill out permit application: 20 staff hours; time for MDEQ processing is 60 to 90 days.

7. Tools Required

8. Information Requirements

Refer to permit application as referenced above.
Extensive use of information generated from protocols for planning, engineering and environmental studies, and preliminary engineering design and plans.
Names and addresses of adjoining riparian landowners.

9. Contract Requirements

Third party consulting engineers and planners may be used to develop the submission to the state for approval.

10. References

Clean Water Act (33 U.S.C. 1344)
Michigan Natural Resources and Environmental Protection Act (NREPA), Act 451 of 1994
Michigan Administrative Rules
Rivers and Harbors Act of 1899 (33 U.S.C. 403)
National Historic Preservation Act (U.S.C. Sec. 470-470t)

11. Use of Other Protocols

Preliminary Engineering Designs and Plans is the key protocol that integrates several protocols for the development of plans for permit applications.
U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction

12. Protocol Authority

12.1. Allowance for Variations from Protocol

This protocol derives from external regulatory requirements, hence there is no allowance for variation.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3 Author and Date

Ellie Koon, March 1999

ONTARIO AND CANADA ENVIRONMENTAL ASSESSMENTS, PERMITS AND APPROVALS REQUIRED FOR BARRIER CONSTRUCTION

1. Protocol Title: Ontario and Canada Environmental Assessments, Permits, and Approvals Required for Barrier Construction

2. Protocol Business Need

This protocol addresses jurisdictional regulatory requirements governing new barrier construction in Ontario, Canada. Repairs and maintenance of existing barriers follow a similar but abbreviated process as described in Section 6.12.

3. Protocol Deliverables

This protocol provides a checklist of environmental documents, permits, and approvals required before lamprey barriers can be constructed. The intended outcome is that barrier practitioners will be familiar with the requirements in all jurisdictions such that barrier projects will receive the required appropriate environmental reviews and obtain the necessary permits and approvals in a timely manner. Assuming it is successful, this protocol will be used once per proposed project.

4. Target Audience

Barrier engineers, practitioners, and administrative staff of the Canadian control agent and the barrier cooperator, the OMNR.

5. The Jurisdiction for Protocol Use

This protocol applies only in Ontario, Canada. It includes procedures for compliance with both federal and provincial laws and regulations. The proponent for barrier construction in Ontario is generally the DFO-SLCC that owns and operates the majority of sea lamprey barriers in Ontario. There is a cooperative agreement between DFO and OMNR for the development of barriers in Ontario (Sea Lamprey Barrier Dam MOU).

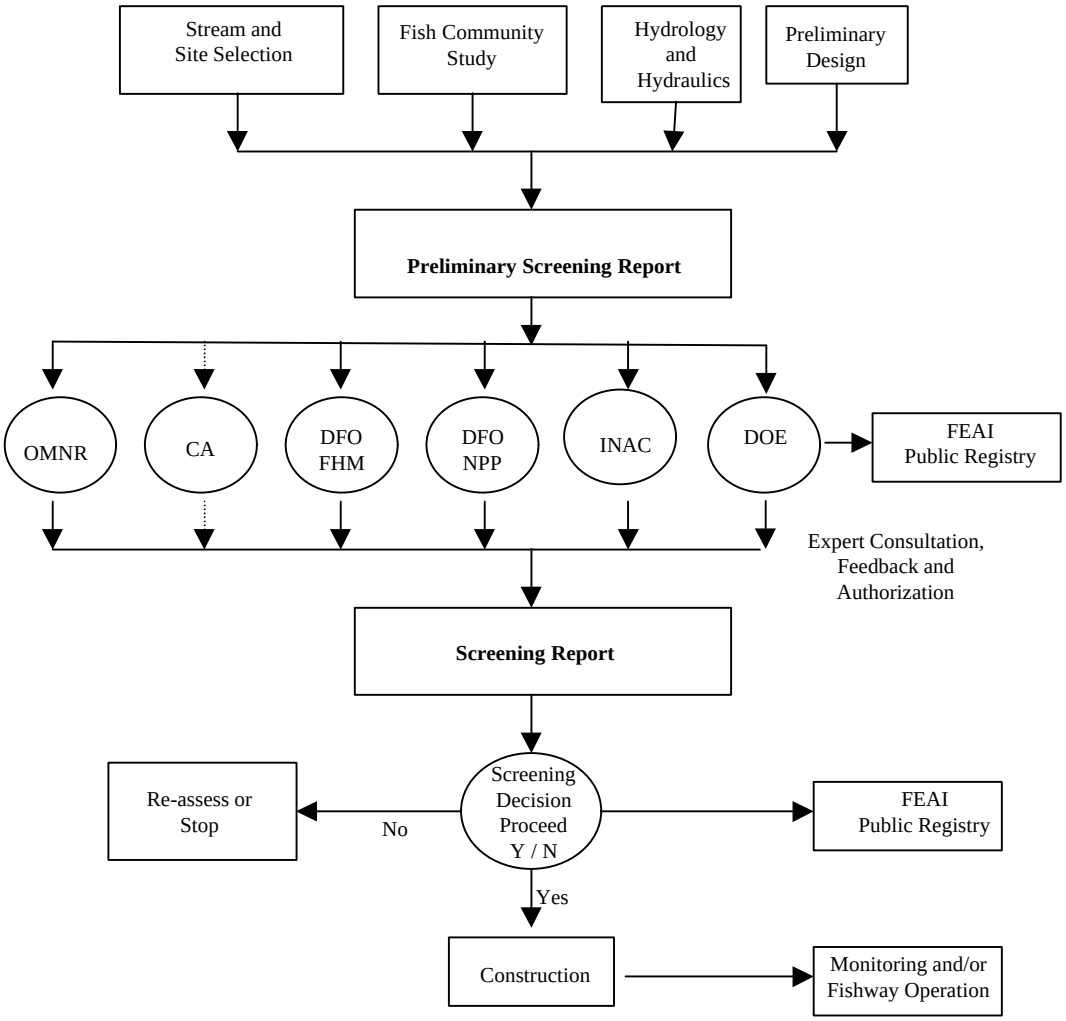
6. Procedures

The overarching legislation governing new barrier projects in Ontario is the Canadian Environmental Assessment Act (CEAA). The screening process under CEAA includes coordination with other federal and provincial agencies and procurement of other necessary permits and approvals. The complete text of the Ontario statutes described below is available on the World Wide Web at <http//www.attorneygeneral.jus.gov.on.ca/legis.htm>. Canadian federal statutes are available at <http://canada.justice.gc.ca>.

The CEAA process as it is applied to the barrier program is outlined by the following flow chart:

ONTARIO AND CANADA ENVIRONMENTAL ASSESSMENTS, PERMITS AND APPROVALS REQUIRED FOR BARRIER CONSTRUCTION

CEAA Screening Process for Sea Lamprey Barriers



The first rows of flow chart elements of the screening process are described in separate subsections in section 6 below.

6.1. Preliminary Screening Report

The CEAA requires that an environmental assessment must contain:

1. A statement of purpose and a rationale for the project,
2. The way it will be done,
3. Alternative methods of carrying it out,
4. A description of the environment affected and expected effects,

5. Potential mitigation actions, and
6. An evaluation of the advantages and disadvantages to the environment and alternatives to the undertaking.

The preliminary screening report, to adequately address these issues, may include a description of the site, a preliminary barrier design with associated hydraulics and hydrology analysis, and a fish community study. The content of the fish community study is not dictated in detail by CEAA, but is the result of negotiations among staff of DFO-SLCC and DFO Fish Habitat Management (DFO-FHM).

Under CEAA, the proponent has the responsibility to contact and inform all “interested parties”, which the proponent is expected to exercise “due diligence” in identifying. In practice, the screening report, with a cover letter, is sent concurrently to five federal and provincial agencies for review and permitting.

6.2. OMNR Review

The OMNR reviews a barrier project and issues permits under the provincial Lakes and Rivers Improvement Act. DFO-SLCC staff follows procedures outlined in the Guidelines and Criteria for approvals under the Lakes and Rivers Improvement Act (OMNR May 1997). Contact is through the OMNR district office in the area of the proposed project. A list of OMNR offices can be found on the World Wide Web at <http:www.mnr.gov.on.ca/MNR/csb/message/mnroffices.html>.

6.3. Conservation Authorities Review

Conservation Authorities, governed by municipalities, regulate flood plain development on watersheds within areas of urban development. They may require additional flood studies for barriers proposed in their jurisdictions. Agreements between conservation authorities and the DFO delegating some fish habitat responsibility are currently evolving. They have the same jurisdictional area as their governing municipalities and application will be made to them for all barriers in urban settings.

6.4. DFO Habitat Management Review

The DFO is vested with fish habitat conservation and protection under the federal Fisheries Act. The Fish Habitat Management Section (FHM) responsibilities and procedures are detailed in their 'Revised' Interim Fish Habitat Referral Process handbook (DFO, 1998). The FHM reviews barrier proposals under the Fisheries Act with the following policy goals in mind: fish habitat conservation (no net loss of productive capacity), fish habitat restoration, and improvement and creation of fish habitat. There is a hierarchy of preferences in the application of the policy to projects as follows:

1. Maintain without harmful alteration, disruption, or destruction (HADD) the natural productive capacity of the habitats in question by avoiding any loss or HADD to site of project. Achieved by encouraging proponent to redesign the project, select alternate sites, or mitigate potential damages using other reliable techniques such as installing a fishway.
2. If impossible or impractical to maintain same level of habitat productive capacity, department may accede to compensation, preferably at the site, but if not, at another site with same habitat or at another site with other habitat.
3. Artificial production to supplement the fishery resource.

DFO-FHM strongly endorses #1, but will agree to #2 if mitigation is roughly equivalent and is near the site, and is likely to deny approval if #3 is the only mitigation offered.

DFO-FHM also reviews barrier proposals for impacts to endangered fishes. Although Canada has no national endangered species legislation, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) maintains a list of species that are usually accorded special consideration in the provinces and territories where they occur and in environmental impact assessments of projects. In Ontario, species at risk may be listed either provincially or nationally, or both. Provincially listed endangered species consist of those species protected under Ontario's Endangered Species Act. Provincially listed threatened or vulnerable species are those species placed on an unregulated but official list by the OMNR. The work of the provincial committee, the Committee on the Status of Species at Risk in Ontario (COSSARO), is integrated with the work of COSEWIC. Lists of Ontario species at risk are available on the World Wide Web at <http://www.mnr.gov.on.ca/MNR/nhic/lists/fish.htm>. Further information on endangered fishes, including range maps, photographs, and drawings, is available at <http://www.rom.on.ca/ontario/risk.html>.

There are four potential outcomes to the DFO-FHM review:

1. A letter of approval of the project as proposed,
2. A letter of approval of the project contingent on implementation of mitigation (modifications to the project design) to alleviate fishery impacts (e.g., installation of a fishway, best management practice for construction),
3. A letter of authorization stating that the proposed project causes a HADD and compensation (replacement of habitat on an equal value) will be required (e.g., provision of non-target spawning habitat below a barrier), or
4. A determination that environmental impacts would be severe enough that they could not be adequately mitigated or compensated and denial of the approval.

The DFO-FHM will favor projects scheduled outside windows of timing restrictions intended to protect spring and fall spawning and eggs.

Contact: L.W. Dahlke
Department of Fisheries and Oceans,
Fish Habitat Management Branch,
1 Canal Drive,
Sault Ste. Marie, Ontario
P6A 6W4

6.5. Federal Environmental Assessment Index

Federal Environmental Assessment Index (FEAI) is a public registry of projects. To document progress in the CEAA screening process, barrier engineers use the DFO Habitat Referral Tracking System (HRTS). After the screening is complete, the DFO-SLCC staff post the report in the FEAI via the HRTS. The FEAI may be accessed at <http:/www.ceaa.gc.ca/registry/registry_e.htm>. This service is provided in order to inform the public of the proposed project and to solicit public input as required under CEAA.

6.6. Navigable Waters Protection Program (DFO-NPP)

Under the national Navigable Waters Protection Act, DFO is charged with review and permitting of projects that may interfere with navigation. The DFO-SLCC staff follow guidelines in Aids and Waterways Navigable Waters Protection Act Application Guide (Minister of Supply and Services, Transport Canada, 1980, ISBN 0-662-50705-3, 16 pp.). Navigable waters under the law "includes a canal and any other body of water created or

altered as a result of the construction of any work". Proposed barrier sites are inspected in the field by NPP staff with either of two results: a determination of non-navigability; or a determination that the water body is navigable and that a permit is required. The permit application must include a copy of the preliminary barrier design. Public comment is solicited by publication of the permit application in the Canada Gazette and two local newspapers. Issuance of the permit may include a stipulation for the provision of boat or canoe passage.

Contact: Navigation Protection Program
Department of Fisheries and Oceans
201 Front Street, Suite 703
Sarnia, Ontario
N7T 8B1
TEL 519-383-1813, 519-383-1865
FAX 519-383-1995

6.7. Department of Environment Review

The federal Department of Environment (DOE) is vested under the national Migratory Birds Convention Act with the protection of migratory birds, listed by species in the Act. No surveys are necessary. The DOE is provided with a copy of the preliminary screening report and determines effects on migratory birds from information therein. DOE then responds with a letter of approval. This approval is an administrative requirement under CEAA; it has been granted for barrier projects in the past without difficulty. It is granted most easily when construction is scheduled in periods when birds are not nesting.

Contact: Mr. Bill Bien
Environment Canada
Canada Centre for Inland Waters
867 Lakeshore Rd.
Burlington, Ontario
L7R 4A6

6.8. Indian and Northern Affairs Review

Indian and Northern Affairs Canada (INAC) approval is needed to ensure that barrier projects will not impact cultural resources on native lands, which the agency will determine after reviewing the screening report. Barrier sites should be selected to avoid native burial grounds or spiritually significant sites (see protocol for Site Selection). On native lands, proper coordination with local authorities should ensure approval by INAC.

Contact: John Higham
Indian and Northern Affairs Canada
25 St. Clair Ave. E.
Toronto, Ontario
M4T1M2

6.9. Compilation of Final Screening Report

Following consultation with other agencies, the preliminary screening report is modified accordingly, finalized, and submitted back to the reviewing agencies to keep them informed of DFO-SLCC intent. Their respective permits are appended to the final screening report.

ONTARIO AND CANADA ENVIRONMENTAL ASSESSMENTS, PERMITS AND APPROVALS REQUIRED FOR BARRIER CONSTRUCTION

6.10. Construction

Under CEAA, the proponents of a project make the final decision to proceed and are responsible for the decision. In this case, DFO-SLCC barrier staff decide whether to proceed with the barrier project. The decision whether to proceed is again posted on FEAI via HRTS. At that point construction may be initiated.

6.11. Post construction

Following construction, commitments made to agencies may dictate monitoring of compensation or mitigation measures such as fishways, to gauge their success and evaluate the need for improvement.

6.12. Repair and Maintenance

Repair and maintenance of existing barriers are not covered by CEAA if they can be considered "modification to existing works that does not affect their function". However, permits will be needed similar to those for new barriers from OMNR, DFO-FHM, and possibly INAC, depending upon the location.

6.13. Skills Required

The Ontario Lakes and Rivers Improvement Act (R.S.O.1990, c.L.3) requires that engineering plans and specifications for dam construction, reconstruction, or repair be prepared by an engineer.

6.14. Level of Effort

Element of Process	Staff time/ review timetable
Preliminary screening report	40 hours
OMNR review	4 to 6 weeks
DFO-FHM review	6 to 8 weeks
DFO-NPP review	2 to 4 weeks, plus 30 day advertising
INAC review	2 to 4 weeks
DOE review	4 to 6 weeks
FEAI public registry	must be posted for 30 days prior to construction
Final screening report/distribution	40 hours
FEAI public registry	Posting occurs within 30 days.

6.15. Definitions

CEAA- Canadian Environmental Assessment Act

COSEWIC - Committee on the Status of Endangered Wildlife in Canada

COSSARO - Committee on the Status of Species at Risk in Ontario

DFO-FHM - Department of Fisheries and Oceans Fish Habitat Management section

DFO-NPP - Department of Fisheries and Oceans Navigation Protection Program

DOE - Federal Department of the Environment

FEAI - Federal Environmental Assessment Index

HADD - Maintain without harmful alteration, disruption, or destruction

HRTS - Habitat Referral Tracking System

INAC - Indian and Northern Affairs Canada

7. Tools Required

8. Information Requirements

See protocols for Site Selection and Preliminary Engineering Designs and Plans.

9. Contract Requirements

Consulting engineers licensed in the province of Ontario may be used to develop engineering designs and plans used in submissions for approval and consultants may be used for environmental studies.

10. References

Canadian Environmental Assessment Act

Fisheries Act

Migratory Birds Convention Act

Navigable Waters Protection Act

The Ontario Lakes and Rivers Improvement Act (R.S.O. 1990, c. L.3)

Minister of Supply and Services, Transport Canada, 1980. Aids and Waterways Navigable Waters Protection Act Application Guide, 16 pp., ISBN 0-662-50705-3

Ontario Ministry of Natural Resources, 1997. Guidelines and Criteria for Approvals under the Lakes and Rivers Improvement Act

Fisheries and Oceans Canada, 1998. A Protocol Detailing the 'Revised' Interim Fish Habitat Referral Process in Ontario. 23 pp. and appendices.

11. Use of Other Protocols

Production of a preliminary screening report assumes that a final site has been selected (Site Selection), a fish community study has been completed if necessary, information needed for a preliminary design has been assembled, and a preliminary design has been completed (Preliminary Engineering Designs and Plans).

12. Protocol Authority

12.1. Allowance for Variations from Protocol

This protocol derives from external regulatory requirements hence there is no allowance for variation.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3. Author and Date

Andrew Hallett and Ellie Koon, March 1999

OHIO ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS NEEDED FOR BARRIER CONSTRUCTION

1. Protocol Title: Ohio Environmental Assessments, Permits, and Approvals Needed for Barrier Construction

2. Protocol Business Need

This protocol addresses Ohio's regulatory and permit requirements governing barrier construction and modification.

3. Protocol Deliverables

This protocol provides a checklist of environmental documents, permits, and approvals required before lamprey barriers can be constructed or significantly modified. The intended outcome is that barrier practitioners will be familiar with the requirements in all jurisdictions such that barrier projects will receive the required appropriate environmental reviews and obtain the necessary permits and approvals in a timely manner. Assuming it is successful, this protocol will be used once per proposed project.

4. Target Audience

Barrier engineers, practitioners, and administrative staff.

5. The Jurisdiction for Protocol Use

This protocol applies only in Ohio. It primarily includes procedures for compliance with state laws and regulations. Refer also to the protocol U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction for U.S. federal jurisdictional requirements.

6. Procedures

The Ohio Revised Code (ORC 6111.03) confers authority for water pollution prevention and control to the Ohio Environmental Protection Agency (OEPA) and establishes the OEPA as the agency responsible for state certification under Section 401 of the Clean Water Act (33 U.S.C. 1251). Dredged or fill material is defined as pollution under ORC 6111.01. The Ohio Administrative Code (OAC 3745-32-01) specifically defines fill material placed in the waters of the state to include dams and dikes, but excludes material placed for the purpose of maintaining existing dams or dikes. OAC 3745-32-02 provides that state Section 401 water quality certification is required to obtain permits from the USACE under Section 404 of the Federal Water Pollution Control Act, or any other federal permit or license to conduct any activity which may result in any discharge to waters of the state. An exception to this rule occurs when a federal project is specifically authorized by Congress and the effects of the discharge are included in an Environmental Impact Statement (see protocol U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction). The Section 401-certification application is comprehensive and highly detailed, including impacts on all aspects of the environment and an analysis of alternatives, such that it constitutes the equivalent of an environmental assessment.

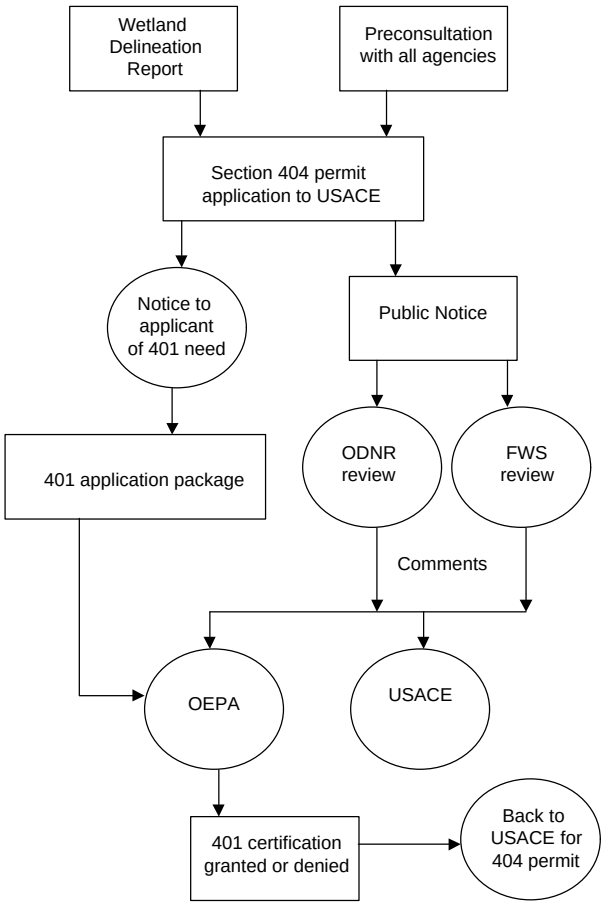
Ohio laws and rules governing the construction and modification of dams are administered by the Division of Water, Department of Natural Resources (ODNR) under the authority of ORC 1521.06 - 1521.064 and associated administrative rules (OAC 1501:21-1 to 23). Permit application consists of a two-step process in which a detailed preliminary design is submitted, allowing the state to evaluate the hazard potential of the proposed structure, and a subsequent process that depends on the hazard classification. Ohio statutes and rules can be accessed on the Internet at <http://orc.avv.com> (ORC) and <http://www.conwaygreene.com> (OAC).

OHIO ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS NEEDED FOR BARRIER CONSTRUCTION

The barrier construction approval process is initiated by application to the USACE for a Section 404 permit (see protocol U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction). If the project is within the jurisdiction of the Buffalo District (Erie and Ontario drainage), a wetland delineation is required to accompany the 404 application if there is any possibility of impact to wetlands. If the USACE determines that a Section 404 permit will be necessary, the USACE notifies the applicant that a state Section 401 certification is also necessary, and issues a public notice that serves as a review document for the ODNR and the FWS. (The wetland delineation report must be field-checked and verified by the USACE before the public notice is issued.) The applicant then submits a 401-application package to the OEPA. The 401 package can also be submitted at the same time as the 404 package if the applicant is certain that 401 certification will be necessary. The OEPA reviews the document and accepts comments from the ODNR and the FWS. The 401 certification is then issued (or not) and the USACE resumes its permitting process under Section 404.

The overall process is illustrated in the following flow-chart:

OHIO BARRIER PERMITTING PROCESS



Individual elements of the flow chart are described as follows, beginning with the 401 application.

6.1. OEPA SECTION 401 CERTIFICATION APPLICATION PACKAGE

OHIO ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS NEEDED FOR BARRIER CONSTRUCTION

Much of the following information was obtained from the Section 401 Water Quality Certification Application Primer (OEPA, 1998). A Section 401 certification from the state of Ohio is necessary to obtain a Clean Water Act Section 404 permit from the USACE. The application package must include:

1. A wetland delineation report approved by the USACE. This is usually contracted to a consulting firm for most large projects. Procedures must conform to the 1987 Wetland Delineation Manual (see citation: Environmental Laboratory, 1987).
2. A wetland assessment with a proposed assignment of wetland category (according to OAC 3745-1-54). Categories are based on the wetland's relative functions and values, sensitivity to disturbance, rarity, and potential to be adequately compensated for by mitigation. The OEPA will evaluate the applicant's proposed wetland category assignment and make the final determination.
3. Application Form: Sections 1 to 9 and 11 of the application require straightforward information including the following: other permits needed; information on the applicant; location of proposed project; purpose and need; and quantity of fill. Section 10 of the application, the alternatives analysis, represents the OEPA Division of Surface Water's response to the "antidegradation rule" (OAC 3745-1-05), which describes the conditions under which water quality may be lowered in surface waters. Existing beneficial uses must be maintained and protected. Water quality better than that needed to protect existing beneficial uses must be maintained unless lower quality is deemed necessary to allow important economic or social development.

Section 10 includes an analysis of three alternatives for the proposed project, including:

1. the "preferred design";
2. the "minimal degradation alternative", a less environmentally damaging or scaled-down version of the project that would result in less damage to surface water quality and still meet the needs of the applicant; and
3. the "non-degradation alternative", a version of the project that would result in no damage to surface water quality, that is, no material would be removed or placed below the ordinary high water mark. If the project is located entirely within water to fulfill the basic project purpose (i.e., a lamprey barrier), this may be considered to be a no-build alternative.

For each alternative, the following issues must be addressed:

6.1.1. Detailed Project Description

6.1.1.1. Construction Details

Description of project; maps and site plans showing present extent and type of vegetative cover, all surface waters and proposed changes to site, including a well-defined map of the construction limits of the site; original topographic map of site; and cross-sectional drawing(s) of project(s).

6.1.1.2. Fill Material

Description of all types and amounts (cubic yards) of fill to be placed below ordinary high water mark or within jurisdictional wetlands, including rock types and sizes, and origin of fill material.

6.1.1.3. Dredge Material

Description of amount of material to be removed from below the ordinary high water mark, particle size analysis as required, and chemical constituent sampling as required. Description and map of dredge spoil disposal location.

6.1.2. Biological and Physical Impact

6.1.2.1. Plants and Animals

Description of how the project will adversely affect animal life (including sport and recreational fishes); plant life; rare, threatened, and endangered animals and plants (include written comments from ODNR and FWS); aquatic habitat and physical characteristics of the water body and adjacent areas; and flow patterns of surface water.

6.1.2.2. Wetlands

Description of type of wetland (forested, emergent, etc.); category (Category I, II, or III) of each type of wetland to be impacted, including a discussion of the functional assessment tool used and the rationale for placing the wetland in the selected categories; individual and total wetland acreage on site; individual and total acreage to be impacted; proximity/location of each wetland in relation to other surface waters; a wetland delineation report; and a demonstration that the post-construction storm water run+off rate will not exceed the pre-construction rate and that water quality will be either unaffected or improved.

6.1.2.3. Streams

Name of each stream to impacted and each receiving stream; water quality use designation for each stream (see http://chagrin.epa.state.oh.us/watershed/findit.htm); type, width, and age of vegetation adjacent to water course; individual and total lineal feet of stream on site; and proximity/location of each watercourse in relation to other surface waters.

6.1.2.4. Lakes and Ponds

Names of each water body; name and description of each stream flowing in or out of each waterbody; type, age, and width of vegetation adjacent to each water body; adjacent land uses.

6.1.2.5. Photographs

Numbered photos of all surface water areas and associated vegetative buffers to be impacted, including directly adjacent land; reference map showing photo locations and directional arrows.

6.1.2.6. Present and Proposed Adjacent Land Uses

Description to the extent known.

6.1.2.7. Additional Information

Ohio EPA may also request the following:
Qualitative Habitat Evaluation Index (QHEI) sheets performed by an OEPA-approved technician (Rankin, 1989)

Index of Biotic Integrity (IBI) data (OEPA, 1990)
Index of Community Integrity (ICI) data (ibid)

6.1.3. Applicant's Project Cost

6.1.3.1. Cost Effectiveness

Itemized analysis of anticipated costs to construct each alternative; itemized anticipated economic profits or losses for each alternative.

6.1.3.2. Availability

Discussion of whether the technology is available to complete the project/alternative as proposed or whether it is theoretical or unproven.

6.1.3.3. Reliability; Operation and Maintenance

Anticipated life of project and repair cost; discussions of whether the aspects of the project/alternative that are designed to address water quality impacts are reliable and dependable.

6.1.4. Related Projects

Consult with other agencies to develop a list of any environmental or recreational improvement projects targeted for the affected surface water.

6.1.5. Water Pollution Controls

Description of best management practices to be used, including but not limited to erosion and turbidity controls and their costs; description of other water pollution controls, water treatment works, or other aspects of the project/alternative incorporated into the project to treat, reduce or eliminate water pollution generated as a result of the project.

6.1.6. Human Health Impacts

Description of how the lowering of water quality may affect human health; overall impacts to quality of the water resource.

6.1.7. Jobs Created and Revenue Gained

Number of jobs to be created, directly or indirectly, by the project; state and local tax revenues to be generated; brief description of the local economy (median household income, poverty rates, population growth, unemployment, etc.); potential direct and indirect increases in property values due to the proposed project; positive impacts on recreational and commercial opportunities of the water resource, including tourism; businesses positively impacted; positive aesthetics of the project.

6.1.8. Jobs and Revenue Lost

Number of jobs to be lost, directly or indirectly, due to the project; state and local tax revenues to be lost; brief description of the local economy (median household income, poverty rates, population growth, unemployment, etc.); potential direct and indirect lowering in property values due to the proposed project; negative impacts on recreational and commercial opportunities of the water resource, including tourism; businesses negatively impacted; negative aesthetics of the project.

6.1.9. Environmental Benefits Lost or Gained

Effect on each stream's natural sediment-moving capabilities; affect on each wetland's pollutant filtering capability; discussion of how any losses will be mitigated.

6.1.10. Mitigation Techniques

Mitigation for the preferred design and each minimal degradation alternative (not the non-degradation alternative) must be proposed for impacts to any surface water.

6.1.10.1. Wetland Mitigation

Wetlands preserved, created, or enhanced to mitigate for wetlands impacted or destroyed must be of equal or greater acreage depending on the classification of the original wetland. These rules are very complicated and are outlined in OAC 3745-1-54. The mitigation proposals must include: description and map of the mitigation site; a scaled plan (6" contours) and sections to illustrate the size, shape, and depth variation of the proposed mitigation; hydrology information showing that there will be sufficient water to sustain the wetland mitigation in perpetuity; soil type in the mitigation area and soil amendments necessary; how and what vegetation will be established; when the mitigation will be constructed and completed; Best Management Practices to be used, including but not limited to erosion and turbidity control; 5-year monitoring plan, including who will be doing it; description of how water quality functions will be replaced on site; description of who will manage the mitigation area, who will retain ownership, and how it will be protected in perpetuity; and a contingency plan in case the mitigation fails, including a time frame for remediation.

6.1.10.2. Stream, Lake, and Pond Mitigation

Description of the mitigation site, including a USGS quad map; scaled plan, sections, and specifications illustrating size, shape, and depth of the proposed mitigation; habitat restoration or enhancement proposed, including a demonstration that there will be no elimination or substantial impairment of existing instream water uses (OAC 3745-1-05(c)(1)); Best Management Practices to be used, including but not limited to velocity reduction structures, erosion control methods, and turbidity controls; a monitoring plan focusing on the reestablishment of habitat and water quality functions, including who will conduct the monitoring, and for streams, proposed Qualitative Habitat Evaluation Index scores and/or biological indices; and a contingency plan in case the mitigation fails, including a time frame for remediation.

6.2. Filing of Application

The OEPA states that their goal is to act on certification of projects within 60 days of receipt of a completed application but recommends that applicants allow a minimum of 180 days for complex projects. Furthermore, the OEPA classifies certain types of projects that may result in greater degradation to water quality as "projects of concern", including dams in streams. OEPA advises that it is not responsible for increased review times due to the submission of projects of concern.

Contact: Section 401 Supervisor
Ohio EPA/DSW
P.O. Box 1049
Columbus, OH 43216-1049

6.3. ODNR Internal Review

Upon receipt of the USACE public notice, the ODNR Environmental Coordinator assigns an ID number to the file and circulates it to several divisions within the agency. When all comments have been received, the Coordinator composes a letter of comment reflecting the composite view of the agency and sends it to the FWS, USACE, and OEPA.

6.4. Dam Safety Determination ODNR Division of Water

Several categories of barriers are automatically exempted from the permit process, as follows:

1. Small dams-if a proposed barrier is less than 10 feet in height and the storage capacity is less than 50 acre-feet; or if the storage capacity is less than 15 acre-feet regardless of height; or if the height is less than six feet regardless of storage capacity, construction is automatically exempt from permitting requirements. Repair, maintenance and improvement of dams meeting the aforementioned criteria are also exempt unless the construction constitutes an enlargement of the structure.
2. Dams designed and constructed by the USACE, and
3. Dams constructed by the Ohio Department of Natural Resources, provided that copies of final design report, plans, and specifications prepared by a registered professional engineer are filed with and approved by the chief.

6.4.1. Dam Permitting Process

Most sea lamprey barriers will likely be exempt from the permit process based on size, depending on the depth of the water at the toe of the dam. The permit process is outlined here with the assumption that lamprey barriers either will be exempt or will be categorized as low-hazard. Procedures for larger dams are omitted or summarized briefly. The following steps describe the process:

1. Determine whether dam is exempt from permitting requirements. Technically construction of exempted projects can proceed without coordination with the Division of Water, however it is recommended that a scaled-down version of the Preliminary Design Report be submitted to allow the state to verify the project's exempt status (Rick Archer, Ohio DNR, Division of Water, 1939 Fountain Square, Columbus, OH 43224-1336, personal communication).
2. Submit Preliminary Design Report: For any project that is not exempted, a Preliminary Design Report must be submitted. The following components must be included: a statement of the purpose for which the dam is to be used, and a statement setting forth the impact of such dam, dike, or levee as it relates to endangering human life, health, or property;
3. Maps showing: the location of the proposed structure; the county, township, and section lines; the outline of the reservoir; the locations of state, county, and township roads; the locations of utilities, i.e., pipe, transmission, telegraph, and telephone lines; the topography; and any other structure or facility affected by the proposed dam, dike, or levee (state, county, and U.S.G.S. maps, and aerial photographs may be used for these purposes);
4. A written report of the surficial conditions, i.e., geology, topography, and cultural features, which is based on a field reconnaissance by the applicant's engineer; typical cross-sections of the dam, dike, or levee accurately showing proposed elevations, pool levels, and top width;
5. Logs of borings in the foundation and in the borrow areas, and results of seismic and resistivity subsurface investigations, when they are readily available;

6. Preliminary design assumptions, tentative conclusions, and references pertaining to such hydrologic parameters as drainage area, rainfall and runoff data, inflow hydrographs, area-capacity-elevation data, and flood routings, in addition to geologic and geotechnical engineering assumptions;
7. A preliminary cost estimate of the structure and appurtenances; and
8. Other pertinent information as may be required by the Division of Water. Plans and specifications must be prepared by a registered professional engineer qualified in the design, construction, and inspection of dams who is practicing in accordance with laws of Ohio.

6.4.2. Application

Contact: Chief, Division of Water
Ohio Department of Natural Resources
1939 Fountain Square, Building E-3
Columbus, Ohio 43224

The Division may request a meeting with the applicant's engineer and/or the applicant to discuss the preliminary design report.

6.4.3. Assignment of Dam Hazard Class

Within thirty days from the date of receipt of the complete preliminary design report, the Division will respond in writing with either approval or disapproval of the report, and will designate the approved classification of the proposed structure. If the proposed structure is placed in class IV (see below) pursuant to OAC 1501:21-13-01 or 1501:21-13-09, the Division will notify the applicant that the proposed structure is exempt from the construction permit requirements (OAC 1501:12-19). Hazard classifications are defined as follows:

1. Class I- When failure of the dam would result in probable loss of human life or serious hazard to health, serious damage to homes, high-value industrial or commercial properties, or major public utilities, the dam is placed in class I. Dams having a storage volume greater than five thousand acre-feet or a height of greater than sixty feet are designated as class I.
2. Class II- When failure of the dam would result in a possible health hazard or probable loss of high-value property or damage to major highways, railroads, or other public utilities, but loss of human life is not envisioned, the dam is placed in class II. Dams having a storage volume greater than five hundred acre-feet or a height of greater than forty feet are designated as class II.
3. Class III- When failure of the dam would result in property losses restricted mainly to rural lands and buildings and local roads, and no loss of human life or hazard to health is envisioned, the dam will be placed in class III. Dams having a height of greater than twenty-five feet, or a storage volume of greater than fifty acre-feet, are designated as class III.
4. Class IV- When failure of the dam would result in property losses restricted mainly to the dam and rural lands, and no loss of human life or hazard to health is envisioned, the dam may be placed in class IV. Dams which are twenty-five feet or less in height and have a storage volume of fifty acre-feet or less, or dams, regardless of height, which have a storage volume of fifteen acre-feet or less, are designated as class IV. No proposed dam can be designated as class IV unless the applicant has submitted the preliminary design report.

These criteria are presented in the Ohio Administrative Code as guidelines, with the chief of the Division of Water retaining final authority in dam classification in order to protect life, health, and property. The chief also retains the right to reclassify dams according to

new information or changing circumstances. If the proposed structure is placed in class IV, the applicant is informed that it is exempt from the construction permit requirements. For the purposes of this protocol, we will assume that sea lamprey barriers will be either automatically exempt or hazard class IV.

For dams in hazard classes I to III, the state requires submission of an application package including a final design report, an application fee based on a percentage of the project cost, and a performance bond in the amount of half the project cost. There are extensive requirements for engineering investigations, design criteria, construction inspection, operation and maintenance manuals, and inspection schedules for higher-hazard dams. These are specified in great detail in the Ohio Revised Code and Ohio Administrative Rules and will not be discussed here.

6.5. ODNR Division of Natural Areas and Preserves (DNAP) (Wild and Scenic Rivers)

The ODNR administers a system of wild, scenic, and recreational river areas under ORC 1517. Classification as wild, scenic, or recreational depends on the presence of impoundments, accessibility, and degree of development. State agencies are enjoined from building any structure that will modify the channel of a designated watercourse without approval from the ODNR.

Ohio has 11 designated river systems, which can be viewed on the Internet at <http:// www.dnr.state.oh.us/odnr/dnap/srsystem/>. The only designated river with a candidate barrier site is the Grand River in Ashtabula County. The candidate site (Madison Road) is about a mile downstream of the lower limit of a wild-designated segment (Harpersfield Dam down to the Norfolk and Western Railroad Bridge), and within the corporate limits of the City of Painesville. It would not be under the direct authority of the DNAP, but their comments would be considered as part of the position taken by the ODNR.

Conneaut Creek, another lamprey barrier candidate, has been suggested for designation as a state wild and scenic river, but the process is lengthy and to date no action has been taken.

6.6. State Endangered Species Consultation

Section 10b of the 401-certification application requires a description of the anticipated impact of the proposed project on aquatic life and wildlife, including threatened and endangered species. The applicant is instructed to include written comments from the ODNR and the FWS.

The Ohio Revised Code splits authority for protection of state endangered species between the ODNR Division of Natural Areas and Preserves for plants (ORC 1518.01) and the ODNR Division of Wildlife for animals (ORC 1531.25). Federally listed endangered species are automatically included on both lists. Rules for Ohio endangered and threatened plants are established by OAC 1501:18-1. There are 642 plant species on the list, which may be found on the Internet at <http://www.dnr.state.oh.us/odnr/dnap/heritage/plantlst.html>. Rules for endangered animals are established in OAC 1501:31-23-01. The list includes 292 animals and may be accessed on the Internet at <http://www.dnr.state.oh.us/odnr/wildlife/diversity/endangered/>. Lake sturgeon (*Acipenser fulvescens*) and northern brook lamprey (*Ichthyomyzon fossor*) are included.

A two page form is provided by the ODNR for requesting information on both plants and animals from the Natural Heritage database. The form can be downloaded at <http://www.dnr.state.oh.us/odnr/dnap/heritage/herform2.pdf>. It requires a map and a fee for staff time based on a rate of $25.00 per half-hour.

Contact: Ohio Department of Natural Resources
Division of Natural Areas and Preserves
Natural Heritage Data Services
1889 Fountain Square Court, Building F-1
Columbus, OH 43224
Phone: 614-265-6543
Fax: 614-267-3096

6.7. ODNR Division of Wildlife

The ODNR administers the fisheries program within the Division of Wildlife. The 401-certification package requires that the applicant provide written comments from the ODNR and FWS regarding impacts on animal life, including sport and recreational fisheries.

6.8. Coastal Zone Management

Proposed barrier sites for the only two barrier candidate streams in Ohio, the Grand River (Madison St. in Painesville) and Conneaut Creek (Main St. in Conneaut) have been determined to be outside of the Coastal Area Boundary, so additional review by the Coastal Management Program will not be needed (Donald Guy, OHDNR Division of Geological Survey, 1634 Sycamore Line, Sandusky, OH 44870-4132, 888-644-6267, personal communication.)

6.9. U.S. Fish and Wildlife Service Review

The Fish and Wildlife Service Ecological Services Office with local jurisdiction reviews the project for compliance with federal environmental law as detailed in the protocol for U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction.

6.10. Ohio Environmental Protection Agency Acts

The OEPA evaluates all documentation and comments and renders a decision on whether the Section 401 certification is granted. The decision is transmitted to the USACE and the Section 404 process resumes.

6.11. Skills Required

Knowledge of environmental assessment and other regulatory permit applications; technical writing and interpersonal skills involving scientific and technical subject matter dealing with environmental, engineering and fisheries biology. Plans and specifications must be prepared by a registered professional engineer qualified in the design, construction, and inspection of dams who is practicing in accordance with laws of Ohio.

6.12. Level of Effort

Depends of the size and complexity of the project

7. Tools Required

8. Information Requirements

Refer to permit application as referenced above.

Extensive use of information generated from protocols for planning, engineering and environmental studies, and pre-engineering design and plans.

9. Contract Requirements

Third party consulting engineers and planners may be used to develop the submission to the state for approval.

10. References

Environmental Laboratory, 1987. Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., 143 pp.

Ohio Environmental Protection Agency, 1990. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, OH.

Ohio Environmental Protection Agency, 1998. Section 401 Water Quality Certification Application Primer. 9pp.

Rankin, E.T., 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, OH.

11. Use of Other Protocols

Preliminary Engineering Design and Plans is the key protocol that integrates several protocols for the development of plans for permits applications.

U.S. Federal Environmental Assessments, Permits, and Approvals Needed for Barrier Construction

12. Protocol Authority

12.1. Allowance for Variations from Protocol

This protocol derives from external regulatory requirements, hence there is no allowance for variation.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevance after two years of use.

12.3. Author and Date

Ellie Koon, May 1999

NEW YORK ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS NEEDED FOR BARRIER CONSTRUCTION

1. Protocol Title: New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction

2. Protocol Business Need

This protocol addresses New York's regulatory and permit requirements governing barrier construction and modification.

3. Protocol Deliverables

This protocol provides a checklist of environmental documents, permits, and approvals required before lamprey barriers can be constructed or significantly modified. The intended outcome is that barrier practitioners will be familiar with the requirements in all jurisdictions such that barrier projects will receive the required appropriate environmental reviews and obtain the necessary permits and approvals in a timely manner. Assuming it is successful, this protocol will be used once per proposed project.

4. Target Audience

Barrier engineers, practitioners, and administrative staff.

5. The Jurisdiction for Protocol Use

This protocol applies only in New York. It primarily includes procedures for compliance with state laws and regulations. For U.S. federal jurisdictional requirements refer to the protocol U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction.

6. Procedures

6.1. Applicable Legislation

The Civil Council to the New York State Department of Environmental Conservation (NYDEC) in 1984 issued an opinion that as an international organization, the GLFC is immune to almost all state regulation and "Hence, New York is without power to directly regulate the GLFC sea lamprey control program". This opinion was issued in relation to the [then] state wetlands permitting process. However, the opinion continues that "If the FWS were to become involved in such actions as the discharge of waste into streams, Ψ or the modification of stream beds then the state regulatory requirements may become relevant".

Barrier projects follow the requirements of two broad pieces of legislation, the State Environmental Quality Review Act (6NYCRR Part 617)(SEQR, referred to as "seeker") and the Uniform Procedures Act (UPA) (NYCRR Part 621). Both are well documented on the New York State web site at <http://www.state.ny.us>.

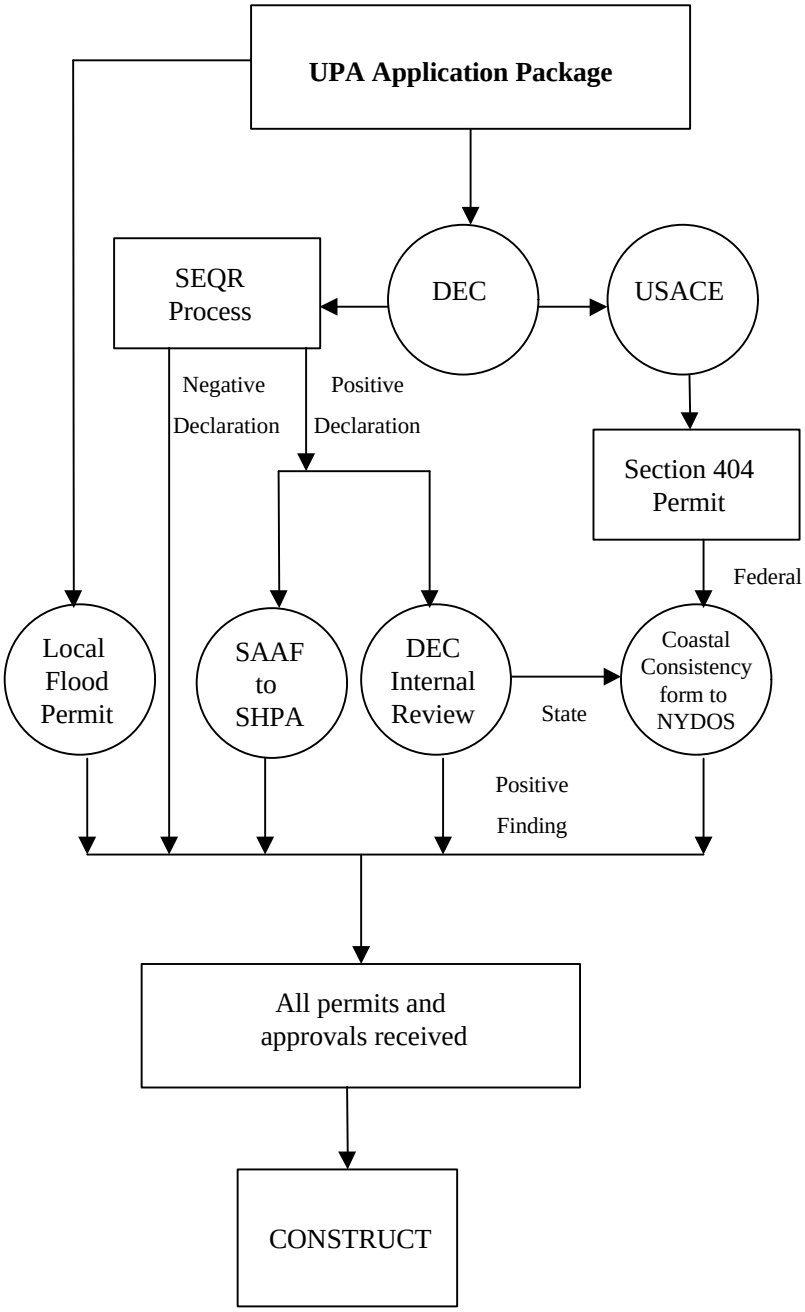
6.2. UPA Application Process

To initiate the process, a UPA joint permit application package (available at the web site cited above or from NYDEC regional offices) is submitted to the regional NYDEC office where the project is proposed. The application must be accompanied by: 1) a detailed description of the project; 2) a map showing the precise location of the project; 3) detailed project plans, which may include wetlands boundaries verified by DEC staff; 4) recent photos of the site and area; and 5) information necessary for the requirements of the SEQR and the State Historic Preservation Act (NYCL C36-B, A14)(SHPA), that is, a State Archaeological Assessment Form (SAAF). Also needed are a local flood hazard permit and a Coastal Consistency Form if the project is located in a Coastal Zone Management area. The flow chart below details the overall process. Not shown in the flow chart are barrier protocols (Reach Selection and Site Selection) leading to site

selection and a preliminary design (Preliminary Engineering Designs and Plans) that must be completed in order to prepare the application. The SEQR process will be described later in this document.

The elements of the flow chart are summarized as follows:

New York Sea Lamprey Barrier Permitting Process



6.2.1 Contents of the Permit Application Package

6.2.1.1. UPA Joint Permit Applications

The UPA joint permit applications constitute simultaneous requests for permits under the Freshwater Wetlands Permit Program (Article 24, 6NYCRR parts 663, 664, 665) and the

Protection of Waters (Article 15, 6NYCRR Part 608). These govern excavation and fill of navigable waters and dam construction and either Section 10 or Section 404 of the Clean Water Act with the USACE.

6.2.1.2. Supplement D1

Supplement D1 is a one page addition to the package that describes technical aspects of a proposed dam such as drainage area, spillway capacity, impoundment capacity, hazard class, soil data, and a hydraulic analysis. This document must be completed by a New York State licensed professional engineer. The submittal must also include all necessary design drawings.

6.2.1.3. State Archaeological Assessment Form

The State Archaeological Assessment Form (SAAF) consists of two pages, one of which is filled out by the applicant and the other by the NYDEC staff. The first page requests information on impacts to buildings on the State or National Register of Historic Places and requires photos in a specified format. The second page asks for information on buildings and also whether the proposed site falls within the Statewide Archaeological Inventory Map or in a known archaeologically sensitive area. If so, an archaeological survey may have to be performed by the applicant depending on consultation with the State Office of Parks, Recreation, and Historic Places.

6.2.1.4. Coastal Assessment Form

A Coastal Assessment form (also known as a Coastal Consistency form) is routed by the NYDEC (if a state project) to the Division of Coastal Resources of the New York Department of State. The shores of lakes Erie and Ontario are considered coasts. Habitat protection for fish and wildlife is a prominent part of the policy. No state agency can carry out, fund, or approve an action until it has been determined that the action is consistent with policies in the Coastal Zone Management Program (described in 19NYCRR Part 600), or a state approved Local Waterfront Revitalization Program. Environmental Impact Statements for Type I actions (see description of SEQR) must include an identification of the applicable coastal policies. If the proposed project is a state activity the Consistency Assessment Form or CAF must be included in the application package. In this case, DEC will forward the form to the New York Department of State.

The provisions of the federal Coastal Zone Management Act of 1972 (16 USC Sec. 1451,1456; 15 CFR 930.57) require federal agency activities to be consistent with the state's federally approved Coastal Zone Management Program. If the proposed project is a federal activity, the Federal Consistency Assessment Form, or FCAF must be included in the application package. The USACE will route it to the New York Department of State if a federal permit is required. If the Department of State determines that the proposed activity would be inconsistent with the state's Coastal Zone Management Program, federal agencies may not fund or approve the proposal.

Both federal and state forms can be downloaded from the New York state web site at <http:www.dos.state.ny.us/cstl/cstlcr.html>.

6.2.2. Routing to the USACE

In NYDEC Regions 6,7,8, and 9, which include Lakes Erie and Ontario drainages, the NYDEC has established a joint application procedure with the USACE Buffalo District. Section 401 of the Federal Water Pollution Control Act of 1972 requires that any federal agency funding, constructing, or issuing a permit to undertake activities affecting U.S. waters or wetlands, must first receive certification from the state in which the project is

located. This is so the project will not abrogate state water quality standards. The UPA joint permit application package is routed to the USACE, which reviews the application to determine whether a federal Section 404 or Section 10 permit is required (see protocol for U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction). The USACE will notify the proponent if a federal permit is required and will act on the application if necessary.

6.2.3. SEQR Process

The SEQR process is described in a separate flow chart in section 6.3.

6.2.4. Flood Hazard Review

Following an approval under SEQR, the proponent must apply to the local municipality if a project is to be located within a 100-year flood plain of a watercourse. Responsibility for flood hazard review and permitting is delegated to local governments under Article 36 of the Environmental Conservation Law and 6NYCRR Part 500 of the State Regulations, in order that the people of the state may participate in the national flood insurance program. Local governments have the principal responsibility for enacting appropriate land use regulation that will meet federal standards. The governing municipality may be a township, village, or city. Many use a common application form but some have their own version.

6.2.5. NYDEC Internal Review

NYDEC internal review should be completed within 14 days. Following approval of the project under SEQR and issuance of all necessary permits and approvals, construction may take place.

6.2.5.1. Division of Fish and Wildlife

The New York Division of Fish and Wildlife reviews the application for effect on water quality, habitat, and endangered species. The location of the proposed project is compared with distributions of state endangered species, both aquatic and terrestrial. A list of New York endangered species is available at the New York state web site <http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/index.html>. If the project is within a one mile radius of a known locality for such a species, is in an area in which an endangered species is otherwise known to occur, or impacts a critical habitat, additional mitigation procedures may be required or the permit may be denied.

6.2.5.2. Division of Water Resources

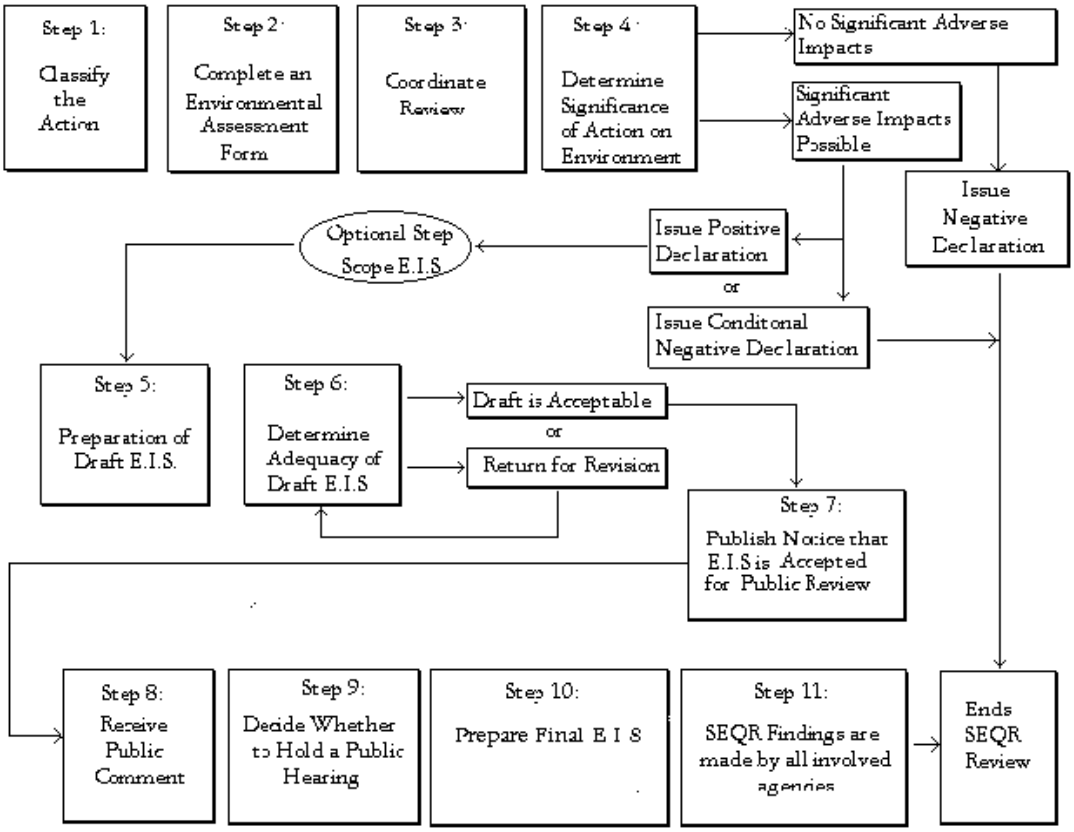
The NYDEC Dam Safety Section is located in the Bureau of Flood Protection, Division of Water in the state capitol in Albany. The Dam Safety Section provides a document entitled Guidelines for Design of Dams (NYDEC, 1989), which represents professional judgment of the Dam Safety Section's staff engineers. The introduction states that "since these are only general guidelines for small dam construction in an average situation, compliance will not necessarily result in approval of the application". It further states that "The determination by the department of the acceptability of the design and adequacy of the plans and specifications will be made on a case-by-case basis. The primary responsibility of proper dam design shall continue to be that of the applicant." The Dam Safety Section may add special conditions to the permit such as the provision of as-built drawings.

6.3. State Environmental Quality Review Act (SEQR)

NEW YORK ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS NEEDED FOR BARRIER CONSTRUCTION

SEQR is the state's overarching environmental statute that requires any state or local government agency to assess the environmental significance of all actions they have discretion to approve, fund, or directly undertake. It is modeled after and closely resembles the National Environmental Policy Act (NEPA). If the proposed project involves a federal agency, a draft and final Environmental Impact Statement (EIS) has been prepared under NEPA, and the project has been approved, the state agency has no obligation to prepare an additional EIS under SEQR. However, where a Finding of No Significant Impact (FONSI) is the result of the federal NEPA process, an EIS may still be required under SEQR. A final decision under NEPA is not considered binding on state agencies.

No state permit, license, or approval for barrier construction or modification may be issued until the project has complied with provisions of SEQR. As the permitting agency and potential partner for barrier projects, the NYDEC is responsible for coordinating SEQR review of proposed barriers. The following flow chart illustrates steps in the SEQR process:



Elements of the flow chart are detailed as follows:

6.3.1.Classify the Action

Upon receipt of the UPA application package, the NYDEC office classifies the proposed action. Type II actions may have already been determined to not significantly affect the environment. Rebuilding or replacement of facilities on the same site, maintenance, repair, and emergency actions fall under this classification. Type II actions require no further SEQR review. Type I actions are those which are already recognized as likely to

have a potentially adverse significant impact on the environment and may require an Environmental Impact Statement (EIS). Unlisted actions are those not previously classified as Type I or II. Until the NYDEC reviews the proposal, new barrier projects cannot be considered classified as either Type 1 or Unlisted. NYDEC staff will evaluate new barrier construction as per SEQR classifications and determine significance.

6.3.2. Prepare an Environmental Assessment Form

A full Environmental Assessment Form (EAF) must be submitted for any Type I action and for an unlisted action either a long or short form EAF may be submitted. The barrier project sponsor or applicant completes Part 1 of the form and submits it to NYDEC (in this case the involved agency) with any other applications that are required. NYDEC is then responsible for completing Part 2, and as needed, Part 3. The requirement for a full EAF may be waived if a draft EIS is prepared and submitted with the application. The EAF form can be downloaded at the New York State web site at <http://www dec.state.ny.us/website/dcs/EP_SEQR/seqr_downloadable.html>.

In addition to the usual information needed for environmental approvals elsewhere, such as site and project descriptions (Part 1 of the form), Part 2 of the form requires a judgement as to impact, on a scale of 1 to 3 (1 = small to moderate, 2 = potential large, 3 =can be mitigated by project change) to land, water, air, plants and animals, agricultural land, aesthetic resources, historic and archaeological resources, open space and recreation, critical environmental areas, transportation, energy, noises and odors, public health, and growth and character of community or neighborhood. If one or more impacts is considered to be potentially large, even it may be mitigated, it requires a separate in-depth analysis (Part 3).

6.3.3. Coordinate Review

The agency initially receiving the application for approval (NYDEC) circulates the completed Part 1 to other involved agencies. If one agency is approving, funding, or directly undertaking an action, that agency is automatically the lead agency, which is the NYDEC in the case of barrier construction.

6.3.4. Determine Significance

The lead agency has 20 calendar days to determine significance. It can request additional information if needed, after receipt of which it has 20 days to make the decision. Substantial interference with movements of any resident or migratory fish or wildlife species, impacts on a significant habitat area, and adverse impacts on threatened or endangered species are some of the criteria considered indicators of significant adverse impacts. If the lead agency determines that the proposed action will have no significant impact to the environment, it issues a Negative Declaration, which must be published and distributed, and the SEQR process ends. In the event that the proposed project is seen to have potentially significant adverse impact on the environment, the agency issues a Positive Declaration, which must also be published and distributed, and an EIS is required.

6.3.5. Scoping

Scoping is an optional but highly recommended step that has the objectives of focusing the draft on adverse impacts, eliminating non-relevant issues, identifying information needs, identifying a range of reasonable alternatives to be considered, and providing the opportunity for public participation. The lead agency or the project sponsor may initiate scoping. The scoping document contains a project description, adverse impacts, identification of information needs, mitigation, and alternatives. Within 60 days of

receiving the draft document from an applicant, the lead agency must supply a final written scope of issues to be addressed in the EIS and circulate it to other agencies and the public. A minimum 20-day period should be allowed for comment.

6.3.6. Preparation of the Draft EIS

Either the applicant or the lead agency can prepare the EIS, or the lead agency can have it prepared by a consultant and charge a fee to the applicant. All draft EISs must contain certain elements as summarized above under scoping, including a concise description of the proposed action, its purpose, public need and benefits, and environmental setting, at an appropriate level of detail. The range of alternatives should include sites, technology, design, timing, and types of action. A No Action alternative must be considered.

6.3.7. Determine Adequacy of Draft EIS

Upon receipt of a draft EIS, the lead agency has 45 days to determine its adequacy for pubic review. If not adequate, it is returned to the applicant with a written identification of the deficiencies. The lead agency has 30 days to determine the adequacy of a resubmitted draft EIS. When the draft EIS is considered adequate, the agency issues a Notice of Completion of a draft EIS, which must be distributed and published.

6.3.8. Public Comment

Filing of the Notice of Completion of a draft EIS starts the public comment period, which must be a minimum of 30 days. The comment period must continue at least 10 days following the close of a public hearing if one is held.

6.3.9. Decision to Hold a Public Hearing

When the lead agency accepts the draft EIS, it must decide whether to hold a public hearing based on the degree of interest shown by the public, the significance of adverse impacts identified, adequacy of mitigation, and other criteria. As per a State Commissioner's directive, if adjudicator hearing is not necessary, a legislative (public) hearing must take place. If a hearing is to be held, the agency must prepare and file a Notice of Public Hearing, which may be separate or may be included in the Notice of Completion of a draft EIS. The hearing must take place after the 15th day following the Notice of Public Hearing and within 60 days of filing the Notice of Completion of a draft EIS.

6.3.10. Prepare Final EIS

The final EIS should be prepared within 45 calendar days after the close of any hearings or within 60 days after the filing of the draft EIS, whichever occurs last. The lead agency is responsible for the adequacy and accuracy of the final EIS regardless of who prepares it. The final EIS must consist of the draft EIS, including any revisions and supplements, copies or a summary of comments received, and the lead agency's response to the comments. A Notice of Completion of the final EIS must be prepared, filed, distributed, and published.

6.3.11. SEQR Findings

Each involved agency must prepare its own written SEQR findings statement after the final EIS has been filed and before the agency makes a final decision. A positive findings statement means that the project can be approved and demonstrates that the alternative chosen is the one that avoids or minimizes adverse environmental impacts and weighs them against social, economic, and other considerations. If the action can not be approved, a negative findings statement documenting the reasons for denial must

be prepared. The findings can be finalized no sooner than 10 days following the filing of the Notice of Completion of a final EIS and if the action involves an applicant, the lead agency's findings must be made within 30 days from the filing date. Findings and a decision may be made simultaneously.

Following a positive finding under SEQR, the application package is forwarded for review and additional state and federal permits as previously described.

6.4. Skills Required

Knowledge of environmental assessment and other regulatory permit applications; technical writing and interpersonal skills involving scientific and technical subject matter dealing with environmental, engineering, and fisheries biology. A licensed professional engineer must supervise construction or reconstruction of a dam. The permit for dam construction must be prepared by a New York State licensed professional engineer.

6.5. Level of Effort

Depends on the size and complexity of the project

7. Tools Required

8. Information Requirements

Refer to permit application as referenced above.
Extensive use of information generated from protocols for planning, engineering and environmental studies, and preliminary engineering design and plans.

9. Contract Requirements

Third party consulting engineers and planners may be used to develop the submission to the state for approval.

10. References

NYSDEC Division of Water, 1989. Guidelines for Design of Dams. 31 pp.

NYSDEC Division of Water, 1987. An Owner's Guidance Manual for the Inspection and Maintenance of Dams in New York State, 117 pp.

11. Use of Other Protocols

Reach Selection

Site Selection

Preliminary Engineering Designs and Plans is the key protocol that integrates several protocols for the development of plans for permit applications

U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction

12. Protocol Authority

12.1. Allowance for Variations from Protocol

This protocol derives from external regulatory requirements, hence there is no allowance for variation.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevance after two years of use.

12.3. Author and Date

Ellie Koon, April 1999

UNITED STATES FEDERAL ENVIRONMENTAL ASSESSMENTS, PERMITS, AND APPROVALS REQUIRED FOR BARRIER CONSTRUCTION

1. Protocol Title: United States Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction

2. Protocol Business Need

This protocol addresses jurisdictional regulatory requirements governing barrier dam construction in the U.S. when the proponent is a federal agency.

3. Protocol Deliverables

This protocol provides a checklist of environmental documents, permits, and approvals required before lamprey barriers can be constructed. The intended outcome is that barrier practitioners will be familiar with the requirements in all jurisdictions such that barrier projects will receive the required, appropriate environmental reviews and obtain the necessary permits and approvals in a timely manner. Assuming it is successful, this protocol will be used once per proposed project.

4. Target Audience

Barrier practitioners and administrative staff.

5. The Jurisdiction for Protocol Use

This protocol includes only federal permits, approvals and consultations required in the U.S. when the proponent is a federal agency and/or the site involves federal lands/waters and/or designations. This protocol addresses primarily requirements and procedures necessary when the FWS is the proponent of a barrier project, with secondary mention of procedures used by the U.S. Army Corps of Engineers. Other protocols should be consulted for each Great Lakes state (Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction, Ohio Environmental Assessments, Permits, and Approvals Required for Barrier Construction, and New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction).

6. Procedures

6.1. Authority for Sea Lamprey Barriers

The Convention on Great Lakes Fisheries ("Convention") is the international treaty between Canada and the United States that established the GLFC in 1955. Article V(b) of the Convention states that the Commission may "take measures and install devices in the Convention Area and the tributaries thereof for lamprey control". The Great Lakes Fisheries Convention Act ("Act") of 1956 (16 U.S.C. 931-939c) implemented the Convention in the United States. Section 935 authorizes the United States Section (of the GLFC) "to construct, operate, and maintain any project or works designed to facilitate compliance with the provisions of the Convention relating to the sea lamprey control program". Section 939b states that "Nothing in this chapter shall be construed as preventing any of the Great Lakes States from making or enforcing laws or regulations within their respective jurisdictions so far as such laws or regulations do not conflict with the Convention or this chapter".

The National Invasive Species Act of 1996 (an amendment to the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990) reinforced the Commission's authority under the Convention by stating that "Nothing in this Act…is intended to effect the authorities and responsibilities of the Great Lakes Fishery Commission established under Article II of the Convention on Great Lakes Fisheries…".

Separately from the Convention, the Secretary of Interior is authorized by sections 757a and 757b of 16 U.S.C. to enter into cooperative agreements with Great Lakes States to "construct, install, maintain, and operate devices and structures for the improvement of feeding and spawning conditions, for the protection of fishery resources, and for facilitating the free migration of fish, and for the control of sea lamprey ".

6.2. National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 makes environmental protection a mandate of every federal agency by requiring an analysis and detailed statement of the impact of any proposed federal action that may significantly affect the quality of the environment. NEPA created the Council on Environmental Quality (CEQ), which in turn formulated the regulations for implementation of the *A*ct as set forth in 40 CFR 1500-1508. NEPA regulations specific to the Department of Interior are described in Departmental Manual (516 DM 1-7). NEPA policies and general guidelines for the FWS are described in the Administrative Manual (30 AM 2-4). The Branch of Federal Activities, Division of Habitat Conservation administers NEPA for the FWS. NEPA terms and definitions will be presented later in this section.

6.2.1. Applicability of NEPA

When the FWS or the USACE is the proponent of a barrier project, NEPA clearly applies. Similarly, when a project is proposed on National Forest land and the U.S. Forest Service (USFS) must permit it, the USFS becomes the lead agency because of its jurisdiction, and NEPA again clearly applies. However, the GLFC 's status as a federal agency has been periodically questioned in regard to applicability of NEPA.

It has been argued that once funds leave the federal governments of Canada and the United States and come to the GLFC, that they are no longer federal funds. The Great Lakes Fishery Act, though, states plainly in Section 937 that related to claims against the United States and tort claims procedure, the U.S. Section [of the GLFC] "…be deemed an agency of the United States". Also, in a document entitled Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations (CEQ, 1981), the CEQ maintains that NEPA regulations apply to independent regulatory agencies such as the Federal Energy Regulatory Commission (FERC), which has organizational similarities to the GLFC. Thus, given the foregoing, and the GLFC's express desire to conduct a sea lamprey management program that is ecologically sound and socially acceptable, it is reasonable to expect that the GLFC will strive to meet the requirements of NEPA in the barrier program.

6.2.2. Existing NEPA Documents

The FWS sea lamprey management program currently treats streams with lampricide under authority of a 1976 Negative Declaration signed by the Director in response to a programmatic Environmental Assessment (EA) prepared by the FWS. The barrier program operates under a programmatic Negative Declaration signed by GLFC officials in 1979. Section 1502.9(c) of CFR states that "If an agency has made a substantial change in a proposed action that is relevant to environmental concerns, or if there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts, a supplemental EIS must be prepared for an old EIS so that the agency has the best possible information to make any necessary substantive changes in its decisions regarding the proposal".

A December 10, 1991 FWS solicitor's opinion addressed the question of whether the government must update the earlier EA or prepare an EIS. The solicitor, addressing the chemical control program, suggested a review of the significance of new information and/or substantiality of changes in the program. If not significant/substantial, a decision not to update or supplement the 1976 EA would be legally defensible. In a follow-up letter to the GLFC dated December 31, 1991, the FWS regional director [Great Lakes] indicated an intention to review information on chemical control only. The director stated that "We do not plan to address other aspects of the control program at this time." and minimized the FWS role in the barrier program, declaring that "Barriers are currently constructed by the states with Commission funds", and "Service involvement is limited to recommendation of potential sites and reviewing designs". The director appears to be arguing that barrier program compliance with NEPA is not actually necessary under these circumstances, or at least is not the responsibility of the FWS. However, with the current FWS role in the program, and recognizing indications that the GLFC can be considered a federal agency at least for some purposes, it appears more likely that NEPA applies to the barrier program.

6.2.3. Need for Revision of Existing Programmatic Documents

Current opinion in the FWS re: NEPA and the barrier program is that the 1979 Negative Declaration is valid and that the program can proceed until and unless it is challenged. However, the recent introduction of new information from the GLFC-funded '"Noakes study" of barrier effects (Noakes et al., 1999) begs a revision of the document as mandated under Section 1502.9(c). Also, the CEQ (1981; ibid.), when questioned about the circumstance under which documents must be revised, states that "As a rule of thumb…if the EIS concerns an ongoing program, EIS's that are more than five years old should be carefully reexamined to determine if the criteria in Section 1502.9 compel preparation of an EIS supplement". Therefore, it seems appropriate that the 1979 document should be reexamined given its age and the results of the Noakes study.

6.2.4. Need for Individual Project Documents

Programmatic NEPA documents are intended to define various policy alternatives and the general environmental effects of each, and thus to make the preparation of site specific environmental documents easier by laying the groundwork for policy direction (30 AM 3.10D(2)(c). They are not intended to take the place of site specific documents. The USFS required a specific EA for the Pere Marquette River barrier, which was prepared by the MDNR as proponent of the project, and reviewed and signed by the USFS because of the river's designation as Wild and Scenic. The USFS prepared a separate EA for the Carp River (also a Wild and Scenic river) temporary electrical weir with input from the FWS adult assessment unit. The USACE has prepared an individual EA for the proposed barrier project on the Paw Paw River. Thus, other federal agencies have required site specific documents, and it seems likely that future barrier projects will need individual analyses.

6.2.5. Other Statutes

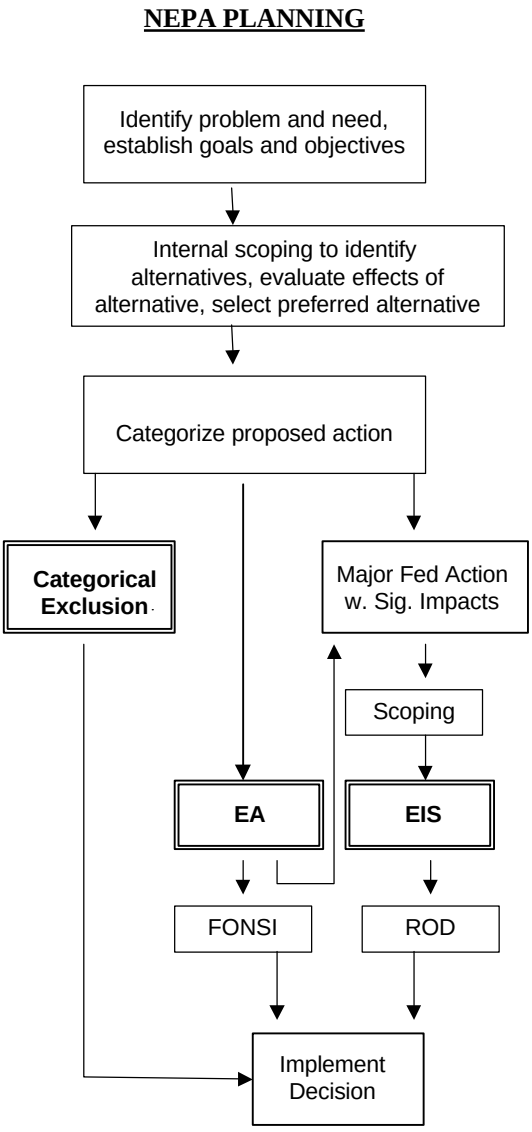
As the overarching environmental statute in the United States, one of the goals of the NEPA process is to identify related issues originating from separate legislation, regulation, and executive order. Section 1502.25 of the regulations requires that draft EISs be prepared concurrently and integrated with environmental analyses and studies required by other federal statutes, for example, the Rivers and Harbors Act, the Clean Water Act, the Endangered Species Act, the Coastal Zone Management Act, the National

Historic Preservation Act, the Wild and Scenic Rivers Act, Executive Order 11990 (Protection of Wetlands), and Executive Order 11998 (Floodplain Management). A list of all environmental and consultation requirements (totaling 44) is presented in 516 DM Exhibit 4 Sheets 11 to 13, although those listed above are most likely to be applicable in the case of barriers. The most important of these are discussed separately later in this document.

6.3. The NEPA Process

The following flow chart illustrates the overall NEPA process. Preparation of EAs and EISs is detailed in an additional flow chart. Preparation of these environmental documents is the responsibility of the FWS project leader of the administrative unit proposing the action.

The elements of the flow chart are described below:



6.3.1. Identify Problem and Need, Goals and Objectives

For the barrier program, the problem and need will be described in terms of restoration of Great Lakes fish populations. Goals and objectives will be related to IMSL and more efficient/cost-effective control of lamprey populations.

6.3.2. Development of Alternatives

A realistic list of alternative means of attaining stated goals is compiled (e.g., continued lampricide treatments, fixed-crest barrier construction, electrical barrier construction, etc.). The effects, both goal-related and on various aspects of the environment, are evaluated for each alternative. A "consequence matrix" may be prepared. FWS 30 AM3 Exhibit 1 provides a worksheet to be used as checklist at the beginning of NEPA planning. Finally, a preferred alternative is identified.

6.3.3. Categorize Proposed Action

The basic question under NEPA is "Is the action a major federal action having a significant impact on the quality of the human environment"? Any action with potential significant effects is considered a major federal action for purposes of compliance with NEPA. If it is a major federal action, an EIS is required. If the action is categorically excluded, this is documented and no further NEPA analysis is required. If neither a major action nor a categorical exclusion, an environmental assessment is required. The decision as to the type and amount of NEPA documentation rests with the agency that is the actual proponent of the barrier project, for example, the FWS Regional Director in the case of the FWS, or the District Engineer in the case of the USACE.

6.3.4. Categorical Exclusions

DOI 516 DM 2 Appendix 1 and 516 DM 6 Appendix 1 contain lists of actions already determined not to be categorically excluded, providing that the exceptions listed in 516 DM 2, Appendix 2 do not prevent the action from being categorically excluded. Examples include research (e.g., SMRT) and monitoring, land acquisition from willing sellers, and reintroduction of native species. If the action is determined to be categorically excluded, it can be implemented immediately. It is recommended that a brief paragraph describing the decision process be included in the administrative record.

6.3.5. Environmental Impact Statements

If an action is judged to be a major federal action, an EIS must be prepared. Following preparation of an EIS a Record of Decision (ROD) is prepared and the action may be implemented.

6.3.6. Environmental Assessments

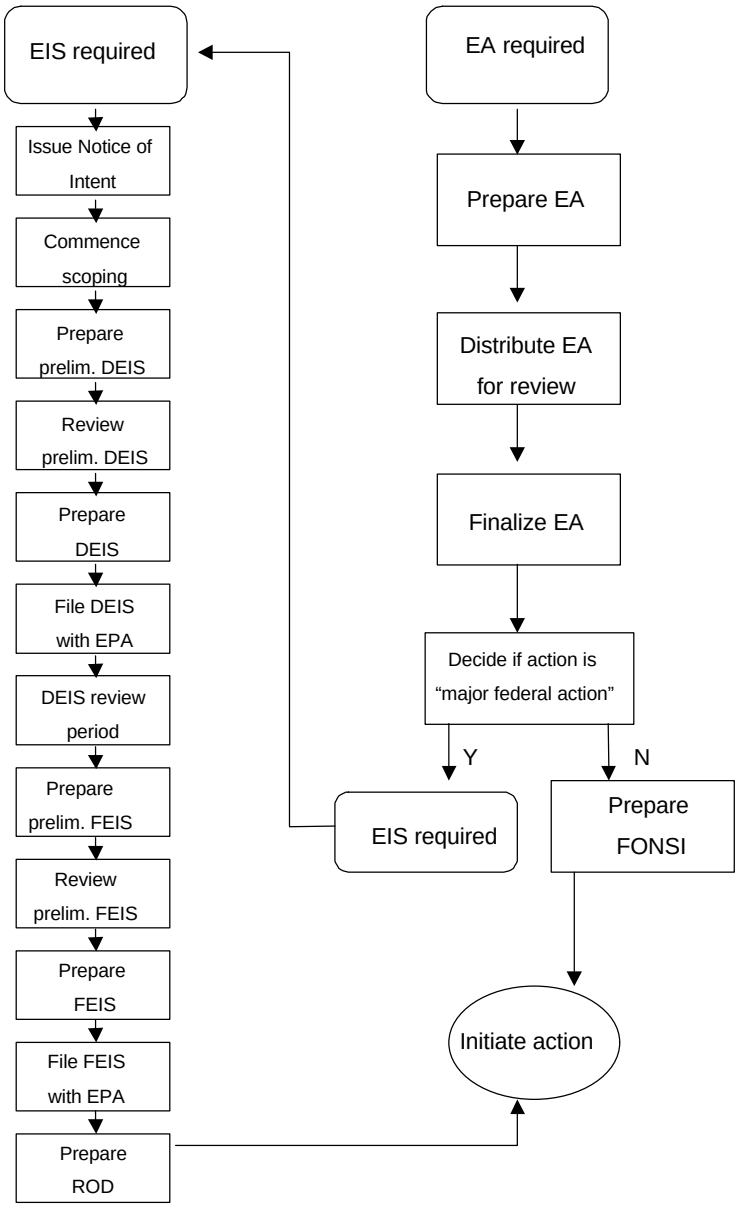
Any action that is not categorically excluded and not classified as a major federal action requires preparation of an EA. The purpose of an EA is to help determine whether an action will have significant effects and also to consider alternatives available to meet purpose and need and the consequences of those alternatives. The possible outcomes of an EA are 1) a Finding of No Significant Impact (FONSI, sometimes called a Negative Declaration) or 2) a determination that an EIS must be prepared.

6.4. EIS and EA Processes

Laws and regulations strictly define the structure, content, procedures, and time frames of EISs and EAs. An EA is a shorter and less formal process than an EIS. The CEQ recommends that the documents not exceed 10 to15 pages, scoping is not required, and the public review process is more flexible. FWS 30 AM 3.10A describes the required format and content of an EA. EIS format is described in 40 CFR 1502.10 - 1502.18. The following flow chart illustrates the EA/EIS process.

Each element of the flow chart is described below, starting with preparation of an EA.

NEPA ENVIRONMENTAL ANALYSES



6.4.1. Prepare EA and Section 404 Evaluation

The EA must contain the following: cover sheet; a statement of purpose and need; a description of the proposed action and the alternatives; a description of the affected environment; and the environmental consequences of each alternative.

6.4.2. Distribute EA for Review and Comment

Circulation of the EA is optional except for actions proposed to occur in a wetland or 100-year flood plain, for which 30 days of public review is required. Notice should be published in the Federal Register or other appropriate medium.

6.4.3. Finalize EA

The EA is revised and improved according to comments received internally and from the public. Feasible mitigation actions can be added here.

6.4.4. Determine if the Proposed Alternative Constitutes a Major Federal Action

This decision is subject to variable interpretation and may require professional judgement. FWS 30 AM 3.9(d) contains a list of criteria to be used in determining whether an EIS is required, including construction within a 100-year flood plain, controversial environmental effects, adverse effects on Wild and Scenic rivers, degradation of important aesthetic resources, and others.

6.4.5. Prepare FONSI

If not a major federal action, a FONSI (Finding of No Significant Impact), must be prepared, signed by the FWS regional director (or District Engineer in the case of USACE), and made available for public review. It must contain a summary of the EA, an explanation of why an EIS is not necessary, a brief description of alternatives considered, an explanation of factors in making the decision, and a demonstration of compliance with Executive Orders. FONSI's can require mitigation.

If the action is determined to be a major federal action, an EIS must be prepared.

6.4.6. Notice of Intent

The first step is to publish a Notice of Intent in the Federal Register apprising interested parties of FWS' or USACE intent to prepare an EIS. 40 CFR 1508.22 describes the content of such a notice. The FWS regional director should sign (for Fish and Wildlife Service EIS's).

6.4.7. Commence Scoping

Scoping is the analytical design step in the preparation of an EIS. It is the process of defining possible actions, alternatives, and impacts, of identifying interested and affected parties, and soliciting public involvement. The culmination of the scoping process is a written report identifying issues and alternatives.

6.4.8. Prepare Preliminary Draft EIS (DEIS)

The EIS format is described in 40 CFR 1502.10 - 1502.18. The EIS must contain a cover sheet; summary; table of contents; purpose and need for action; alternatives including the proposed action and no action; affected environment; environmental consequences; list of authors; list of agencies, organizations, and persons to whom copies of the EIS are sent; index; and appendices.

6.4.9. Review of Preliminary DEIS

The draft document, if prepared by FWS, is distributed within the FWS to field stations, the regional and Washington offices, the solicitor's office, and endangered species and cultural resource specialists. The preliminary DEIS is approved for distribution to the general public. The USACE follows their own procedures for DEIS review.

6.4.10. Prepare DEIS

The document is revised, assigned an "DES" control number by the FWS Washington Office/ Division of Habitat Conservation (WO/DHC), and printed.

6.4.11. Distribute DEIS and File with EPA

The document accompanied by a transmittal letter is sent to a list of recipients in 30 AM 3.9 B(4)(f), including federal, state, and local agencies, affected tribes, and interested parties. The proponent (if the FWS) works with the Regional Environmental Coordinator in this effort. Five copies are sent to the Washington office of the EPA, five copies to WO/DHC and five copies to the Department of Interior Office of Environmental Policy and Compliance (OEPC). The EPA sends one copy to the CEQ. The EPA publishes a notice of the EIS availability in the Federal Register. The final agency decision cannot be made sooner than 90 days following publication of availability of the DEIS or 30 days following publication of availability of the final EIS, whichever is later.

6.4.12. DEIS Review Period

NEPA requires a minimum of 45 days for comments but U.S. Department of Interior (DOI) require at least 60 days from the date of transmittal to the EPA. During this period a public meeting or hearing may be held, the date and location of which should be published in the Federal Register. A meeting shall not be held sooner than 15 days following publication of the notice of availability of the DEIS in the Federal Register.

6.4.13. Prepare Preliminary Final EIS (FEIS)

Substantive comments are incorporated by appropriate revisions. Letters of comment received during the review period are published in the FEIS.

6.4.14. Review of Preliminary FEIS

The document is circulated for internal review with the same distribution as that of the preliminary DEIS.

6.4.15. Prepare FEIS

The document is revised according to comments received in-house. An "FES" control number is assigned by WO/DHC.

6.4.16. Distribute FEIS and File with EPA

A copy of the FEIS is sent to all those who received the DEIS, all who request it, and all who submitted comments on the DEIS. Five copies are sent to the EPA, which publishes a notice of availability of FEIS in the Federal Register. Five copies are also sent to WO/DHC and to OEPC.

6.4.17. Make Decision and Prepare Record of Decision (ROD)

The decision to implement the preferred alternative may not be made sooner than 30 days following publication of the notice of availability. The substantive requirements of a ROD are discussed in 40 CFR 1505.2.

6.4.18. Initiate Action

The proposed action may be initiated immediately after completion of the ROD, assuming that other federal permits and approvals have been obtained.

Supplemental and revised EISs are prepared, circulated, and filed in the same manner and are subject to the same waiting periods as a regular DEIS and FEIS.

6.5. National Wild and Scenic Rivers

The National Wild and Scenic Rivers Act of 1968 ("Act") (P.L. 90-542) declares that it is the policy of the United States that certain rivers possessing outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, and cultural values, will be preserved in free-flowing condition to protect the water quality of such rivers and to fulfill other vital national conservation purposes. The Act designated many such rivers nationally, however, the only designated rivers that are barrier candidate streams are located in Michigan. These include portions of the Pere Marquette, Ontonagon, Whitefish, and Carp Rivers and Bear Creek (tributary to the Manistee River). Each stream is categorized in the Act as wild, scenic, or recreational. The wild designation receives the most stringent protection and recreational the least. A project on stream reaches outside of designated reaches may also be evaluated under the Act if there is the potential for indirect effects on the designated reach.

The Act specifies the administering authority for each river. The Secretary of Agriculture (the USFS) administers all designated streams that are barrier candidates because of their location on National Forest lands. The text of the Act, a list of designated streams, and an additional list of proposed streams can be found at <http://www4.law.cornell.edu/uscode/16/ch28.text.html>. The Act was amended in 1984 (P.L. 98-444) to allow for construction of a lamprey barrier on the Pere Marquette River. Several streams in Michigan were proposed for designation (so-called "Congressional study streams") by the Michigan Scenic Rivers Act of 1991 (P.L. 102-49), including sections of the White River and the Little Manistee River and additional sections of the Ontonagon, Whitefish, and Carp Rivers. Section 6 (b) of the Michigan Scenic Rivers Act states that "Notwithstanding any other provision of law, the installation and operation of

facilities…within…the boundaries of those river segments designated by this Act for the control of the lamprey eel shall be permitted subject to such restrictions and conditions as the Secretary of Agriculture may prescribe for the protection of …the wild and scenic characteristics of the river: provided, that the Secretary shall determine in the river management plan for each such designated river that such facilities or activities are necessary for control of the lamprey eel ". Thus, while the Convention bestows on the GLFC the authority for sea lamprey control, the Michigan Scenic Rivers Act subjects sea lamprey control activities to the authority of the Secretary of Agriculture, an apparent conflict of law. Note also that proposed projects must also be described in each river management plan, which typically are revised every 10 years, some of which have not yet been prepared for study streams. The National Invasive Species Act of 1996 reiterates the GLFC's authority under the Convention. The "last in time" doctrine derived from case law holds that if there is a conflict of law, the last in time prevails, which in this case is the National Invasive Species Act. This principal is yet to be tested in the case of lamprey barriers on designated Wild and Scenic Rivers.

Regulations for implementing Section 7 of the Wild and Scenic Rivers Act are set forth in the Code of Federal Regulations 36 CFR 297. The regulations state that no federal agency will participate in construction of any water resources project that would have a direct and adverse affect on the values for which the river was designated, as determined by the Secretary charged with its administration. Water resources projects are defined as "…any dam, water conduit…which would affect the free-flowing characteristics…" of a designated river. Section 16(b) of the Act defines "free-flowing" as "existing or flowing in natural condition without impoundment, diversion, straightening, riprapping, or other modifications of the waterway". The CFR requires that determination of direct and adverse affects of a proposed project be completed through the NEPA process by an interdisciplinary team. The USFS directs that the "Section 7 determination" (not to be confused with Section 7 consultation under the Endangered Species Act) be attached to the NEPA document as an appendix, and provides a step-by-step process for such a determination as follows (Forest Service Manual Sec. 2354.76, 1994):

1. Define the need for the proposed activity and make a preliminary determination whether it is consistent with the desired conditions for the river. If there is no compelling need for the activity or it is inconsistent with management goals and objectives for the river, the analysis ends here.
2. Provide an objective description of the proposed activity.
3. Describe how the proposed activity will directly alter within-channel conditions, including channel location, geometry, slope, form, and water quality.
4. Describe how the activity will directly alter riparian and/or flood plain conditions, including physical changes and changes in vegetation and soils.
5. Describe how the activity will alter upland conditions, including vegetation and soils.
6. Evaluate and describe how changes in on-site conditions will alter existing hydrologic and biologic processes by quantifying and modeling, if appropriate.
7. Estimate the magnitude and spatial extent of off-site changes, or changes that may influence the rest of the river system.
8. Define the time scale over which steps 3 to 7 are likely to occur.
9. Based on steps 3 to 8, identify the effects of the proposed project on the desired conditions of the river relative to free flow, water quality, riparian and flood plain conditions, and the remarkable river-related values.

10. Based on steps 3 to 9, prepare the Section 7 determination describing effects of the proposed activity on conditions of free flow and direct and adverse effects on river-related values for which the river was designated.

National Scenic Rivers System; Final Revised Guidelines for Eligibility, Classification and Management of River Areas (U.S.D.A./U.S.D.I, 1982) identifies three criteria for evaluation: 1) compatibility with the values for which the rivers were designated, 2) no impact on natural appearance, and 3) harmonize with the surrounding environment.

Additionally, the U.S. Forest Service Handbook (Forest Service Handbook Sec. 1909.12, Ch. 8.2) defines standards for the three levels of protection as follows:

Wild Rivers: [re: flood control] No flood control dams, levees, or other works are allowed in the channel or river corridor. [re: structures] New structures would not be allowed except in rare instances to achieve management objectives.

Scenic Rivers: [re: structures:] New structures that would have a direct and adverse effect on river values would not be allowed.

Recreational: [re: structures] New structures are allowed for both habitation and for intensive recreational use.

It is important to note that all water resources projects are not automatically prohibited. Even if they affect the free-flowing characteristic of a river, they may be permitted if they protect or enhance the values for which the river was designated, the impacts on the free-flowing characteristics of the river are minimized to the extent practicable, and the proponent is a federal, state, or local government entity (Forest Service Manual Sec. 2354.72, 1994). Thus, barrier construction in reaches designated wild or scenic is likely to be difficult, but it should be possible in reaches designated recreational, although this has not been tested for a permanent barrier. A temporary electrical barrier was operated in a recreational reach of the Carp River (Mackinac Co., MI) for three years to collect male lampreys for sterilization under a special use permit from the USFS, which was issued after a NEPA analysis and a Section 7 determination.

6.6. Endangered Species Act

The Endangered Species Act (Act) of 1973 (16 USC 1531 et seq.) declares it to be the policy of Congress that all Federal departments and agencies seek to conserve endangered and threatened species. The Act is administered jointly by the FWS and the National Marine Fisheries Service (NMFS), an agency of the Department of Commerce. Section 7 of the Act states that all federal agencies, in consultation with the Secretary (of Interior or Commerce) must insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. Although the law does not require including candidate or proposed species, it is the policy of the FWS to consider them when evaluating internal FWS actions under Section 7.

The FWS Endangered Species Consultation Handbook (USFWS and NMFS, 1998) provides detailed guidelines for conducting Section 7 consultations with federal agencies in general. The FWS Final Intra-Service Consultation Handbook (USFWS, 1998) provides guidelines on Section 7 evaluations of FWS internal projects. The following steps summarize the process:

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1. The project leader of the FWS administrative unit proposing the project reviews it to determine whether a) it is indeed a federal action, defined as any activity or program authorized, funded, carried out, or permitted by federal agencies; and b) whether it is considered a major construction activity under NEPA. Dams and water resources developments are classified as major construction activities.

2. The project leader determines whether listed, proposed, or candidate species, or their habitats occur, or have the potential to occur in the action area. FWS Ecological Services Office (ESO) are responsible for providing lists of endangered, threatened, proposed, and candidate species and critical habitats to FWS programs within their jurisdictions. If the project is a major construction activity, the project leader is required to request a species list from the ESO or to submit a list for confirmation. The ESO has 30 days to respond.

3. If such species or habitats are present, a biological assessment is required for major activities unless only proposed or candidate species or habitats are present, in which case it is recommended rather than required. The assessment must be initiated within 90 days of receiving the list and completed, along with a final determination, within 180 days. Surveys in the project area may be needed to determine species' presence and status, seasonal use pattern, and condition of habitat. The biological assessment generally includes results of on-site inspections, an analysis of likely effects based on biological studies, a literature review, and the opinion of experts on the species. If the project is not a major activity, the Intra-Service Section 7 Biological Evaluation Form (available in the Intra-Service Handbook cited above) should be completed.

4. Using either the biological assessment or the intra-Service form, the project leader determines whether the project has the potential, or "may affect" the species (even if only one individual) or habitat of concern. Effects considered should include, but are not limited to, the species population, reproductive capability, food supply, cover needs, pollinators, symbionts, and predators/competitors.

5. If it is determined that a proposed project may affect a species or habitat, the project leader must further determine whether the project is "likely…" or "not likely to adversely affect…" the species or habitat. If "not likely to adversely affect", the project leader submits the finding and supporting data to the ESO to request a written concurrence, and the ESO must reply within 30 days of receiving the request. If the process follows this path, the consultation is considered by the FWS to be informal.

6. If adverse effects are predicted to be likely, the project leader is required to request formal consultation or conference with the ESO, which must be concluded within 90 days of receipt of the request. The request includes either a completed intra-Service form or a biological assessment. After the consultation or conference is finished, the ESO must issue a biological opinion or conference report within 45 days. If the opinion is one of "non-jeopardy" to a species or "no adverse modification" to a habitat, the project leader may fund, approve, or undertake the project.

7. If the opinion is one of "jeopardy" or "adverse modification", the project leader can refrain from undertaking the project or implement reasonable and prudent alternatives provided with the biological opinion.

There are a small number of barrier candidate streams with known populations of federally endangered aquatic species, for example, the Carp Lake River in Emmet Co., Michigan, which contains the Hungerford's crawling water beetle. However, it is likely that

Section 7 consultations will be necessary for construction projects near known distributions of other animal species such as the bald eagle or of wetland plants. Each barrier project must be examined on a case-by-case basis as described above.

6.7. Clean Water Act

The United States Army Corps of Engineers (USACE) is responsible for administering Section 404 of the Clean Water Act (33 U.S.C. 1344), which requires approval prior to discharging dredged or fill material into the waters of the United States, including such activities as construction of revetments, groins, breakwaters, levees, dams, dikes, and weirs. Barrier projects in the states, with the exception of Michigan, are likely to require a Section 404 permit. Michigan is one of only two states to which the USACE has delegated its responsibility for wetland protection under Section 404. Coastal waters in Michigan that are subject to Great Lakes inundation were not transferred and section 404 and Section 10 permits are required. USACE regulations (ER 200-2-2a Sect 404 of the Clean Water Act) describe the evaluation that is required. It is usually appended to the EA and/or EIS)

The Section 404 permit process is described as follows:

1. Pre-application Consultation: This is optional but recommended. The proponent meets with USACE officials; discussion may include alternatives, environmental documents, NEPA procedures, and scope of the data needed if an environmental impact statement is required.

2. Permit Application: The proponent submits form Engineer Form 4345, which may be downloaded from the World Wide Web at "<http://www.usace.army.mil>" or obtained from the district regulatory offices listed below. The permit requires details regarding the location and purpose of the project; vicinity, plan, and elevation drawings; and a statement of the type and amount of fill and surface area of wetland to be filled.

3. Public Notice: The permit application is reviewed by the USACE and distributed to the general public, special interest groups, and local, state and, federal agencies, who are allowed from 15 to 30 days to comment.

4. Public Hearing: The USACE may hold a public hearing if it is deemed necessary by the district engineer or if a request from the public for a hearing is considered justified. The hearing may be held jointly with other federal or state agencies.

5. Decision on Issuance of Permit: The proposal is reviewed, balancing the need and expected benefits against the probable impacts of the work, taking into consideration all comments received and other relevant factors. The USACE may adopt any NEPA documents prepared by proponents provided they verify facts and conclusions. The permit is either issued or denied and the applicant advised of the reason.

Two to three months are required to process routine applications; large or complex activities take longer.

Contacts: For projects in the Lake Superior, Michigan, or Huron drainage:
U.S. Army Corps of Engineers
Detroit District
P.O. Box 1027, Detroit, Michigan 48231-1027

For projects in the Lake Erie or Ontario drainage:
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara St., Buffalo, New York 14207

The USACE is also responsible for enforcing Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), which pertains only to navigable waters. Navigable waters are defined as "waters that have been used in the past, are now used, or are susceptible to use as a means to transport interstate or foreign commerce up to the head of navigation". Since this statute is unlikely to apply to sea lamprey barrier projects, Section 10 is not discussed here. If barriers are constructed within tributary reaches backwatered by navigable waters, they need both Section 10 and Section 404 permits in Michigan. Since this is unlikely to occur with sea lamprey barrier projects, Section 10 is not discussed here.

6.8. National Historic Preservation Act

Section 106 of the National Historic Preservation Act of 1966 (80 State. 915, 16 U.S.C. 4321) requires federal agencies to consider the effects of their actions on prehistoric and historic resources. Regulations in 36 CFR 800 describe the process by which this is done.

1. Determine whether the proposed action is considered an "undertaking", which is anything a federal agency does, assists, or permits that has the potential to affect historic properties.

2. If the action is an undertaking, determine its "area of potential effect" (APE), the area where the action could affect historic properties.

3. Within the APE, identify historic properties that may be affected. This usually involves background research, consultation with the "State Historic Preservation Office" (SHPO: see below) and other interested parties, and often some kind of fieldwork such as architectural or archeological surveys.

4. Determine what effects the action will have, if any, on any historic properties. The proponent of a project determines the effect of the action in consultation with the SHPO and others, using criteria included in the Section 106 regulations.

5. Seek to resolve any effects that are adverse. Through further study, consideration of alternatives, and consultation with the SHPO and others, find ways to resolve or mitigate any adverse effects on historic or archaeological properties. In the case of barriers, this could mean project relocation.

6. Execute an agreement. The regulations provide for executing various kinds of agreements, most commonly a Memorandum of Agreement (MOA), stipulating how adverse effects will be resolved. The MOA is signed by the FWS official responsible for the action, by the SHPO, sometimes by the Advisory Council on Historic Preservation (ACHP), and sometimes by others (local government officials, Indian tribes, or other interested parties).

7. Implement the agreement. Ways to implement the MOA must be built into contract documents and other project planning documents.

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7. Tools Required

8. Information Requirements

9. Contract Requirements

10. References

Council on Environmental Quality (CEQ), 1981. Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations (40 CFR 1500-1508). Federal Register, Vol. 46, No. 55, 18026-18038, 3/21/81.

Noakes, David G., et al. 1999. Biological Impact of Low-head Barrier Dams, 1998 Final Report. to Great Lakes Fishery Commission. 48 pp.

U.S. Department of Interior and U.S. Department of Agriculture, 1982. National Scenic Rivers System; Final Revised Guidelines for Eligibility, Classification and Management of River Areas. Federal Register Vol. 47, No. 173.

U.S. Forest Service Handbook, FSH 1909.12 - Land and Resource Management Planning Handbook, WO Amendment 1909.12-92-1, Effective August 3, 1992.

U.S. Forest Service Manual, Title 2300 - Recreation, Wilderness, and Related Resource Management, Amendment No. 2300-94-4, Effective July 8, 1994.

U.S. Forest Service and National Marine Fisheries Service, 1998. Endangered Species Act Consultation Handbook: Procedures for Conducting Section 7 Consultations and Conferences.

U.S. Fish and Wildlife Service, 1998. Endangered Species Act: U.S. Fish and Wildlife Service Final Intra-Service Consultation Handbook.

11. Use of Other Protocols

Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction

Ohio Environmental Assessments, Permits, and Approvals Required for Barrier Construction

New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction

12. Protocol Authority

12.1. Allowance for Variations from Protocol

This protocol derives from external regulatory requirements, hence there is no allowance for variation.

12.2. Protocol Status and Revision

This protocol needs to be revised whenever laws and regulations change.

12.3. Author and Date

E. Koon, April 1999

PRELIMINARY ENGINEERING DESIGNS AND PLANS

1. Protocol Title: Preliminary Engineering Designs and Plans

2. Protocol Business Need

This protocol applies to the preliminary engineering design and planning of new barriers, major functional modifications to existing lamprey barriers, and the lamprey proofing of existing dams constructed for purposes other than sea lamprey control (de facto barriers). The protocol uses several other protocols and their outputs for the integration and synthesis of engineering plans, budgets, drawings, and specifications.

The protocol is required to satisfy internal business requirements of the GLFC budget approval process (see Barrier Annual Work Plan protocol). The protocol is also required to satisfy external regulatory requirements for environmental assessment and other permitting as required in the jurisdiction where construction is to occur.

3. Protocol Deliverables

The protocol is to be used for each and every proposed construction project under consideration, which involves capital approval by the GLFC and regulatory approval by the jurisdiction requiring construction permits. When multiple projects are considered in the annual construction plan multiple use of the protocol will occur. Three types of deliverables are considered for each project:

1. Project based letters of understanding and a draft contractual agreement with the proposed barrier owner, and
2. Project description and budget for GLFC approval as part of the BAWP, and detailed individual project plans as required by state, provincial, tribal (U.S.)/First Nation (Canada) agencies, and/or federal regulatory bodies for their plan input and review for approval and construction permitting.

Also to be considered is a project management process where multiple projects running concurrently are managed and coordinated in a well organized fashion.

4. Target Audience

The U.S. Barrier Coordinator and the Canadian Barrier Coordinator (responsible for the DFO-SLCC Engineering Unit) share direction and coordination of all barrier program projects. The Engineering Unit has responsibility for all Canadian preliminary barrier engineering work. This engineering unit also has an extended responsibility for providing and/or coordinating and verifying preliminary engineering for barrier project design in the U.S. on behalf of the GLFC with the FWS Engineering, USACE, and state/provincial/native/First Nation cooperators/partners/owners. The barrier coordinators are co-responsible for contracting with design-build contractors and consulting engineers on behalf of the GLFC (Use of Consultants by the GLFC protocol).

The subject matter is technical in nature and involves professionals in the applied sciences (engineers and hydrologists) and the environmental sciences (biologists and ecologists). The target audience for deliverables is the GLFC, control agents, regulatory agencies, barrier cooperators, and barrier owners. The U.S. and Canadian Barrier Coordinators coordinate the planning and timing of all program projects.

5. The Jurisdiction for Protocol Use

This protocol involves application across the entire Great Lakes Basin to assure that consistent design objectives of the GLFC for the barrier program are met. The protocol is adaptable for use in all jurisdictions.

6. Procedures

6.1. Regulatory Requirement Analysis

At the beginning of each barrier project to be built in a given jurisdiction, review the appropriate protocol for the jurisdiction for Environmental Assessments, Permits, and Approvals Required for Barrier Construction for currency and amend according to any new statutes and regulations that may have occurred since the last revision. Develop a detailed list of requirements including all required plans, surveys, technical reports, and permit application forms. Based on professional judgement include pre-consultation with the regulatory bodies to determine if the requirements list is complete.

6.2. Establish Project Schedule

The timing of project activity needs to be determined as part of project planning. Short form preliminary designs and plans are prepared at least one year in advance of permit applications for approval by the GLFC through the BAWP process.

Once the project is approved by the GLFC and funding is secured, detailed long form project applications are submitted to regulatory agencies for plan input and review. Use the protocols for Environmental Assessments, Permits, and Approvals Required for Barrier Construction by jurisdiction to determine the time required for application review and permit approval. Construction permits for working in and near water are generally limited to July through September in Ontario. Fall and winter construction takes place less often, but is a viable option, particularly in southern Michigan and other states. To establish the timing of application submission estimate the time required to complete the following steps in reverse order: Construction, contracting, contractor selection, contractor bids, request for proposal, final engineering design and plans, and permit plan input and review. Backing off the time requirements for the subsequent steps provides the schedule necessary to meet critical deadlines for the short construction time window of two months.

6.3. Barrier Agreements

Based on the MOU between the GLFC and a U.S. agency (e.g., state or tribe), wishing to cooperate in the barrier program in the U.S., finalize negotiations with the potential barrier owner as to the draft terms and conditions for a cooperative agreement (CA) for the proposed barrier project. In some cases the barrier owner may be the state cooperator or another entity such as a tribal council, local water authority, or private sector. Determine and initiate realty arrangements as required using the procedures of the barrier owner or cooperator.

In Canada, the general MOU for barriers is between the DFO and the OMNR (barrier cooperator), with DFO-SLCC as the barrier owner. Details of the current year's barrier program are described in the annual MOA between the GLFC and the DFO-SLCC.

6.4. Determine Barrier Type and Options

Based on the known characteristics of the site(s), the engineer determines the type or types of barrier design that best suit the project. The barrier types and options include:

- Fixed-crest barrier:
    - Steel sheet piling plus jumping pool,
    - Steel sheet piling plus jumping pool and built-in lamprey trap,

- Reinforced concrete plus jumping pool,
- Reinforced concrete plus jumping pool and built-in lamprey trap,
- Steel sheet piling plus simple fishway (with or without built-in lamprey trap), or
- Reinforced concrete plus simple fishway (with or without built-in lamprey trap).

- Adjustable-crest barrier:
  - Steel sheet piling,
  - Reinforced concrete plus steel sheet piling (to prevent lamprey escapement beneath the structure), or
  - Adjustable-crest of both types plus trap-and-sort fishway (if fish passage is needed 100% of the time).

The above barrier types and options presently suit most situations.

Velocity barriers are still viewed as experimental from the perspective of design and effectiveness. Two velocity barrier options are:

- Velocity barrier (materials hybrid involving wood/concrete/sheet pile/plastics), or
- Velocity barrier with built-in lamprey trap and/or trap-and-sort fish passage.

Electrical barriers are also suited for special circumstances when the stream reach has limited range of elevation and stage to maintain a crest during the lamprey run. They are also beneficial to use where impact on upstream water levels (e.g., flooding private land) must be limited. The options for electrical barriers are:

- Electrical,
- Electrical with lamprey trap,
- Electrical with built-in lamprey trap and fish passage,
- Electrical with built-in lamprey trap and more complex fish passage (e.g., pumped source as on Pere Marquette River), or
- Electrical low-head barriers (as recently constructed on the Ocqueoc River – experimental).

6.5. Determine Barrier Crest Height and Width

Based on the information received through the Hydrology and Hydraulics in Barrier Design protocol the engineer determines barrier crest heights and widths. These dimensions are preliminary but are close to what will be used in final design. Crest height is determined using the Fixed-Crest Barrier Design Criteria protocol.

6.6. Determine Lamprey Trap Requirements

Using the Design Criteria for Permanent Traps protocol determine the design objectives and technical requirements for a lamprey trap.

6.7. Determine Fish Passage Requirements

Using best available information from regulatory agencies and the Design Criteria for Fish Passage protocol, determine the design objectives and technical requirements for several fish passage alternatives.

6.8. Synthesis of Preliminary Design

Based on the integration of design objectives and technical requirements for the barrier, lamprey trap, and fish passage develop preliminary designs for several (one to three) alternative barriers (according to professional judgement and site specific needs) and prepare life cycle cost estimates. This includes the selection of barrier type, traps, and fishways.

6.9. Use of Consulting Engineers

The control agents do not have staff engineers qualified to practice in all jurisdictions and specialties where barrier projects are proposed. The control agents may retain the services of consulting engineers. When they do this directly they will use the procurement policies and procedures of their agency. The GLFC may also retain the services of consulting engineers in the jurisdiction to conform to regulatory requirements. Should this be necessary the protocol Use of Consultants by the GLFC is used.

6.10. Select Target Design

If applicable, review design alternatives with the barrier cooperator and barrier owner. Select target design and one or more alternatives (if required under permit regulations).

6.11. Finalize Documentation for BAWP

As part of the BAWP, prepare short form descriptions, full life cycle cost estimates, and briefing notes for barrier projects to be constructed in the next calendar year for SLIC, including draft MOA /CA with barrier owners.

6.12. Finalize Engineering Plans, EA and other Permit Applications

For GLFC capital approved barrier projects prepare all forms, plans, drawings, specifications, and technical reports as required for regulatory plan input and review based on regulatory requirements in the jurisdiction (see protocols by jurisdiction for Environmental Assessments, Permits, and Approvals Required for Barrier Construction). Some regulatory bodies may require specific licensure requirements for professional engineers that submit plans. Timing of application will be subject to approval of project funds by the GLFC. Timing of the application is critical in order to meet construction schedules for permitting that usually occur from July to August.

6.13. Skills Required

Licensed professional engineers with experience in dam design and construction and knowledge of the control program are required. Specific in-state registered professional engineering licensure may be required in some jurisdictions. Environmental science professionals are required for consultation on instream species migrations, habitat, environmental effects, etc.

6.14. Level of Effort

The level of effort varies according to project size and is expected to be in the range of 20 to 40 person-days for small projects to 40 to 200 person-days on larger projects.

7. Tools Required

Tools include office equipment such as computers, printers, plotters, photocopier, fax, and software associated with engineering applications, such as word processing, spreadsheet, CADD (AutoCad Release 14 or interchangeable format), Internet, and specialized hydraulic, structural, and geotechnical analysis.

8. Information Requirements

Information requirements will vary by jurisdiction and are determined by procedure 6.1. Regulatory Requirement Analysis. Contents may include maps, design plans, drawings, reports, operations plans, technical specifications, and mitigation plans. All records will be maintained and may be revised during final design and engineering in preparation of technical requirements for construction tenders. Upon completion of construction all records, both hardcopy and electronic, are to be retained by the engineer responsible for the project and become part of the barrier inventory.

9. Contract Requirements

MOU with barrier cooperators
MOA or cooperating agreements (CA) with barrier owners
Use of consulting engineers

10. References

11. Use of Other Protocols

Reach Selection

Site Selection

Barrier Annual Work Plan

Hydrology and Hydraulics in Barrier Design

Surveys at Barrier Sites

Fixed-Crest Barrier Design Criteria

Design Criteria for Permanent Traps

Design Criteria for Fish Passage

Use of Consultants by the GLFC

Michigan Environmental Assessments, Permits, and Approvals Required for Barrier Construction

Ontario and Canada Environmental Assessments, Permits, and Approvals Required for Barrier Construction

U.S. Federal Environmental Assessments, Permits, and Approvals Required for Barrier Construction

Ohio Environmental Assessments, Permits, and Approvals Required for Barrier Construction

New York Environmental Assessments, Permits, and Approvals Required for Barrier Construction

12. Protocol Authority

The Engineering Unit of the DFO-SLCC has responsibility for coordinating all barrier preliminary engineering design projects basinwide and is the authority for the implementation of this protocol. Protocols will be peer reviewed and final approval will rest with the GLFC.

12.1. Allowance for Variations from Protocol

No set of protocols will give the correct instructions for every situation barrier practitioners will encounter. Professional judgement is to be used by barrier practitioners in consultation with appropriate experts, if required, to carry out the level of preliminary engineering work best suited to the needs of each project.

12.2. Protocol Status and Revision

This is a new protocol and should be reviewed for currency and relevance after two years of use or on request of the barrier coordinators.

12.3 Author and Date

Tom McAuley, March 1999

1. Protocol Title: Fixed-Crest Barrier Design Criteria

2. Protocol Business Need

To rely on barriers as a sea lamprey control alternative the GLFC and control agents need to ensure that the best available knowledge is being applied to all new barrier designs and that such knowledge may also be applied to all barriers in the inventory. Current and consistent barrier design criteria are required to meet sea lamprey control performance objectives throughout the Great Lakes Basin.

The goal of lamprey barrier design is to cost-effectively reduce the risk of lamprey escapement to a predetermined, acceptable level with the least environmental impact. Sea lamprey barrier designs must, therefore, compromise between objectives with potentially conflicting results. Objectives such as minimizing cost and environmental effect may be met by building smaller structures and operating them for a shorter season. Environmental effects may also be reduced by the incorporation of mitigating features into barrier design, typically at extra cost. Other objectives such as minimizing risk of lamprey escapement can point toward larger, more costly structures with greater potential for environmental impact. In this context of cost and environmental impact, there is an internal program requirement for criteria with acceptable lamprey escapement risk applicable to barriers both in the design stage and to existing structures.

The selection of temporal bounds of the sea lamprey migration window for which a barrier is to be operated greatly influences hydrologic circumstances for which it must be designed. Perceived factors of safety, achieved through conservative estimates of these boundaries, can propagate through risk analysis and design processes and lead to unnecessary increases in cost and environmental impact. There is an internal program requirement for criteria rigorously defining these temporal boundaries, so that the benchmark of minimum acceptable level of control may be calculated accurately. This will allow incremental reductions in risk beyond this break-even point to be measured with precision, and weighed against factors such as increased cost and environmental impact.

3. Protocol Deliverables

This protocol begins by defining the concept of minimum acceptable level of control as it relates to the barrier program. When a candidate barrier location can offer the minimum acceptable level of control, it would subsequently be advanced into the Barrier Strategy and Implementation Plan, where it is ranked among other candidate projects. In practice, the barrier program would seek to further minimize escapement risk, in each case, as may be done with economy and practicality.

The protocol also provides criteria defining temporal bounds on the window for which a barrier is to be operated based on data from lamprey traps operated by the adult assessment units of the control agents. An inherent weakness of this guideline is that it requires the use of professional judgement on a question with little consensus as a tool to extrapolate first presence of a lamprey at a barrier, which occurs sometime prior to the first observed catch. This guideline should be applied accordingly. This guideline is intended to temporarily satisfy internal program requirements of barrier design until a more rigorous tool becomes available. Catch data used in this protocol may also be applied to the design of surveys used to monitor performance of existing barriers.

This protocol describes four criteria that may be applied to barrier design in the context of risk assessment and minimum acceptable level of control. The range in style of these criteria, from a simple rule of thumb to a multi-parameter model, reflects the evolution of the barrier program as we have learned more about sea lamprey. All are based on the concept of minimum acceptable level of control. To be implemented best, these criteria require stage-discharge data for a period of record of at least ten years. When these data are not available, comparative hydrology techniques, also widely accepted in the engineering profession, may be applied, albeit with a higher degree of uncertainty.

4. Target Audience

The principal role of this protocol is as a tool used in the Preliminary Engineering Designs and Plans protocol for new barriers and for retrofitting existing barriers. Control agent staff engineers will be the principal users of this protocol. Engineers must take a collaborative approach with biologists for the design of barriers. Design of barriers is a multi-disciplinary problem, for which all participants will use this protocol.

Criteria presented in this protocol are also required by control agent staff to evaluate barrier performance, which should include, but not necessarily be limited to, their ability to satisfy the criteria for which they were designed. A related protocol Operating Times for Barriers is available for barrier owners seeking to establish schedules for trap operations and seasonally operated barriers.

5. Jurisdiction for Protocol Use

This protocol may be implemented basinwide and without jurisdictional requirements.

6. Procedures

6.1. Acceptable Level of Control

Acceptable level of control means a barrier performs as planned when, over a 50-year amortization period, the (Net Present Cost) total life cycle cost of the barrier is less than or equal to the (Net Present Cost of) total cost of lampricide control over the same period for the affected stream area. Barrier life cycle costs include any recurring lampricide treatment(s) required after barrier construction, maintenance, fishway operation, trap operation if used to supplement control, and costs of any environmental monitoring including larval assessment. There may be other reasons favoring the barrier alternative over lampricide treatment – e.g., endangered species harmed by treatments (native lampreys, sturgeon) or public pressure discouraging chemical use.

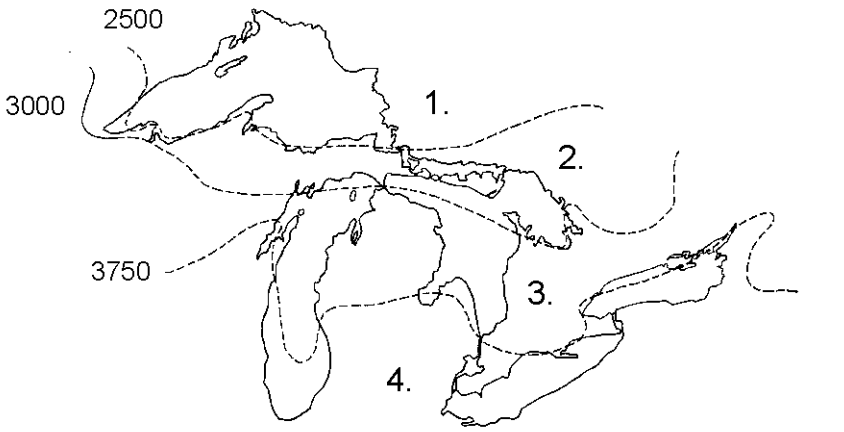
After construction of a fixed-crest barrier, a river can be expected to require less frequent lampricide treatments. At some reduced frequency of treatment, the combination of a barrier and continued, less frequent treatment can become less costly than the exclusive use of lampricides. At this point, the benefit/cost ratio for constructing a barrier equals one, representing the minimum acceptable level of control that should be accepted for a barrier design. Increases to the benefit/cost ratio from further treatment frequency reduction may be realized by building a higher crest barrier. This increased benefit may be partially, wholly, or more than offset by the increased construction cost of larger barriers over their 50-year design life.

6.2. Sea Lamprey Run-Times

The first stage of analysis involves the determination of the characteristic timing for the sea lamprey spawning run that is likely to occur at the candidate barrier site. Spawning-run times are critical in establishing the time period for the analysis of hydrologic data in order to determine design parameters such as crest height. A compilation of characteristic run-times for five zones in the Great Lakes Basin has been developed as a planning tool for this purpose.

Figure 1. Zones for analysis of sea lamprey run times

Isotherms represent mean annual growing degree days above 42° F (5.5° C)



(Zone '0' = St. Marys R.)

Zone	Lake/River Area	< 1% Catch	> 99% Catch	Operation Window
1	Superior North	May 7	June 25	May 1 – June 30
2	Superior South, Huron North & Georgian Bay	April 29	July 12	April 15 to July 15
3	Michigan North, Huron South Ontario & Erie extreme North	April 27	June 17	April 1 to June 30
4	Michigan South , Erie, Ontario South	April 10	June 11	Mar 15 to June 30

Table 1: Operation Window for Barriers and Fish Passage Devices

This model of sea lamprey migrations is based on trap data from sites in the Great Lakes, and on an Environment Canada Atmospheric Environment Service Chart "Mean Annual Growing Degree-Days Above 42°F (5.5°C) " (Phillips & McCullouch, 1972). The model assumes that Great Lakes tributaries in areas defined by similar isotherms will increase similarly in temperature after ice-out at similar times, and consequently have similar spawning-run times. This assumption is generally supported by trap catch data. The approach is general though, and where trap catch data are available on the candidate stream in question, it could be considered more appropriate than the five zone map, because the map cannot account for local variations in river temperature attributed to watershed area and fluvial geomorphologic characteristics. Numerous other aquatic studies have applied atmospheric temperatures to their work. At this point the control agents have not consistently collected enough temperature data on which to base this model. In the future, more intensive consistent temperature sampling is anticipated and the model could be revised at that point.

In all cases, the use of trap catch data to determine migration timing requires professional judgement to determine when during the year a lamprey barrier must begin to function relative to the first observed lamprey catch. This is the period when the barrier must be designed to perform under a corresponding range of hydrologic conditions. Because the operation window of barriers is during the spring flow recession, shifts of one to two weeks in the operation window can have large impacts on the hydrologic conditions the barrier is to be designed for. This "design window" will have similar influence on the size and cost of the barrier.

Lampreys are likely present at barriers some time before they enter traps and are caught. At this time, lampreys' ability to escape to upstream habitat at a flooded barrier is subject to debate. A 1980 study in a flume on the Ocqueoc River, (Hansen, 1981) suggested that, based on their observations, "at temperatures below 15 °C (59 °F)… a much lower water velocity than 3.7 m/s (12 ft/s) might serve as an effective barrier during the early portion of the spawning run". In another paper, discussing velocity barriers, (McAuley, 1996) similar observations were documented. Application of these observations certainly merit further testing and study as they could improve the accuracy of risk forecasting at barriers. Development of probability functions for escapement at barriers as a function of temperature and flow could be used to improve hydrologic studies, and center them around thermal events rather than on calendar dates.

This template for spawning-run times also has application in fishway, trap, and adjustable-crest barrier operation, and is discussed in the protocol Operating Times for Barriers.

6.3. Crest Height Criteria

Perhaps the most important question which must be answered in each fixed-crest barrier design is "how high". In engineering terms, this might be described as the crest elevation which provides a flow condition presenting a barrier to lamprey except during an n^{th}- (or greater than n^{th}-) year flow event within the spawning run. Hydrology studies allow the computation of flow rates and water levels associated with various n^{th} year events. Design criteria should identify a minimum return period for which the barrier must prevent escapement of sea lamprey. This minimum value may change from one site to the next. Performance is then optimized as budget and site constraints allow.

Difficulties arise when trying to label a set of environmental circumstances, such as a flood flow event, as an event where lamprey passage could occur. A significant fraction of fixed-crest barriers are inundated one or more times each year during the period between April and June without resulting in recruitment upstream of the barrier. Lamprey behavior is related to parameters such as water temperature and velocity effects of flood flows, but these relationships are not immediately quantifiable. The regular operation of a trap could effect the presence/absence of large numbers of lamprey which could be ready to pass the barrier during a given flow event. Although larval surveys can assist evaluations on existing barriers to determine when a historical high flow event caused a barrier failure, we are unable to forecast what the effect of a given high flow is on lamprey escapement. The data and tools currently available to the barrier program lack the precision necessary to equate a future high flow event with barrier failure.

Four methods of determining crest height are presented in the following sections. They represent the evolution that has occurred in the crest-height design process to date. With the exception of the empirical method, the recent general trend is to rely on more data and on more assumptions in design. This is a result of observations stemming from lamprey research to date that may not have undergone applied testing.

No particular method presented below is always inappropriate or always appropriate. The selection of a method will be a result of available data and the assumptions the barrier coordinator must make. The wise barrier practitioner would attempt to apply more than one of these models to a given candidate site, and use professional judgement in the selection of a crest design based on the two or more model outputs.

The barrier practitioner must balance other objectives such as cost and environmental impact. As project size increases, more rigorous risk analysis is done, and the cost of contributing data acquisition and analysis increases the cost of design. The engineer must apply discretion, based on project size in determining the scope of the design studies.

6.4. Empirical Method for Determining Crest Height Criteria

Assumptions	A barrier crest design featuring a 45 to 61 cm (18 to 24 in.) water level drop at mean annual flow conditions will provide an effective barrier at most times during the spawning run, and yield an acceptable level of control.

During the 1980s, a number of low-head sea lamprey barrier dams were constructed in Canada using this rule and continue to function today with good return on lampricide savings.

$$\textit{Crest Height (inches)} = \textit{Stage @ Mean Annual Discharge} + \textit{Offset}$$

Where: *Offset = 45 – 61 cm (SI)*
Offset = 18 – 24 in. (Imperial)

This method can be thought of as providing a factor of safety *(Offset)* over and above water levels corresponding to mean annual discharge. Use of this model involved considerable professional judgement on the part of the engineer to accommodate variations in river morphology between candidate sites. As a result, there has been some variation in this model. The offset from the stage at mean annual river flow by 61 cm (24 in.) was decreased in some cases to as low as 45 cm (18 in.). **This model has been applied with good success on small rivers with mean annual flows between 0.5 and 3 m^3/s (17 and 106 cfs), and where tail water conditions feature good gradient characteristics.** Many of these barriers are flooded by spring flows with almost annual frequency but without an escapement.

In these designs, the crest length was adjusted to pass water more efficiently than the downstream channel section. This served to keep the headwater as low as possible to reduce flooding to adjacent property owners and to cause the head at the dam to diminish as discharges increased, thereby reducing the danger of washout.

6.5. Single Parameter (Hydrology) Method for Determining Crest Height Criteria

Assumptions	A vertical drop of 46 cm (18 in.) between an overhanging crest and the tail water constitutes a barrier to sea lamprey passage
	Any flow event creating a drop of less than a 46 cm (18 in.) drop will result in escapement, and is equated to a barrier failure.
	The barrier will provide an acceptable level of control if it will provide a 46 cm (18 in.) drop at flows with an annual frequency of return of ten years. (These barriers were designed to resist structural failure at the 100-year flow event.)

This method for determining crest height was last used about 12 years ago, predominantly in Michigan. These barriers have been effective at preventing lamprey escapement, and thus far, none has required treatment to address escapement resulting from high flow events. Use of these criteria requires no assumptions to be made regarding behavioral patterns of lamprey, effects of temperature on swimming performance of lamprey, or spawning run patterns of lamprey. This is partly a result of a conservative approach to the concept of acceptable level of control. When these barriers were built, it was assumed that an optimized barrier would eliminate all future treatments.

This method of determining crest height is versatile, as it can take advantage of historical data, when available, for improved reliability, but is not restricted to the use of historical data. There are well-established hydrologic relationships for determining floods such as the ten-year event, which rely on empirical techniques, and on regional rule-curves.

In these designs, (fewer than five structures built in Michigan satisfied this criteria) the structures were built to pass the 100-year flow event between the abutments of the dam, without overflow. These dams also featured crest lengths that fit between the existing riverbanks, in an effort to accelerate flow over the crest to reduce escapement risk at high flows. These design characteristics increase flow energy as flow and water level increase. These characteristics also place increased load on the barrier structure as flows increase

The low escapement of these barriers also represents the cumulative result of several conservative assumptions. Flood flows are associated with storm events that are, in the field of hydrology, considered to be random events. There is equal likelihood of large storms happening at any time of year and, therefore, neglecting effects of seasonal variation in base flow, large flood flows may also be considered to be randomly distributed over the year. So, neglecting base flow variation for floods in the order of magnitude of ten-year events over 95% of lamprey caught during a migration on a given river are caught over a 60-day period. If the entire run were assumed to occupy a 90-day period, this would represent only 25% of one year. The probability of a random, 10-year storm event occurring in this particular time of year is once every 40 years. This is an example of how one conservative assumption can propagate through a very simple model. The combined effects of several conservative assumptions are difficult to quantify.

The low risk of escapement in barriers built to this criterion has several trade-offs. As a result of the conservative approach taken in this design process, barriers built to this criterion are typically larger, have higher head and erosive forces, are more costly to build, and have greater environmental impact than smaller structures built to less

stringent escapement criteria. Use of the ten-year flood usually means the barrier must be located further upstream in the watershed, where high gradient areas result in less vertical change in water levels. This offsets post-barrier treatment reductions contributing to decreased cost-effectiveness. Another shortfall inherent in the use of this technique is that it may predict less than satisfactory performance for a barrier at a candidate location, eliminating that site from the barrier program, even though a cost-effective barrier may have been built there.

6.6. Modified Single Parameter Method for Determining Crest Height Criteria

Assumptions	A vertical drop of 30 cm (12 in.) between an overhanging crest and the tail water shall constitute a barrier (Young 1979).
	Any flow event creating a drop of less than a 30 cm (12 in.) while spawning run are present may not necessarily result in escapement.
	Higher flows allowing potential for escapement occur more frequently during the early portion of the spawning run when river temperatures are colder, and swimming performance is poor.
	An escapement event will not necessarily result in enough recruitment to warrant a lampricide treatment if QAS protocols are adhered to.
	The spawning run may be bounded temporally within a 90-day period at any given candidate barrier location. These temporal bounds may be applied to hydrologic frequency analysis to forecast frequency of occurrence of tail water elevations within 20 cm (8 in.) of the crest.
	Over a given spawning run, risk of escapement may be conservatively expressed in terms of the percentage of the spawning run with flows with the potential to permit escapement.
	An acceptable level of control may be achieved, depending on the site, with such a crest elevation as results in a 1% risk of escapement each year (1 flow event per 90-day season within 20 cm (8 in.) of the crest). That is, on average, one day occurs during the spawning run that could allow escapement if conditions were ideal.

This method of determining crest height criteria has been applied principally in Canada on barriers built since 1993. Although no formal post-construction evaluation of these barriers has been done, the application of this criterion appears to work well, especially where historic hydrologic data is available on-site. These barrier designs rely on the application of historical data from the candidate stream or a suitable surrogate to determine hydrologic risk statistically. In this approach, allowing an average of one day per year during the spawning run is assumed to provide an acceptable level of control.

Designing specifically for flows that are anticipated during the spawning run can reduce cost and environmental impact. River flows associated with spring snow and ice melt are more frequently higher than and occur prior to typical flows during the spawning run. As the timing of the lamprey run may be defined more precisely, more accurate escapement predictions may be made because hydrology outside of the timing window of concern is dropped from the analysis. This also allows hydrologic risk, which may be calculated with relative ease, to be equated to escapement risk.

This method assumes that the Single Parameter Method for Determining Crest Height that uses the ten-year flood flow event as the design flow is excessively conservative. Because lamprey only run during one quarter of the year, and 10-year flood flows may be assumed to occur at random, at any time of year, the frequency of return of lamprey escapement is once every forty years. To truly design for one escapement event every ten years, one would expect to design for the two and one half-year flood flow,

recognizing that one's only concern is the quarter of the year when lamprey are migrating. Smaller flood flows such as the two and one half-year event are not defensibly assumed to occur at any time of year, because of their similarity in size to commonly occurring flows, which do have an annual distribution. Therefore, this method concentrates on the probability or frequency with which a barrier may pose a risk of escapement during the spawning run.

Like the first two methods, this method does not back-calculate acceptable hydrologic risk based on the minimum acceptable level of control. These methods simply assume that the crest height criteria (in this case, such a height as may deliver an average of one hydrologic circumstance permitting escapement each year) will provide an acceptable level of control. Although it may be too early to tell, these structures appear to be working well. Of note is that structures designed to this rule are of similar size to structures designed to the rule of Empirical Method of Determining Crest Height.

6.7. Three-Parameter Model for Escapement Risk at Duffins Creek

This model exploits knowledge of the swimming ability of lamprey as a function of stream velocity and temperature.

6.7.1. Physical Barriers

Falling Water: Youngs (1979) found that a 30 cm (12 in.) crest to tail water drop was a definitive barrier to 3,000 sea lampreys in a 3 m (9.9 ft.) wide flume. A 15 cm (6 in.) drop was a formidable barrier to x/y lamprey. This investigation was limited to falling water with flows of x to y cfs producing a narrow well-defined jet entering the tail water at angles greater than 35 ^{o}.

Rapid Water: In most high discharge events at barriers the over-crest water flow is in the form of a thick jet, usually between 20 and 200 cm (7.9 and 79 in.) deep, that enters the tail water at a low angle (<20 ^{o}). On its way over the crest, water velocity continually increases from a point just upstream of the crest to the downstream interface of the jet. Where super-critical flow starts near mid-crest, average velocities of 1.7 to 2.8 m/s (5.6 to 9.2 ft/s) can be expected for depths of 30 to 80 cm (11.8 to 31.5 in.). Average jet velocities at the downstream water surface of 2.4 to 2.8 m/s (7.9 to 9.2 ft/s) can be expected where heads of 30 to 40 cm (11.8 to 15.7 in.) are involved.

6.7.2. Sea Lamprey Swimming Ability

In thick-flow low-drop conditions, white suckers, known to be non-jumping fish, attempt and succeed swimming up over low-head barrier dams (McDonald R., and B.G. Johnson,1984). In high flows, low-head dams can present velocity barrier conditions to sea lamprey. Whether sea lampreys attempt and succeed at passage in these conditions depends on water velocity and temperature and their size and swimming ability.

For this reason, the following information is included (The following is an excerpt on the subject from McAuley, 1996: "The anguilliform swimming mode employed by sea lamprey is relatively inefficient from the hydromechanical point of view "(Lighthill, 1969; Lindsey, 1978; and Webb, 1975). Beamish (1979), Bergstedt, et al. (1981), and Hanson (1980) have conducted some swimming performance analyses for sea lamprey. Beamish (1979) found that all marine teleosts (e.g., Atlantic cod, redfish, winter flounder, longhorn sculpin, sea raven, and ocean pout) in his preceding tests of swimming endurance were able to swim for longer periods at higher speeds than could sea lampreys. Bergstedt, et al. (1981) tested adult sea lamprey in 1977 at water velocities of 1.0 to 1.5 m/s (3.3 to 4.9ft/s) and temperatures of 6 and 10° C in a tunnel respirometer.

Endurance times for the four sea lamprey tested at 1.4 m/s (4.6ft/s) were 4, 9, 32, and 0 s. However, at 1.5 m/s (4.9ft/s), three out of the four sea lamprey tested were not able to swim and one endured for 15 s. Bergstedt, et al. noted that the dimensions and nature of the tunnel apparatus used were not ideally suited for burst swimming tests and that 1.5 m/s (4.9ft/s) exceeded the maximum current velocity for which it was designed." (McAuley, 1996).

6.7.3. Effect of Temperature

Hanson (1980) tested migrating sea lamprey ranging from 37 cm to 55 cm (14.6 in. to 21.7 in.) in length in a horizontal 3 m (9.8 ft.) long flume that was set up beside a stream from which the sea lamprey were trapped. A large irrigation pump fed a storage tank at the upstream end of the flume. Temperature had a significant effect on the number of sea lamprey swimming attempts in Hanson's work. The number of lamprey attempting to swim up the flume quadrupled between the 11 to 15.3 °C (52 to 60 °F) tests and the 16 to 18 °C (61 to 64.4 °F) tests. In the five tests conducted at temperatures between 11 and 15.3° C, only 4 out of 168 sea lampreys, i.e., 2.4%, attempted to challenge the flume. In the five tests conducted at temperatures between 16 and 18° C, (61 to 64.4 °F) 10.6% attempted to swim the flume. In the three tests between 19 and 23.6 °C, (66.2 to 74.5 °F) and average of 35.4% of the lamprey (51/144) attempted the flume. Only at water temperatures greater than 16.5°C, were sea lamprey able to swim as fast as 4 m/s (13.1ft/s). However, they could only endure at this speed for an average of 1.3 seconds.

Extensive tests of sea lamprey swimming ability were carried out by McAuley in 1991 and 1992 in flumes of 5 and 30 m (16.4 ft. and 98 ft.) in length and which did not permit oral attachment. Temperature was found to be a 'sine qua non' factor in determining whether sea lamprey would attempt swimming through rapid water as well as being a determinant in their performance. Sea lamprey could swim at speeds over 3.1 m/s (10.2 ft/s) for short duration of about two to four seconds in water at 19 ° C (62.2°F). Since water velocities over inundated barrier crests are often 2 m/s (6.56 ft/s) or more, early cold-water runoff over dam crests can function as velocity barriers to sea lamprey.

At higher water temperatures, fish (and sea lamprey) can attain higher swimming speeds due to the dependence of fast white muscle contraction times on temperature (Wardle and Videler , 1980; Wardle, 1980).

6.7.4. Assumptions of the Three-Parameter Model for Escapement Risk

Assumptions:	A flow event creating a drop of less than a 20 cm (8 in.) contributes to a calculable risk of escapement.
	Stream temperature plays a contributing role in the risk of escapement at an inundated barrier, and presents a calculable risk of escapement.
	The presence, absence, and temporal distribution of lamprey abundance at an inundated barrier contribute to a calculable risk of escapement.
	The spawning run may be bounded within a temporal window at any given candidate barrier location. These temporal bounds may be applied to hydrologic frequency analysis, temperature frequency analysis, and lamprey presence/absence frequency analysis to forecast frequency of occurrence of escapement events.
	The temporal bounds on the spawning run window may be determined using lamprey trap catch data. The spawning run normally occurs over a 50 to 90 day period sometime between early April and late June.
	The start and end of the spawning run generally coincides with the dates within which 98-99% of the sea lamprey catch occurs in the stream, or in nearby lamprey streams. Start/end dates are also the dates before and after which catch per day is less than one. For proper context, studies will also include a margin of one to two weeks at each end of the spawning run.
	The risk of lamprey escapement is the product of probabilistic hydrologic, temperature, and presence/absence events that must occur simultaneously to create escapement.
	A barrier project may proceed if designed for a cost-effectiveness of one or greater, taking into account the concept of minimum acceptable level of control. Barrier height may be increased above this minimum level to reduce risk of escapement as site conditions and cost-effectiveness permit.

The 3 Parameter Model for Escapement Risk was under development at the time of the writing of this protocol. The purpose for developing this model is to improve the accuracy of the risk of escapement assessment process to an extent that it is not necessary to rely on a number of conservative estimates. The difficulty with making conservative estimates is that the sum of conservative error propagates through the design process, and has the potential to result in over-built structures that do not optimize barrier design objectives. The alternative targeted by this method is to define minimum acceptable level of control in terms of an accurate escapement risk, and then to optimize the design to best satisfy all barrier design objectives.

Observations of performance of a number of fixed-and adjustable-crest barriers that are regularly inundated during the spawning run window suggest that hydrologic events are not the only factors contributing to escapement. For example, flood flows inundated the Duffins Creek barrier 15 out of 18 years during the April-June period, and resulted in only one escapement event. Similar observations have been made at a number of other sea lamprey barriers built to date. Observed risk of escapement was much less than the risk of escapement forecasted by hydrologic events. This model postulates that lamprey presence, hydrology, and temperature contributes simultaneously to the risk of lamprey escapement at barriers.

To calculate escapement risk, this model begins by breaking down the spawning run into five-day periods. For each period, annual frequencies of recurrence of discharges exceeding the barrier crest, of temperatures exceeding 15°C (Hansen, 1991), and of catch are calculated. The product of the probabilities of each of these three criteria (that must occur simultaneously) is the probability of escapement during that five-day period. Annual risk of escapement is calculated by summing the combined risks for each consecutive five-day period of the spawning run.

This model is under evaluation in a case study on the Duffins Creek barrier, where data collection has been intensive. The study compares the historical record of escapement, (one escapement event over a period of operation of 18 years) to a probabilistic model of escapement potential based on three parameters: lamprey presence, temperature, and discharge. The table below summarizes some preliminary findings of this study.

Method	Risk
Historically observed annual risk of escapement over 18 years. (Adult Assessment record)	5.5%
Annual risk of escapement = Hydrologic Risk	88.0%
Annual risk of escapement = (Hydrologic) X (Temperature >10°C)	32.0%
Annual risk of escapement = (Hydrologic) X (Temperature >15°C)	18.0%
Annual risk of escapement = (Hydrologic) X (Temperature >10°C) X (Presence)	12.6%
Annual risk of escapement = (Hydrologic) X (Temperature Risk >13°C) X (Presence)	9.5%
Annual risk of escapement = (Hydrologic) X (Temperature >15°C) X (Presence)	6.0%

This model makes a conservative assumption in its approach, because it assumes that an escapement will cause sufficient recruitment as to warrant a treatment. Historically, a number of escapements have not required treatment when evaluated in terms of QAS in the protocol Performance Measures for Escapement at Barriers. Mechanisms such as competition with other species which have become established in the absence of sea lamprey, low numbers of spawning parents, and predation on larvae are little-documented mechanisms with the potential to produce these results. As our ability to understand and model stock-recruitment processes improves, it may be possible to incorporate this as a 4^{th} parameter in such a model.

In theory, this model should be universally applicable. The model requires a large data set, including hydrology, temperature, and catch, over a period of about ten years. Although this information is not available for a number of candidate barrier locations, substitution of data from surrogate rivers is defensible if carefully documented, recognizing potential sources of error. As experience is gained in the application of this model, its reliability needs to be tested and documented. This model is intended to provide an accurate assessment of escapement risk on a case-by-case basis. This is intended to allow crest height to be back calculated from the minimum acceptable level of control, rather than requiring assumptions to be made regarding the acceptability of a forecasted risk of escapement. Once the minimum acceptable crest height is known an iterative process may be undertaken, incrementally increasing crest height and tracking environmental impacts and cost, to reach an optimized design.

6.8. Definitions

Crest length - the length of the spillway of the dam perpendicular to the direction of flow over the crest

Crest height - the vertical elevation of the top surface of the barrier spillway

Elevation - the vertical distance between a surface and a reference point or benchmark

Escapement risk - the probabilistic risk of lamprey passing a barrier, thereby accessing reproductive habitat

Inundated (flooded) barrier – tail water elevation has risen so that it is within 20 cm (7.9 in.) of the crest or is above the crest

Stage - the vertical elevation of the water surface

7. Tools Required

Computer models and statistical software
Meetings for collaborative, interdisciplinary work

8. Information Requirements

Hydrology, temperature, and catch data for each candidate river, or acceptable surrogates.
Rough habitat mapping or knowledge of candidate stream for predicting need for downstream treatment post-construction.
Consensus in lamprey research community as to factors influencing spawning run-timing and behavior of sea lamprey as they pertain to operating times for barriers.
New research in lamprey behavior and stock-recruitment models that may be applied to refine design criteria, and thus increase barrier efficiency.

9. Contract Requirements

10. References

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11. Use of Other Protocols

Hydrology and Hydraulics in Barrier Design

Environmental Assessments, Permits, and Approvals Required for Barrier Construction by jurisdiction

Barrier Annual Work Plan

Performance Measures for Traps at Barriers

Performance Measures for Escapement at Barriers

Operations and Maintenance of Traps

Operations and Maintenance of Fishways

Preliminary Engineering Designs and Plans

Site Selection

Reach Selection

Operating Times for Barriers

12. Protocol Authority

This is an interim protocol. The barrier coordinators plan additional developmental work on the subject for FY1999/2000. The SLBTF will review the revised protocol with an independent peer review by statistics/mathematics experts. Recommendations made by SLBTF for a final working version of the protocol would then be reviewed by the SLIC, further peer reviewed if required, and subsequently approved by the GLFC if the proposed changes are significant.

Changes to what constitutes a minimum acceptable level of control will likely require approval by SLIC.

12.1. Allowance for Variations from Protocol

Engineering design is a creative process. The engineer requires license to deviate from established methods presented here if new solutions to design problems are to be found.

12.2 Protocol Status and Revision

This is a new protocol and should be reviewed for currency and relevance after two years of use.

12.3. Protocol Author and Date

A.G. Hallett, March 1999

DESIGN CRITERIA FOR PERMANENT TRAPS

1. Protocol Title: Design Criteria for Permanent Traps

2. Protocol Business Need

This protocol provides guidance for designing permanent traps into barriers and is required to satisfy business requirements within the sea lamprey barrier program (internal).

3. Protocol Deliverables

This protocol provides background information and design requirements for permanent traps in barriers. An "optimum" design based on sea lamprey spawning run size is given as well as other options that may be considered for traps with different purposes or special circumstances. This protocol will be used each time a new barrier is designed with a permanent trap.

Note: This protocol does not address traps at electrical barriers. There are additional considerations for traps at electrical barriers that are not covered here.

4. Target Audience

The target audience for this protocol is engineering personnel (control agent engineers and consulting engineers) and adult assessment personnel involved in the trap design process. Engineering and adult assessment personnel will implement the protocol collaboratively.

5. The Jurisdiction for Protocol Use

This protocol will have general application across the Great Lakes Basin (basinwide without jurisdictional requirements).

6. Procedures

6.1. Introduction

The purpose of this protocol is to provide the information necessary to design permanent traps at sea lamprey barriers that maximize capture of sea lampreys, minimize capture of non-target species, can be safely and efficiently serviced, and maintain the health of both target and non-target species captured.

It is not feasible to describe a single trap design that would be applicable in all instances. Some general trap concepts will be universal in their implementation, but specific site considerations will almost always play a role in trap design. This protocol provides the criteria and rationale to be used in the trap design process.

6.2. Background

Understanding the behavioral response of lampreys to conditions/factors present upon approach to a barrier is the key to lamprey trapping. Historically, lamprey behavior has been studied either by observation (incidental or deliberate) or by designed studies. Applegate (1950) describes classic examples of interpreting behavior through observation. Recent studies involving telemetry work by the DFO Great Lakes Laboratory for Fisheries and Aquatic Sciences have added to our knowledge.

6.2.1. Behavioral characteristics to consider in designing traps

Lamprey behavior plays an important role in trap design. It is believed that lampreys are drawn to a stream from the lake by a combination of flow, temperature, and larval

lampreys residing in the stream. Once in a stream, spawning-phase sea lampreys migrate upstream. When and how much time they spend seeking habitat and spawning depends on when they enter the stream. If they encounter a barrier during their upstream migration, they follow along the face of the barrier (leading) searching for a way to bypass the barrier. They will often rise to the surface in their search for a way over the barrier. If there is a concentrated discharge of water at any location during this search, the lamprey will be attracted to it and may focus their continued search in that area. These two things (leading and attractant water) are manipulated at all trap sites to establish ideal trapping conditions.

The response of sea lampreys to the physical, biological, and other stream characteristics are discussed in detail below. This description will serve as useful background information for the trap design process since it is helpful to understand these characteristics in order to design a trap that maximizes the capture of sea lampreys.

6.2.1.1. Entering a Stream

Spawning-phase lampreys stage near the mouths of streams prior to migrations. First movement into streams occurs during ice-out with temperatures as low as 0-1°C (FWS data). During this period of low temperature, lampreys gradually move upstream and gather in pools leading up to and immediately below a barrier. This occurs for some time prior to first catch being made at a collecting device. Lampreys are rarely trapped at barriers in any numbers until temperatures reach about 10°C. Applegate (1950) reported the gradual build-up of spawners at night immediately below the Ocqueoc River weir. First sightings occurred on April 12, but no catch was made until April 27. Adults are often reported being netted during smelt runs which occur a month before lamprey traps commence catching. SCUBA divers in the St. Marys River have observed and killed large numbers of spawners hidden in the rocks in the Great Lakes Power tailrace up to five weeks before the first lampreys were captured in the proximal traps.

6.2.1.2. Swimming and Resting

Lampreys are capable of burst swimming when moving through swift water, when surmounting obstacles, or when frightened. During these times, they are presumably attaining a short-lived terminal swimming velocity (Applegate 1950). Flows in excess of 2 m/s (6.6 ft/s) exhaust a bursting lamprey within 30 s under moderate mid-season temperatures (McAuley 1996). Personnel of the DFO-SLCC have recorded velocities above 4 m/s (13.1 ft/s) in small streams at no greater than high too near-flood conditions (R. Bouchard, personal communication).

Lampreys can surmount natural and low man-made obstacles by throwing themselves upward and forward, then attaching firmly, resting, and traversing again. Lampreys are able to attach to many of the types of surfaces encountered in the stream environment. Air chambers behind a fall of water are handled readily, and no more than a spray of water on a solid surface permits attachment for extended periods without apparent discomfort (Applegate 1950). Also, lampreys are able to attach to materials typically used for barrier trap construction.

6.2.1.3. Light and Cover

Applegate (1950) recognized that lampreys, especially in the early part of their spawning run, seem most active at night, avoiding daylight. Later, with the onset of blindness and the need to spawn, they become more active out in the open, swimming below a barrier or on spawning beds in full sunlight. During their spawning migration, lampreys are found in a variety of locations but almost always under cover or in refugia. They are commonly

found in brush piles, under overhanging banks, under boulders and, in general, in locations where light is reduced (Kelso 1998). Overhead and instream cover has potential value to the lamprey when they are seeking escapement from daylight. Consequently, the natural cover available could influence the course of initial approach and the eventual position adopted by lampreys below a barrier. However, attempting to utilize natural cover (or possibly artificially contrived cover) to direct lampreys to a preferred side of the stream, or removing cover for the opposite effect, has not been attempted to any degree, for the returns to be realized are questionable.

One way of attempting to take advantage of the avoidance of light has been to design traps that are particularly dark. Lampreys in a trap at the onset of dawn may prefer the darkness of the trap as opposed to the daylight outside. The high level of efficiency of some permanent traps has been attributed to this response. However, a possible consequence could be escapement from the trap if the lampreys are attracted to the daylight focussed through the entrance of the darkened trap.

Upstream migrating adult sea lampreys responded positively to a lighted trap in the Cheboygan River. A study conducted by Purvis (1985) demonstrated that illuminated traps consistently caught significantly more lampreys. Illumination of traps could play a prominent role in attracting lampreys to the trap (Purvis et al. 1985).

6.2.1.4. Effects of the Presence of its Own or Other Species

There is circumstantial and anecdotal evidence that suggests that a residue from dead lampreys can actually repel live lampreys. Lampreys can be injured or killed in the presence of overwhelming numbers of suckers (or other fish) if in the confines of a trap. Observations have shown that lampreys will avoid spawning where large numbers of suckers are present on the grounds.

6.2.2. Behavioral Characteristics Relating to Barrier and Trap Features

The distance of a barrier from the mouth of a stream may play a role in barrier site selection if more than one site is being considered. Water depth on approach, attractant water, and leading are critical to trap success and are manipulated at all sites to maximize trap potential. These characteristics are discussed in detail in this section and their application is described in section 6.3.3 Trap Features.

6.2.2.1. Distance of Barrier from Mouth

A stream with a barrier close to the estuary will have higher emigration rates than those with barriers located further upstream (Kelso 1998) if they are not removed by trapping. Early migrants may spend up to eight weeks in the watershed before initiating spawning activity. Consequently, early-run animals are more likely to attain barriers located at considerable distance from the mouth. Later migrants will generally settle for the more readily attained spawning grounds, and commence spawning activity more quickly (Applegate 1950). Lampreys that are blocked but not removed by traps may be diverted to other streams (Applegate and Smith 1951). Site selection of a barrier that takes trapping into account may be facilitated by this concept.

6.2.2.2. Water Depth on Approach

It is believed (at least in small to moderate discharge streams) that lampreys follow the line of deeper water while migrating upstream. Applying this concept may facilitate selection of the preferred trap site along the face of a barrier (especially on a very wide shallow river). This application is discussed further in section 6.3.2.3.

6.2.2.3. Attraction to Discharge

Lampreys are attracted to discharge throughout their spawning phase. When lampreys encounter a barrier and engage in a search for a way to bypass the barrier, they are attracted to areas of concentrated discharge. When water becomes very turbulent, lampreys appear to move more randomly. See section 6.3.3.9 for design considerations relating to attractant water.

6.2.2.4. Leading

Lampreys are willing to follow a wall or other lead, although their searching behavior is not automatically in an upstream direction. Their willingness to prod and poke for openings, both up and down an angled obstacle set to lead them, results in phenomenal success at locating the smallest break or aperture. This same obsessive searching also permits a high degree of success in escaping from confined areas (Applegate 1950).

Angling a porous barrier (e.g., a mesh of hardware cloth) to the direction of flow permits the major downstream movement of the water to continue in the same direction and thereby facilitates leading. However, a solid barrier set at even a severe angle tends to bend the water crossing over the lip so that the water column at point assumes an angle of 90 degrees to the lip. The fall of water over a solid barrier is consequently orientated much the same, whether the barrier itself is angled or perpendicular to the direction of flow. Therefore, a lamprey receives no specific cues as to where upstream is located, and the leading component of the water is reduced. Leading plays an important role in trap location and is critical to trap success. Application of this concept is described in section 6.3.2.1.

6.2.2.5. Lamprey Health in Trap

A trap will be designed to handle the maximum single catch anticipated, while keeping the lamprey in the best of health. Specimens for mark-recapture, sterile release program, or research must remain fully healthy to serve their purpose. Although catches done strictly for control will be removed upon capture, operators do not want to be continuously handling decomposing lamprey. Further, if dying/dead lamprey do repel live specimens, catches would be negatively affected. Water levels in traps and attractant water affect lamprey health in trap and are discussed in section 6.3.3.9.

6.2.3. Permanent Trap History

Trapping success (when measured by trap efficiency) varies markedly, not only between sites, but also at the same site across seasons and between years. Permanent traps have been built into or on the upstream side of the barrier (with the entrance in the face of the dam), on the downstream side of the barrier, or in a fishway. The following table lists all permanent barriers with traps currently in operation (1998) and the average efficiency of each. All provide some example of permanent trap option that may be useful to consider in the design of new barriers with traps.

Barrier type	Trap location	Example	Average efficiency	Jurisdiction/Lake
Fixed-crest	Downstream of barrier	Gimlet	0.23	CAN/Lake Superior
		Wolf	0.68	CAN/Lake Superior
		Ocqueoc	0.54	US/Lake Huron
	Into/upstream of barrier	Stokely	0.68	CAN/Lake Superior
		Carp	0.65	CAN/Lake Superior
		Echo	0.79	CAN/Lake Huron
		Koshkawong	0.59	CAN/Lake Huron
		Trout	0.57	US/Lake Huron
		Tittabawassee	0.14	US/Lake Huron
		Duffins	0.67	CAN/Lake Ontario
		Graham	0.66	CAN/Lake Ontario
		Port Britain	0.59	CAN/Lake Ontario
		Grafton	0.71	CAN/Lake Ontario
		Shelter Valley	0.69	CAN/Lake Ontario
		Salmon	0.57	CAN/Lake Ontario
	Fishway	Brule	0.70	US/Lake Superior
		Cobourg	0.60	CAN/Lake Ontario
Adjustable-crest	Fishway	Big Carp	0.77	CAN/Lake Superior
		Big Creek	0.22	CAN/Lake Erie
Velocity	Into/upstream of barrier	McIntyre	0.28	CAN/Lake Superior

6.3. Trap Design Process

During the barrier design process, potential barrier sites should be assessed with trapping in mind. Areas where water depth and velocity can be manipulated to lead lampreys will greatly enhance trapping potential. It is important to keep in mind that trap design is a process just as getting lampreys to enter a trap is a process. When a deviation from this protocol is contemplated, the effect of the deviation and its role in the process must be addressed, analyzing steps both before and after the deviated item. Sometimes, seemingly minor changes can significantly affect the efficiency of the trap or servicing procedures.

Engineers and adult assessment personnel on the project will work collaboratively to design traps for barriers. Both the engineer(s) and adult assessment personnel are an integral part of the design process and must be involved from the start. The engineer will be responsible for providing the detailed drawings and addressing the engineering and hydrology issues. The adult assessment biologist/technician will provide information and guidance based on trapping experience and concur with the final design.

6.3.1. Trap purpose

A trap may have one or a combination of any of the following purposes: assessment, control, harvest of adults for the SMRT program, and research.

6.3.1.1. Assessment

The current objective of a trap operated for spawning-phase assessment is to conduct a mark-recapture study to obtain a statistically reliable estimate of the total number of lampreys present instream and to collect biological data (gender, length, and weight).

This method is implemented in such a way as to avoid imposing a significant level of control on the population being assessed and confounding the data. Experimental assessment alternatives rely on capturing an acceptable number of spawners to provide a recapture number for mark-recapture studies conducted at the transformer or parasitic stage.

6.3.1.2. Control

The main objective of a trap operated for control is to remove as many lampreys from a system as possible in an attempt to reduce the production of sea lamprey transformers. The number of spawners that would need to be removed to reduce the production of sea lamprey transformers has not yet been defined. As understanding of the stock-recruitment relationship increases, the percent of the stream spawning population that needs to be removed for control will become more apparent. A stock-recruitment model developed for the St. Marys River suggested the population of the present spawning run (~25,000 annually) would have to be reduced by about 90% before it would begin to affect recruitment. We do not achieve this rate of capture with our current approach to trapping.

An additional consideration related to control is the effect of spawner removal by traps and its relation to potential barrier inundation. As lamprey congregate below a barrier, there is potential for them to bypass the barrier during high water. Congregated lampreys removed by trapping would be unable to pass the barrier during a flood event. However, there is no data to support what level of removal and when it would need to take place to have a measurable effect.

6.3.1.3. Harvest

The purpose of a trap operated for the harvest of spawning-phase sea lampreys (males and/or females) for the SMRT program is to remove and maintain the health of the captured lampreys until they can be transported to the sterilization facility. This type of removal may or may not have a significant effect on reducing the stream population depending on its operational protocol. A trap operated solely for harvest would only be operated during a portion of the run when numbers are high and it is early enough in the run for the animals to be useful. Therefore, a significant number of lampreys may still be available to spawn in the stream.

6.3.1.4. Research

About 15,000 (1998) spawning-phase sea lampreys are currently used for research purposes each year. As lamprey mechanisms continue to be a focus of researchers and the search for alternative control options continues (attractants and/or repellants), the potential exists for traps to be operated solely for the collection of research animals. The objective of such traps would be to collect enough lampreys to meet the requirements of the research study designs.

6.3.1.5. Combined Purpose

Traps can be and are operated for more than one purpose. Currently (1998), we have several examples of single traps being operated for assessment, harvest of males for the SMRT program, and research. Also, trapping on the St. Marys River is part of an integrated approach to control on that river as well as providing assessment and harvesting of males.

6.3.1.6. Additional Considerations Relating to Trap Purpose

Trap purpose plays a role in the access and service design. A trap operated for the harvest of males may require holding capabilities to contain the lampreys until they can be transported to the sterilization facility. Since preservation of lamprey health is important in this process, there may also be servicing considerations that need to be addressed, such as sorting areas or fish truck access (see servicing features section).

6.3.2. Trap Location

Locating a trap is predicated on two areas of consideration. The first, the biological, relies on predicting lamprey behavior and judging where along the barrier face lampreys are expected to be attracted to or congregate or where they can be successfully led (see Behavioral Characteristics section). The second, the engineering, encompasses the practical design/construction considerations including costs.

6.3.2.1. Preliminary Engineering Considerations

Permanent traps must be sited to take advantage of stream characteristics, barrier style, and lampreys' natural tendencies when migrating upstream. This is best achieved by designing the trap in conjunction with the barrier so that a balance can be achieved between the objectives for each while meeting the many design parameters. For very large systems it may be helpful to have some behavioral studies done prior to the barrier/trap design process. Traps will be more efficient if placed where the lampreys tend to naturally lead. Telemetry, underwater camera, and SCUBA have been used in the past in an attempt to identify sites for trap placement. Telemetry may be more useful for siting traps at existing barriers/dams.

6.3.2.2. Site Visits

Site layout will have an effect on where the trap is located in relation to the barrier. Each new site must be visited at the beginning of the design process to assess the streams physical characteristics and determine the optimum location of the trap.

6.3.2.3. Location Criteria/Requirements

Traps may either be constructed on the bank or out in the stream flow. While a trap in midstream (e.g., Stokely Creek) may be closer to the deepest part of the stream, it poses efficiency and operator safety concerns, is more difficult to impossible to service in high water, increases the risk of losing lamprey above the barrier, and becomes a harmful target for jumping fish. It is more beneficial to physically alter the stream profile directly below a trap to make the trap site the deepest part of the stream than to continuously deal with the servicing difficulties associated with locating a trap in the middle of the river.

Factors that must be considered in determining trap location and preferences include:

- As near to the face of the dam/barrier as possible,
- Adjacent to shore,
- Where there is enough space for the size of trap needed,
- Where there is enough room to service the trap,
- Where there is enough room to access the trap,
- On the side of the river where lampreys are expected to approach, where attractant discharge is available, or where they can be led, and

- Where trap and entrance will remain in water (and retain enough water within) during length of trapping season.

In addition to the above considerations, trap designed into fishways need to address the following:

- Be located at a point where the lampreys are reasonably committed and more likely to remain in the fishway.
- Be located at a point where lampreys can no longer proceed upstream.
- Be located where stop logs (if being used) will be set low enough prior to trap location to allow lampreys to approach trap, yet high enough at trap location to stop upstream movement).

6.3.3. Trap Features

Once a site and location for a trap has been identified then the size and type of trap is determined. Since there is a level of comfort in being able to read that an "optimum" trap exists, a description of the most common type of trap will serve as this model. However, each site must be considered unique and flexibility to adapt to each site will remain as the overall guidance. The "optimum" trap is described is section 6.3.3.2. The recommended funnel with this trap is described in the fifth paragraph of section 6.3.3.7.

6.3.3.1. Trap Size and Type

Trap type depends on the trap purpose and the maximum expected catch from the time period between servicing. Presently, there are two general types of permanent traps being designed into barriers. Each of these types has two servicing options.

1. The first trap type consists of a permanent box constructed from the same or similar materials as the barrier. Lampreys are removed from the trap by servicing personnel with a dip net while standing either outside or inside the trap.
2. The second trap type is a permanent box or box frame outfitted with a removable inner cage. The box or box frame is constructed from the same or similar materials as the barrier. The removable cage serves as the trap and is usually constructed from a combination of expanded metal, steel mesh, and angle iron or aluminum. The trap is lifted out of the water in order to retrieve the catch. The catch is either emptied through a door on the bottom (or side) of the trap or dipped from a partially lifted trap. These may be referred to as semi-permanent traps since a part of the structure is permanent (remains in place year-round) and other parts are removed at the end of the trapping season. For the purposes of this protocol, the term permanent trap will include semi-permanent traps.

An adult assessment biologist/technician will work with the engineer on the project to determine the type of trap to be designed based on maximum expected trap catch, trap purpose, and trap depth. In general, traps will be designed for dipping unless trap depth is greater than 1.8 m (6 ft.) and/or the maximum expected catch between servicing is greater than 2,000 lampreys. This is not a rigid guideline. There may be other factors (trap purpose) that will call for a lift trap even when these guidelines are met. The decision will be the responsibility of adult assessment personnel.

6.3.3.2. Dip Trap, Net-Dipped By Personnel Standing Outside/Inside Trap

This is the most common type of permanent trap constructed to date (1998). It is essential that a trap be large enough for an operator to climb down inside and have room to maneuver a dip net to remove lampreys. Even a trap that will be serviced with a dip

net from outside the trap must provide room for an operator to enter and use tools to shovel out silt/sand deposits, make repairs, or free a jammed funnel. Minimum dimensions for a trap designed for servicing with a dip net is 0.9 m x 1.5 m (3 ft. x 5 ft.). Trap depth will not exceed 1.5 m to 1.8 m (5 ft. to 6 ft.). It is recommended that trap depth not exceed 1.5 m (5 ft.), because if it does it may be considered a confined space as defined by OSHA (Regulation 1910.146 Appendix A). A confined space requires a permit entry program that may substantially complicate employee/contractor operation. Trap depths exceeding 1.8m (6 ft.) make dipping difficult and a lift and empty or partial-lift and dip method should be considered.

6.3.3.3. Lift Trap, Lifted and Emptied, or Partially-Lifted and Dipped

There will be times when a lift trap is a better choice than a dip trap. Most notably, when trap depth exceeds 1.8 m (6 ft.), a large number of lampreys are expected to be captured, and/or preservation of lamprey health is required. Lift traps must fit snugly within the well, having just enough latitude to avoid jamming (usually a couple of inches on each side of the trap). There are two options for servicing a lift trap: (1) lift and empty, and (2) partial-lift and dip. The lift and empty option consists of a trap that is lifted out of the water by some type of hoist. The catch is emptied through a door on the bottom (or side) of the trap. When a large catch of lampreys are trapped and need to be sorted on site, the trap will be designed so that it can be partially lifted. This partial-lift ability will allow servicing personnel to dip and sort workable portions of the catch without compromising lamprey health. This is accomplished by allowing lampreys to remain in water until they are processed. The partial-lift and dip technique requires a trap opening on the top that will not interfere with lamprey removal using a dip net. This type of trap will require more maintenance than a dip trap, but has significant servicing advantages.

6.3.3.4. Servicing Flow

Water flow and level in the trap will most likely not be the same when the trap is fishing verses when the trap is serviced, and will need to be adjusted accordingly. Trap design must provide mechanisms for controlling the level of water in the trap, and the amount of inflow/outflow from the trap.

6.3.3.5. Trap Height

Since temperature plays a significant role in when lampreys will first enter a stream, this factor will affect the design considerations for trap height. The trap will be built so that it can be serviced during the flow regimes expected when the water reaches these temperatures. An analysis of the stream's discharge levels will be required to determine trap height. Trap height must be above the level of the water so the top trap doors can be opened and water will not pour in (higher than crest height plus a reasonable water column).

6.3.3.6. Trap Walls and Floor

To prevent the servicing net or inner cage (lift trap) from snagging or hanging up during lifting, and to prevent fish/lamprey from finding areas to escape capture, the walls and floor must be constructed of a smooth concrete or steel plate set in straight lines. Steel plate could even be used to line a concrete trap to minimize water erosion. The floor of the trap may be elevated slightly above grade to minimize silt buildup so the bottom of the entrance is flush with the floor. If not, the trap floor may be flush with grade or even sunk below if considered advantageous.

6.3.3.7. Trap Entrance/Funnel

All traps have an entrance/funnel combination. The entrance is the first thing the lamprey encounters on approach to the trap. In general, the entrance is the fixed part of the trap (the hole which lampreys enter through in the concrete/sheet piling). Behind the entrance is the funnel that tapers to the funnel opening.

Entrance dimensions will vary with the type of barrier and must be considered when addressing attractant water requirements. In general, entrance dimensions will be designed to accommodate the expected attractant water discharge. Larger entrances will be designed when more attractant water is to be expelled. The entrance of a trap constructed within or upstream of the barrier is located in the face of the barrier. The entrance of a trap on the downstream side of the barrier is near the face of the dam and located at right angles to the barrier. A second entrance may be located on the downstream side of the trap. The stream profile may require some alteration to locate the entrance in an ideal spot. Such a modification should carry a sufficient distance downstream to minimize hydraulic effects.

The most successful entrances to date (1998) are square or rectangular, which remain largely underwater at even the lowest discharges expected. The entrance will be located 15.2 cm to 20.3 cm (6 in. to 8 in.) off the floor to provide a catch basin effect in the trap. By raising the entrance, it will not be blocked by sand/gravel/stone deposition immediately below the barrier. In shallow streams there is an ongoing concern that under low water conditions the water level may drop to the point there is insufficient water in the trap to safely hold any number of lamprey. Indeed the tail water might conceivably fall low enough that the entrance is totally exposed. This can be avoided by installing a sheet pile or other wall at the downstream edge of the plunge pool to control the pool level (Stokely and Duffins Creeks); designing the trap with grade-level entrance inclining up into the trap; or installing a sunken trap (Humber River). In deep water, the entrance will be centered about 30.5 cm to 61 cm (12 in. to 24 in.) below surface.

Funnels provide a taper to lead lampreys into the trap and make it more difficult for lampreys to escape once they have been caught. Funnels (normally constructed of screen mesh) are fitted to the inside of the entrance and taper to a square or circular opening sufficient in size to minimize escapement while keeping larger fish out 5.1 cm to 7.6 cm (2 in. to 3 in.). A funnel may also be designed to taper to a vertical slot. While square/circular funnels are more commonly employed, the use of vertical slots can increase the available column being fished and adjust to fluctuating water levels. Vertical slots are still being experimented with and no ideal design for this type currently exists.

There are several examples of successful funnel types currently being used. The funnels on many successful Canadian permanent traps taper from a 15.2 cm x 10.2 cm (6 in. x 4 in.) entrance to a 5.1 cm x 5.1 cm (2 in. x 2 in.) diameter square or circular opening. The linear distance between the entrance and the square/circular opening is 30.5 cm to 35.6 cm (12 in. to 14 in.). Another successful funnel type is used in Duffins Creek. This funnel tapers from a 66 cm x 7.6 cm (26 in. x 3 in.) entrance to a 15.2 cm x 5.1 cm (6 in. x 2 in.) vertical slot and has a linear distance of 33 cm (13 in.) between the two. Work on optimal funnel designs for various traps is ongoing. As methods improve, the most efficient designs will be implemented.

In designing funnels, lamprey retention is as important as lamprey capture. This may be accomplished by attaching one of several potential escapement inhibitors to the funnel opening/slot. These inhibitors allow only one way movement through the funnel apex. These include “fingers”, plastic mesh, or brush bristles. There has been limited experience and varied success with these. Care must be taken in implementing these so the advantage gained by retaining the catch is not outweighed by the reduction of catch

due to lampreys not being able to penetrate the funnel opening. Another (and possibly the most effective method) of preventing escapement is to design a double (inner/outer) funnel system. The Cheboygan River trap utilizes this type of system. The distance between the two funnel entrances is 1.7 m (5 ft. 8 in.) (from the apex of first funnel to the entrance of the second funnel is 1.1 m (3 ft. 5 in.)).

Dip traps and partial lift traps require removable funnels/baffles. These allow the funnel to be removed and replaced with a flat surface so there are no obstructions to servicing with a net and also to prevent escapement during servicing. Funnel/baffle devices will be built with handles to facilitate removal/replacement. In traps fished with inner cages, the funnels are placed inside the cage so that the cage can fit flush to the wall having the entrance.

6.3.3.8. Grates

At some sites, such as the Humber River, a grate covers the entrance on the barrier face to prevents ingress to the tunnel by fish. The design tolerances on these are close to being efficient while permitting lamprey access. Streams will be assessed on an individual basis as to whether this will be required.

6.3.3.9. Attractant Water

Because lampreys are attracted to flow, all permanent traps have been designed with a water intake to permit water to enter the trap and exit through the funnel/entranceway. This outflow of the water through the entranceway serves as an attractant. This apparent preference for larger water volumes has been catered to at many sites by providing drops in the weir crest adjacent the trap to increase the water volume near the base of the trap. The present engineering criterion calls for 0.2 to 0.3 m/s (0.7 to 1.0 ft/s) flow from the entranceway to a trap.

The intake water will feed from an opening on the upstream side of the barrier and must be located to supply adequate water under all conditions (below the lowest level in barrier crest). Water intakes that are gravity fed are preferred over mechanical/electrical options. The intake pipe is typically 10.2 cm to 15.2 cm (4 in. to 6 in.) in diameter (20.3 cm (8 in.) being nearly always too big) and should never have a major bend in it (the straighter it is the better). The intake must be protected from debris blockage by placement, screening, and baffling. Intakes will have baffles installed that are fine enough to prevent lamprey escapement via the intake and yet deflect litter without fouling (ideally a two plate or two bar system). The screening/baffling needs to be accessible for cleaning and repair.

A valve is needed on the intake (normally inside the trap) for the attractant water. The valve will be placed so that it is easily accessed from the servicing deck yet recessed to be out of the way, including its handle, during servicing. If it is not possible to avoid completely, intrusion needs to be limited to the greatest extent possible. The valve will be designed so that it will not pour where the operator will most likely be moving. Valves will be used that do not rust (PVC, stainless steel) with handles set to turn out of the way while closing off the flow during servicing. In addition, they need to be at or above crest height so that under even major rises in tail water (which affects levels in the trap) the valve is acceptably above the water to prevent upstream escapement.

6.3.4. Special Considerations for Trap Designed into Fishway

The key to a successful trap in a fishway is to design a successful fishway. The fishway entrance at a barrier is critical and should meet the same criteria listed in the trap location section of this protocol.

One type of fishway is a fish ladder. The sea lamprey trap in the Brule River is located within the fish ladder and is considered a highly successful trap. Listed below are some of the design specifications of the Brule River fish ladder/sea lamprey trap.

Design specifications of Brule River fish ladder/sea lamprey trap:

- Fishway entrance is in the deepest part of the river channel,
- Ladder has 10 steps,
- Entrance to lamprey trap is in the 6th step of the ladder (about 21 m (70 ft.) from fishway entrance,
- Height of stop gate is set at 38.1 cm (15 in.) when water temperature is below 50°F; 45.7 cm (18 in.) at 50-60°F; 55.9 cm (22 in.) above 60°F,
- Lip on stop gate at the top of the 6th step is 30.5 cm (12 in.),
- Trap dimensions are 3.8 m x 1.1 m (12 ft. 6 in. x 3 ft. 8 in.),
- Discharge through the ladder is about 1.1 m^3/s (40 cfs) at normal flow 4.2 to 4.5 m^3/s (150-160 cfs), with approximately 40% of this flow going through the trap (thus, the fish ladder is approximately 20% of the total river at normal flows), and
- Operated as a vertical slot fishway from September through March and as a pool and weir fishway from April through August.

6.3.5. Servicing Features

6.3.5.1. Trap Access

Trap access refers to the area provided for servicing personnel and transport equipment to reach the location of the trap within the barrier. The expected catch and trap purpose will determine what type of access is needed at the site. If the lampreys are trapped for assessment purposes, vehicular access to within a few hundred feet is probably sufficient. When lampreys are trapped for the sterile release program, it is essential to be able to access the trap within a few feet (especially when large numbers of lampreys are expected).

Steps into a trap for either servicing or maintenance may be necessary. Recessed steps built into the side of the trap would provide the best situation when dipping lamprey. Ideally, recessed steps should not extend below the level of water in the trap when servicing, to avoid creating hiding places for lamprey. Permanent steps protruding from the wall and ending above servicing water level are acceptable. A third choice would be a removable ladder (OSHA Regulation 1910.24, .25, .26, .27).

6.3.5.2. Working Platform

Some type of working platform is necessary when servicing traps. The size and location of the platform is dependent on the number of lamprey and their intended use. A 2.4 m x 3 m (8 ft. x10 ft.) working area should be built adjacent to the trap for lampreys to be sorted and checked for tags (a coded wire tag (CWT) detector setup) on site. A platform made of concrete, steel grating, or wood is preferred, but a level gravel or stone area would be sufficient (OSHA Walking–Working Surfaces Reg. 1910.21). Doors or lids covering the trap may be used as a working surface and should meet the same OSHA requirements. A 1.2 m x 1.5 m (4 ft. x 5 ft.) area would be adequate if the expected catch is small or the trap is lifted from the river and the lampreys are dumped directly into the

fish truck and sorting/tag checking is not done on site. A walkway around the perimeter of the trap will be built to provide for safe and efficient servicing.

6.3.5.3. Lift Mechanism

When a lift trap is being designed it will need a mechanism for lifting the cage from the water for servicing. The mechanism will involve a hoist with a boom or overhead framework.

6.3.6. Safety Features

The following references provide guidance for addressing safety and health concerns that may be associated with implementation of this protocol.

For the United States:

- Occupational Safety and Health Administration (OSHA)
- Code of Federal Regulations (CFR)

For Canada:

- Occupational Health and Safety Act and Regulations for Construction Projects, Revised Statutes of Ontario 1990, Chapter 0.1 as amended, Ontario Regulation 213/91, R.R.O. 1990 Reg. 834, ISBN 0-7778-2124-9
- Occupational Health and Safety Act and Regulations for Industrial Establishments, Revised Statutes of Ontario 1990, Chapter 0.1 as amended, R.R.O. 1990 Reg. 851 as amended by O. Reg. 516/92 O. Reg. 630/94 and O. Reg. 230/95, R.R.O. 1990 Reg. 834

6.3.6.1. Hand Railings

Railings will be installed around the working area if a danger exists where a person servicing the trap could fall into the river (OSHA Regulation 1910.28). If ice or debris damage during periods of high water is a concern, the railings should be removable and installed only during the trapping season. For sites where railings are not practical, safety lines and harnesses could be used.

6.3.6.2. Signs

Appropriate signs would be required if the trap compartment is considered a confined space (OSHA Regulation 1910.146). Warning signs that designate work areas requiring personal floatation devices, safety lines and harnesses, hardhats, or other personal safety gear would be site specific (OSHA Regulation 1910.132).

6.3.7. Security Features

The trap compartment should be covered with a door/lid that can be secured and locked for safety reasons and to deter vandalism. If the weight of the door required to fully cover the trap well (0.6 cm (¼in.) checker plate) is too heavy to be a single plate, then two half doors that open away from the work area, or become part of the work area are to be installed. They may open in the same direction or in opposite directions.

6.4. Skills Required

Knowledge of sea lamprey migration and trapping. An experienced adult assessment biologist/technician must be a part of the design process right from the start, including pre-design site visit, direct contact with engineer developing trap design, and review of all preliminary design drafts. Conceptual and experiential input from assessment biologist is essential.

A civil engineering technologist (CET) or equivalent can design the trap, but a professional engineer should do final review on permanent traps at barriers or large trapping facilities (i.e., spillway capacity and hydraulic blockage, moments and stability, etc.). This requirement does not apply to portable traps as standard off-the-shelf designs are used. A hydrologist may be required to develop plans for trap design and to signoff on the final design. The adult assessment supervisor must also signoff on the final design.

6.5. Level of Effort

The level of effort will vary by project and personnel involved.

7. Tools Required

Adult assessment personnel of both control agents have information on file regarding materials to be used in building traps. In general, the permanent structures will be constructed from the same or similar materials as the barrier being constructed. Trap funnels and inner cage materials are available from adult assessment personnel.

8. Information Requirements

This protocol will generate information on how to design a permanent trap at a barrier. It will require information regarding stream morphology, hydrology, and lamprey data to implement.

9. Contract Requirements

10. References

Applegate, V.C. 1950. Natural history of the sea lamprey, *Petromyzon marinus*, in Michigan. U.S. Fish. Wildl. Serv. Spec. Sci. Rep. Fish. 55.

Applegate, V.C. and B.R. Smith. 1951. Movement of a blocked spawning run of sea lampreys in the Great Lakes in the Great Lakes Trans. North Am. Wildl. Nat. Resour. Conf. 16:243-251.

Kelso, J.R.M. 1998. Radio telemetry investigations of the upstream migratory behavior of sea lampreys, including sterilized males in the Completion Report Great Lakes Fish. Comm. Great Lakes Fishery Commission, Ann Arbor, MI.

McAuley, T.C. 1996. Development of an Instream velocity barrier to stop sea lamprey, *Petromyzon marinus,* migrations in Great Lakes streams. Masters thesis, Dept. of Civil Engineering. Univ. of Manitoba, Winnipeg.

Purvis, H.A., C.L. Chudy, E.L. King, and V.K. Dawson. 1985. Response of spawning-phase sea lampreys, *Petromyzon marinus,* to a lighted trap. Great Lakes Fishery Commission Tech. Rep. 42. Great Lakes Fishery Commission, Ann Arbor, MI.

11. Use of Other Protocols

Preliminary Engineering Designs and Plans
Design Criteria for Fish Passage
Operations and Maintenance of Traps

12. Protocol Authority

Lead adult assessment personnel of the sea lamprey management program in both the U.S. and Canada are the approval authority for all processes and action of trap design that relate to this protocol. The lead adult assessment biologists also are the approval authorities for amendments to this protocol.

12.1. Allowance for Variations from Protocol

Protocol variation can only take place with the full concurrence of both the engineer and lead adult assessment person on the project.

12.2. Protocol Status and Revision

This protocol should be reviewed each time a new barrier is built to assess accuracy and relevancy.

12.3. Author and Date

K.M. Mullett, February 1999

DESIGN CRITERIA FOR FISH PASSAGE

1. Protocol Title: Design Criteria for Fish Passage

2. Protocol Business Need

This protocol is driven both by external statutory requirements and by internal GLFC commitments to minimize environmental impacts of sea lamprey control.

3. Protocol Deliverables

This protocol is intended to provide a guideline for determining which types of fish passage should be provided at lamprey barriers. It should be used for each candidate barrier site considered in the GLFC Sea Lamprey Barrier Strategy and Implementation Plan.

4. Target Audience

Engineers and biologists involved in the design of new barriers or the retrofitting of existing barriers.

5. The Jurisdiction for Protocol Use

This protocol is applicable basinwide with some jurisdictional differences.

6. Procedures

6.1. Jurisdictional Requirements

All jurisdictions within the Convention area have laws and regulations pertaining to fish passage over dams or barriers. Most require passage depending upon the discretion of an agency director or minister, subject to compensation or mitigation. The laws and regulations are briefly summarized as follows for jurisdictions with high priority barrier candidate streams:

6.1.1. Canada

The Fisheries Act (R.S., c. F-14, s. 20-22) specifies that "Every obstruction across or in a stream where the Minister determines it to be necessary…a fish-pass will be provided." If not feasible, the owner can be required to subsidize a fish hatchery. The design must be approved prior to construction; it must be provided with sufficient water flow; the ministry may in some cases share the expense; the ministry may accomplish construction itself if the owner refuses; and the ministry may remove the obstruction if it is abandoned.

6.1.2. Ontario

Section 14.5 of the Lakes and Rivers Improvement Act (R.S.O. 1990, c.L.3) states that "the Minister may ….require that the dam shall be provided with a fishway that will permit the free and unobstructed passage of fish.". Section 17.6 provides for requirement that an existing dam be retrofitted with a fishway "that will permit the free and unobstructed passage of fish up and down stream at any season of the year.".

6.1.3. United States

The Federal Power Act (16 U.S.C. 791-828c.) provides for fish passage, but applies only to hydropower dams licensed by the Federal Energy Regulatory Commission (FERC). Other dams or barriers are under the jurisdiction of the states.

6.1.4. Michigan

Section 483 (Passage of Fish Over Dams) of the Michigan Environmental Protection Act (Act 451), provides that "The department shall prescribe rules and regulations to provide for the free passage…of fish over…dams now in existence or that are or may be erected over rivers, streams, and creeks.", but allows that the provision may be abrogated if the department determines it to be impractical or unnecessary. Section 483 also states that the department shall provide owners with a "general plan" for construction of fish passage at each site; that the department shall prosecute owners in violation; and gives the department the right to construct a fishway if the owner fails to do so and to bill the county, which is directed to recover the cost via taxes.

6.1.5. Wisconsin

Fish passage is mentioned in the Wisconsin Statutes Chapter 31 (Regulation of Dams and Bridges Affecting Navigable Waters). Section 31.02 (4) states "The Department [DNR] may order and require any dam heretofore or hereafter constructed to be equipped and operated… as follows:…c) With good and sufficient fishway or fishways." The law provides that as an alternative, the owner may pay for or supply stocked game fish per an agreement with the department.

6.1.6. New York

Fish passage is not specifically legislated in New York, but is accomplished indirectly in the laws pertaining to environmental conservation (Chapter 43-B). Article 11 Section 0505 states that "Except as permitted by the Department, no person shall obstruct the passage of fish in any stream or river by a screen or otherwise.". Article 15 Section 0503-0505 describes permits required for work in water courses, and states that before granting a permit the department (NY Department of Environmental Conservation) must ascertain the effect of the proposed project on "… water, fish, and aquatic resources". Permit applications are reviewed by fisheries biologists and may include mandates for fish passage as a condition for issuance of the permit.

6.1.7. Indiana

Indiana's fish passage law is contained in its fishing regulations (I.C. 14-22-9-9). Section 9 states that "A person who owns, operates, or controls a dam…whose watershed is greater than fifty (50) square miles…may be required to construct and maintain…(1) Fish ladders on the dam sufficient to allow the fish below the dam to pass over the dam into the water above the dam." Small-boat portage paths are also required. The fish ladders are to be "constructed in the manner and of the materials that are prescribed by the director (of the Indiana Department of Natural Resources)".

6.1.8. Ohio

As in New York, fish passage is not specifically legislated in Ohio, but is addressed indirectly in the procedure for obtaining an Ohio EPA Section 401 Water Quality Certification. The permit application must contain an analysis of alternatives to the project and for each, it must give a description of how the project will adversely affect animal life, including sport and recreational fishes, and rare, threatened, or endangered animals. The application is also reviewed by the Ohio Department of Natural Resources Division of Wildlife (which includes jurisdiction of fisheries), who provide written comments that may result in requirement of a fishway.

6.2. GLFC Direction

The GLFC in its Strategic Vision for the 1990s (GLFC, 1992) expresses its desire to provide a sea lamprey management program that is ecologically sound. In its current policy statement and guidelines for the barrier program (GLFC, 1993), the GLFC expresses its intention to develop a barrier program with concern and sensitivity to the conservation of other ecological values. It further states that their barrier planning and design process will seek to minimize and mitigate significant environmental impacts. Impacts of barriers are either physical/chemical changes caused by impoundment or biological changes caused by blockage of fish or other organisms. Preliminary results of the GLFC-funded "Noakes study" (Noakes, et al., 1997) on barrier effects indicate that physical/chemical changes are minimal, but that barriers may have pronounced effects on certain species of fish. Provision of appropriate fish passage is a means to minimize these effects.

6.3. Fish Passage Requirements

Assessment of the need for fish passage begins with an evaluation of fish species present, both anadromous and riverine, the necessity of passage for each species, and a determination of the technology best suited to pass the assemblage of species needing to be passed. This process should always be engaged in with the full cooperation and participation of the cooperating agency with jurisdiction over fish management. Following is an outline of the process.

6.3.1. Determine Species Present

Existing fish data are gathered per protocols entitled Reach Selection and Site Selection. At this point, cooperating agencies are consulted and data is drawn from control agent records and other sources. Particular attention is paid to game fish, endangered species, and other species that may be the subject of restoration efforts.

6.3.2. Review Species Data in Relation to Barrier Site and Habitat Location

Review with agency personnel the species present and solicit their agreement as to the accuracy and completeness of the list. At this point, the need for further study may be identified using sampling protocols for the jurisdiction or the draft GLFC protocol for fish studies.

6.3.3. Species of Concern

Determine for species of concern whether the proposed barrier will isolate critical habitat, or whether the barrier is otherwise likely to have a deleterious impact on these species. Timing of fish spawning runs or other movements necessary to the fishes' life cycle must be evaluated to determine whether they can be accommodated by a "temporary barrier", such as a adjustable-crest or electrical barrier. A list of target species is compiled. As a minimum, fish passage needs identified by agency biologists must be met in order to obtain the permits and approvals required for barrier construction. Future direction from the GLFC, driven by environmental goals and standards, may mandate that additional species be passed (see protocol Environmental Effects Evaluation).

6.3.4. Establish Fishway Goals

Once target species are established, each fishway should have a clearly defined and explicitly stated goal. Without a predetermined goal, it is impossible to measure effectiveness (see Section 6.7 Evaluate the Fishway During Operation). Goals for fishways will vary from site to site, can be short-term or long-term, and can be broadly or narrowly stated. For example, a goal can be set to "pass riverine and anadromous fishes". In this case, success can be measured by direct observation of species using the fishway. Or, the goal can be stated as "pass 90% of the annual steelhead run". Evaluation might then entail continual monitoring of the run, annual population estimates, and mark-recapture studies.

6.3.5. Engineering and Hydrology Factors

Evaluate engineering and hydrology factors that may define potential options in the selection of fish passage design, including stream hydrology/hydraulics, space limitations on site, and cost (see protocols Hydrology and Hydraulics in Barrier Design and Preliminary Engineering Designs and Plans). Understanding stream hydrology and correctly estimating the flows at which fishways will have to function properly are critical both to barrier and fishway design. Some fishway types are not suitable for hydrologically unstable streams, or require more space than is available at the site. The cost of a fishway can in some cases exceed the cost of the barrier itself, and may skew benefit/cost ratios.

6.4. Engineering Design Options

Determine technology compatible with engineering requirements that are suitable to pass the targeted species or assemblage of species. Fish passage technologies suitable for use at lamprey barriers can be roughly divided into two groups: a) those that pass only jumping fish and, therefore, block lampreys, and b) those that pass non-jumping fish, and, therefore, require operation as trap-and-sort facilities during the lamprey run in order to avoid passage of lampreys above the barrier. Jumping fish are exclusively salmonids, although some sucker species have limited capability to jump. Pacific salmon (*Oncorhynchus kisutch* and *O. tshawytscha*), Atlantic salmon (*Salmo salar*), and steelhead (rainbow trout *Oncorhynchus mykiss)* are considered excellent jumpers, and can clear two to three meters or more in some situations. Brown trout (*Salmo trutta*) and brook trout (*Salvelinus fontinalis*) are considered to have poorer jumping ability. All other Great Lakes fishes should be considered non-jumping.

6.4.1. Passage for Jumping Fish Only

Jumping pools are the simplest form of fish passage used at lamprey barriers and consist of providing a pool area below the barrier of sufficient depth for a fish to accelerate to a speed necessary to jump high enough to clear the barrier crest. It is recommended that a minimum depth of one and one quarter times the average drop be maintained to allow passage of large salmonids over fixed- and adjustable-crest barriers of up to one and one half meters in height.

Pool and weir fishways are fishways in which pools are arranged in a stepped pattern and are separated by overflow weirs. If barrier height exceeds the jumping capability of target fish, or in the case of an electrical barrier where salmonids are the target fish, jumping fish can be passed and lamprey excluded by provision of a pool and weir fishway, designed with a head differential between pools of at least 30.5 cm (12 in.).

Some pool and weir fishways are designed with submerged orifices in the weirs to facilitate passage of certain species. Inclusion of submerged orifices will obviate the lamprey blocking advantage of these fishways unless at least one weir is left without an orifice.

Pool and weir fishways require a great deal of space, due to minimum requirements for pool size, but will operate with very little water, to the point that additional attraction water is often needed. They are sensitive to changing headwater levels, hence are unsuited to streams with large stage variations.

6.4.2. Passage for Non-jumping Fish

Denil fishways are chutes with baffles extending from the sides and bottoms that are angled upstream. The roughness caused by the baffles slows the flow enough that fish can negotiate it. Denil fishways accommodate more species of fish than other types of fishways and have been used successfully for passing a wide variety of riverine and anadromous fish. Denil fishways function in a wider range of flow conditions than pool and weir fishways. They resist sedimentation but are vulnerable to obstruction by debris.

Vertical slot fishways are similar in construction to pool and weir fishways, but water flows through a vertical opening in each weir, rather than over the crest. Like the Denil fishway, vertical slot fishways have been successfully deployed to pass a large variety of riverine and anadromous fish. The primary advantage of vertical slot fishways is that they are hydraulically self-regulating through a large range of water levels, hence they are appropriate for streams with large stage variations.

Locks and elevators have not been used at sea lamprey barriers, but should be considered an option. Locks and elevators attract fish to a water-filled chamber at the downstream side of the barrier, and they are then transported to the upstream side for release. The advantage of this approach over other fishways is that large numbers of fish can be handled, and that target species that do not move well through fishways can be accommodated.

Liftovers (also known as trap and haul) Depending on the goal of fish passage, it may be feasible to collect manually, by seining, electroshocking, or dipnetting, a prescribed number of individuals of a species and to move them above a barrier. This could also be done to improve the performance of a fishway that may not pass a particular species in the desired numbers or where the cost of a conventional barrier is cost prohibitive.

6.5. Additional Considerations

Descriptions of fish swimming and jumping ability can be found in Bell 1984, Kynard 1993, and McAuley 1996. Descriptions of the preferred fish behavior patterns (i.e., swimming at the bottom through orifices, avoidance/attraction to light, day/night movements, etc.) can be found in a wide variety of unpublished sources and "grey literature", mostly consisting of agency internal reports.

Knowledge of lake sturgeon (*Acipenser fulvescens*) passage is in a developmental phase. Research on swimming ability and behavior at dams is ongoing. Lake sturgeon are classified as endangered or threatened in many Great Lakes jurisdictions. In the absence of demonstrated methods of passing sturgeon, it is unlikely that agencies would issue permits for lamprey barriers streams where sturgeon passage is required.

Detailed engineering and design guidance for fishways is given in Clay 1995, Bell 1984, and Katopodis 1992. In order to pass riverine species, it is generally recommended that

the slope of fishways be no more than 10%. The location of the fishway entrance and the amount of attraction water provided are critical to the success of fishways. Pool and weir fishways are frequently the least expensive, while Denil fishways are usually less expensive than vertical slot fishways (Katopodis,1992). Katopodis (ibid) cites a range of costs per meter of vertical rise for fishways in Canada and the U.S.

Fishways can be paired with adjustable-crest lamprey barriers for very inexpensive and efficient fish passage. Because the vertical drop is maintained at a constant 45 cm, the fishway can be very short and operate at low water velocities. The vertical slot, trap-and-sort fishway at the Big Carp River inflatable barrier near Sault Ste. Marie, Canada passes small non-game fishes through an upstream screen that traps larger fish and lampreys.

Jumping pools, pool and weir fishways, Denil fishways, and vertical slot fishways have all been used successfully at sea lamprey barriers. It must be noted that there is no single solution for fish passage at any site; effective fish passage design requires good communication between engineers and biologists and a thorough understanding of the particular stream hydrology and site characteristics.

The USGS/BRD S.O.Conte Anadromous Fish Research Lab has prepared a bibliography of fish passage literature. It is available from their web site at http://www.lsc.nbs.gov/cafl/passage.htm.

6.6. Operation and Maintenance Needs and Schedules

A common cause of fishway failure is inadequate attention to operation and maintenance, e.g., siltation, obstruction by debris, failure to adjust gates and stop logs, etc. At the point that a fishway is included in a barrier design, consideration of whom will be responsible for day to day maintenance, particularly when a labor intensive daily trap-and-sort operation is required. Maintenance and operation activities and their frequency need to be specified in detail, whether performed under an agreement with another agency or by contract. Details pertaining to the operation and maintenance of fish passage systems are described in the protocol Operations and Maintenance of Fishways.

6.7. Evaluation of the Fishway during Operation

An often ignored aspect of fishway design and installation is evaluation. In order to determine a fishway's success at reaching goals prescribed by permits or internal GLFC goals, it will be necessary to conduct an evaluation.

If fishway goals are stated simply in terms of passing various species, they can be evaluated by direct observation of fish moving through the fishway or by sampling fish upstream. If goals are stated numerically, fish can be counted when sorted from lampreys and released; video or hydroacoustics can be used; or mark-recapture studies can be done. When the goal is to pass a certain percent of the population of a species, evaluation will require mark-recapture studies and possibly the use of telemetry.

The American Fisheries Society is currently in the process of preparing a document offering guidelines for fish passage evaluations (American Fisheries Society Bioengineering Section, 1999). It can be viewed or downloaded at http://biosys.bre.orst.edu/afseng/news.htm#passcomm.

6.8. Adjustment of the Fishway Depending on Results of the Evaluation

Fishways usually need adjustments to function optimally. If fishways are not meeting stated goals, environmental costs of lamprey barriers may exceed benefits, and permits

or approvals may be withdrawn. Some causes of fishway failure include inappropriate operation (which may result in lamprey passage and thus failure of the barrier), too little attractant flow, poorly placed entrances and exits, poor hydraulic conditions, and inadequate maintenance. Retrofits or changes in operations and maintenance procedures can usually address these problems and maximize the benefits of fishways.

6.8. Skills Required

A barrier practitioner with fishery experience should determine fish passage needs and goals in conjunction with state/provincial/tribal/First Nation agency staff. Since fishways are an integral part of barrier structures, have a fisheries biologist provide conceptual and experiential input to the design requirements. A professional engineer, preferably with prior experience in fish passage design, will develop the design and plans to make sure it will last. The design must be integrated as a whole within the barrier itself.

6.9. Definitions

Denil fishways - chutes with baffles extending from the sides and bottoms that are angled upstream.

Pool and weir fishways - chutes in which pools are arranged in a stepped pattern and are separated by overflow weirs.

Vertical slot fishway - chutes with pools separated by weirs with water flowing through a vertical opening in each weir.

7. Tools Required

8. Information Requirements

9. Contract Requirements

Barrier program staff and cooperator agency personnel will determine fishway needs and goals. Engineering and design will be done by a barrier engineer in most cases but could be contracted to the FWS or to an engineering consultant.

10. References

American Fisheries Society Bioengineering Section, Ned Taft, Chairman, 1999. Guidelines for evaluating fish passage technologies. Draft document of June 9, 1999,

Bell, M.C. 1984. Fisheries Handbook of Engineering Requirements and Biological Criteria, U.S. Army Corps of Engineers, North Pac. Div., Portland, OR. 290 pp.

Clay, C.H. 1995. Design of Fishways and Other Facilities, Second Edition, Lewis Publishers, Boca Raton, FL. 248 pp.

Great Lakes Fishery Commission, 1992. Strategic Vision of the Great Lakes Fishery Commission for the Decade of the 1990s. 40 pp.

Great Lakes Fishery Commission, 1993. Policy Statement: the Role of Barriers in an Integrated Sea Lamprey Control Program and Guidelines for the Sea Lamprey Barrier Program. 6 pp.

Katopodis, C. 1992. Introduction to fishway design (unpublished working document), 68 pp. and Addendum, 1994. Xx pp.

Kynard, B. 1993. Fish Behavior Important for Fish Passage, *in* Fish Passage: Policy and Technology Symposium, Bioeng. Sect. AFS, Sept. 1993, Portland, OR.

McAuley, T.C. 1996. Development of an instream velocity barrier to stop sea lamprey (*Petromyzon marinus*) migrations in Great Lakes streams. Univ. of Manitoba M.Sc. thesis 104 pp plus append.

Noakes, David, L.G., Robert L. McLaughlin, Jeffry R. Baylis, Leon M. Carl, Daniel B. Hayes, Robert G. Randall, 1997. The effects of low-head barriers on stream fish communities: magnitudes and mechanisms of impact, GLFC Project Progress Report, 29 pp.

11. Use of Other Protocols

Reach Selection

Site Selection

Preliminary Engineering Designs and Plans

Operations and Maintenance of Fishways

Environmental Effects Evaluation

12. Protocol Authority

Subject to requirements by jurisdiction and direction from the GLFC based on the protocol Environmental Effects Evaluation.

12.1. Allowance for Variations from Protocol

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3. Author and Date

Ellie Koon, March 1999

USE OF CONSULTANTS BY THE GLFC

1. Protocol Title: Use of Consultants by the GLFC

2. Protocol Business Need

From time to time there is a need to contract for the services of consultants. The term consultant is widely defined and includes firms providing professional services from the applied sciences (engineers, surveyors, and hydrologists) and the environmental sciences (ecologists, biologists). The need may be created by:

1. A shortage in the internal engineering capacity of the control agents to meet project deliverables and timelines,
2. Additional specialized engineering skills are required outside of the core competency of control agent staff (e.g., mechanical, electrical, hydrological, surveying, systems, and geotechnical engineering),
3. To access proprietary technology available only through sole source (e.g., electrical barriers), and
4. To meet state/province licensure requirements for engineering designs and plans in jurisdictions where barriers are to be constructed.

3. Protocol Deliverables

The protocol applies only to the acquisition of external consulting services from the private sector directly by the GLFC. Use of the protocol is dependent on the number, location, and types of barrier projects under consideration. The protocol defines a process for the competitive selection of qualified consultants and awarding and managing contracts. The protocol is scaled to the value of each individual engineering project deliverable.

The direct selection and contracting of consulting engineering services by the control agents requires use of their respective procurement and contracting procedures.

4. Target Audience

The Canadian Barrier Coordinator is designated to act on behalf of the GLFC in managing the technical aspects of this protocol. The GLFC Secretariat will manage the administrative aspects of the protocol, including procurement and contracting. The Division of Engineering of the FWS, Twin Cities, Minnesota will provide engineering oversight and contract management for BAWP planned projects which they have chosen to complete in the U.S. portion of the Great Lakes Basin.

The barrier coordinators, in cases where they need short-term consultant assistance on other projects in the U.S., whether foreseen in the BAWP or unforeseen, will manage the technical aspect of this protocol with GLFC Secretariat managing the administrative aspects.

5. The Jurisdiction for Protocol Use

The protocol applies only to those engineering services acquired directly by the GLFC. These services may be required anywhere in the Great Lakes Basin.

Engineering services directly acquired for the program by the control agents are not included in this protocol as other government procurement policies take precedence (i.e., U.S. Federal Acquisition Regulations-FAR, Government of Canada Supply and Services).

This protocol does not include engineering services that might be contracted through an engineering department of a barrier cooperator and/or barrier owner in a partnered cost sharing arrangement (i.e., government agency or institution such as a state, province, tribal or First Nation agency, regional

water authority, utility). Such arrangements would be subject to negotiation of a MOA requiring approval by the GLFC on a case-by-case basis.

Depending on the location of the contracted work, specific state, provincial, and/or federal professional engineering licensure requirements may apply as well as jurisdictional requirements for legal contracts, labor codes, and workers' health and safety.

6. Procedures

6.1 Scope of Contracting Requirements

There are four scales of engineering contract requirements for the barrier program. These are in the context of the total planned construction budget for an individual barrier project. The scales are:

1. Small barrier projects with total construction budget not to exceed $100,000 U.S. per project,
2. Medium barrier projects with total construction budget ranging from $100,000 to $300,000 U.S. per project,
3. Large barrier projects with total construction budget ranging from $300,000 to $1,000,000 U.S. per project (this range constitutes the majority of projects listed in the Barrier Strategy and Implementation Plan), and
4. Very large barrier projects with a total construction budget in excess of $1,000,000 U.S. per project.

In addition, the Engineering Unit of the DFO-SLCC requires short-term on demand engineering services contracts consisting of hours to days of a professional engineer or surveyor time, the total cost of which is not to exceed $5,000 U.S. per contract. These will be administered at the discretion of the Engineering Unit using local engineering firms on a roster rotation basis without the need for the formal Request For Information (RFI) and Request For Proposal (RFP) processes indicated in the following sections.

The GLFC Secretariat administration requires short-term on demand legal services contracts with law firms licensed in the jurisdiction where the engineering service contracts are to be issued (see Section 9). These services will be acquired at the discretion of the GLFC Secretariat.

6.2 Consulting Services Required

Services may be required and are not limited to the following:

1. Engineering services as a sub-component of the engineering on an individual project,
2. Complete final engineering, specifications, and drawings for an individual barrier project,
3. Engineering project management for one or more barrier projects,
4. Independent third party engineering supervision/inspection of one or more barrier construction projects,
5. Preliminary engineering design and planning services including permit applications,
6. Services of registered professional engineers, environmental scientists, biologists, ecologists, land surveyors, geotechnical engineers, and professional hydrologists for engineering and environmental studies, or

7. Provision of a contract engineer to provide on-site services to the DFO-SLCC Engineering Unit.

6.3. Rationale for Contractor Selection

The barrier program does not constitute a large sustained market for the private engineering/surveying services sector. Total annual budget for such services is expected to vary in the range of $50,000 to $150,000 per year. As such it may not be attractive to the larger diversified multinational engineering firms. It is more attractive to small local engineering firms, which deal with small resource industries and municipalities. Such firms possess local knowledge of permitting requirements, and have staff with appropriate professional licenses to practice in the state/province where a barrier is to be constructed. There is a need to streamline the selection process for engineering firms used in the program without placing an excessive administrative burden on the limited staff of the DFO-SLCC and the GLFC.

6.4. Prescreening Consulting Engineering Firms

It is anticipated that a list of four to six engineering firms that are prescreened on an annual or multi-year basis will be sufficient to meet the requirements of small to very large project scales (Section 6.1 items 1 to 4).

Based on the Barrier Annual Work Plan protocol, project plans for the following fiscal year and the one two years hence are made. This requires knowledge of potential sites, budgets, jurisdictions, and partners where barriers are planned. These plans will form the basis for defining requirements for outside consulting services.

During planning, the Division of Engineering of the FWS, Twin Cities, Minnesota will identify which projects they will provide engineering oversight and contract management for in the U.S. portion of the Great Lakes Basin. A process for screening and prequalifying engineering services firms will be initiated as required and consist of the following general steps:

6.4.1. Develop a Request for Information

Develop a Request for Information (RFI) document in which you:

1. Define the process for preselection (that it is a prescreening process that will establish a short list of qualified firms which will be subsequently requested to competitively bid by short form RFP on individual projects as they arise),
2. Description of the short form RFP process that will follow for eligible contractors,
3. Summarize the background of the projects that may be issued in the course of the next two to three years and the estimated budgets (with appropriate caveats that such work is subject to GLFC project approval and available funds),
4. Define the level of detail you need to receive- namely the firm's skills, experience, references, qualifications, and professional engineering license(s) to practice in the required jurisdiction(s),
5. List your major functional and technical requirements,
6. Define the scope of potential projects,
7. Develop selection criteria,
8. Establish and brief a review panel (including FWS engineer on U.S. projects),

9. Develop a list of engineering firms (available through state/province engineering associations and other sources), and
10. Issue the RFI on a common release date and with a common closing date and place of deposit.

6.4.2. RFI Review and Selection

Evaluation of submissions and selection of the short list:

1. Meeting of the review panel,
2. Ranking using selection criteria,
3. Interviews,
4. Site visits (as required),
5. Verification of references, and
6. Notification to short list participants.

6.5. Short Form Request for Proposal (RFP)

As projects are brought forward from site selection through the BAWP and GLFC approvals, specific RFP documents will be issued in short form (technical requirements only) to those firms preselected by the RFI process. The selection will be based on criteria of design, price, schedule, and deliverables. The scope of work is drawn up by the barrier coordinators (they may involve the SLBTF if they decide to do so).

6.6. Special Conditions

Under special conditions, waivers of competition may be required and sole sourcing authorized on a case-by-case basis by the GLFC Executive Secretary based on supporting documentation. Such conditions include:

1. Firms which are sole source as the technology used is proprietary (licensed or patented) such as with electrical barriers;
2. For contract extensions due to unforeseen circumstances such as weather, materials delivery delays, or labor disputes; or
3. Time is of the essence for emergency repairs.

6.7 Retention of Records

RFI and RFP documentation will be retained by the DFO-SLCC Engineering Unit while the files are active and made available on request by the GLFC for audit purposes if required. Original copies of all contracts will be retained by the GLFC with photocopies provided to the Engineering Unit.

On completion of contracts the Engineering Unit will, as part of the basinwide barrier inventory, retain all documentation of engineering deliverables (specifications, designs, drawings, and plans). The balance of administrative records for each completed project will be submitted to the GLFC for their record retention. The procedure will be the same for barrier projects under the jurisdiction of the FWS.

6.8. Engineering Oversight

All GLFC contracts for outside consulting engineering services require technical supervision by a professional engineer (registration in the jurisdiction where the contract is being executed is not required unless plans are to be signed and stamped by control agent engineers).

Engineers of the DFO-SLCC Engineering Unit are designated to act as the coordinating lead on behalf of the GLFC by providing engineering oversight on all engineering service contracts basinwide. They will coordinate with the Division of Engineering of the FWS, Twin Cities, Minnesota to determine which projects the FWS will provide engineering oversight and contract management for in the U.S. portion of the Great Lakes Basin.

Depending upon workloads of the control agents, the services of third party engineering inspection services may also be used (selected using the RFI process) to provide engineering oversight on construction projects.

The requirements will vary depending on the scope and complexity of individual projects. This will involve travel for site inspections and meeting with contractors. The engineers providing oversight will be required to confirm work completed and signoff invoices from contractors prior to any and all payments by the GLFC.

6.9. Skills Required

Familiarity and experience with the public administration of open bidding processes involving complex technical matters.

All contracts will require a professional engineer to oversee the development of RFI and RFP documents, review barrier construction plans and designs, and signoff on deliverables and invoices submitted to the GLFC.

6.10. Level of Effort

The level of effort is project dependent and will vary with the number and scope of projects undertaken in a year. Estimates of time and costs for this protocol are to be included in project estimates provided in the BAWP.

6.11. Definitions

RFI- request for information is a process for the prequalification of consultants
RFP- Request for Proposal
CADD – generic term used to describe computer assisted drawing/drafting software

7. Tools Required

General office automation and desktop productivity tools such as networked personal computers with software for financial management, CADD, word-processing, spreadsheets, project management, and electronic mail.

8. Information Requirements

Use of spreadsheets and project management tools to develop budgets, track expenditures, and the barrier inventory.

Records of contract deliverables (i.e., design, drawings, and specifications) for each barrier need to be retained as part of the barrier inventory based on the life cycle of barriers (50 years). The preferred means of record retention is computerized CADD files (including engineering drawings). An open systems approach is to be used, where contractors will use the computer assisted engineering tools of their choice, provided they provide all engineering drawing files in an export format which is compatible with AutoCAD (*.dxf files).

To protect intellectual property rights of the original owners of the design, the onus will be on the contractor to provide lockup security features on the engineering design files to prevent unauthorized alterations of the original (Grabowski, R., 1998 and Anon. 1996).

9. Contract Requirements

There is a need for the GLFC to retain legal council registered in the jurisdiction to prepare contracts in accordance with state/provincial laws and regulations and to represent the interests of the GLFC should there be a need in the case of contract disputes. Although standard boilerplate legal contracts are used these need to be reviewed and amended on a case-by-case basis so that they reflect current statutes and case law in order to protect the interests of the GLFC.

9.1. Intellectual Property

As an interim policy, intellectual property ownership of barrier engineering designs will follow accepted practice within each jurisdiction. This will likely involve retention of design ownership by the engineering firm. Contracts will require that plans be provided as digital files with the onus on the contractor to provide lockup security features on the files to prevent unauthorized alterations and use of originals.

Barriers represent a long-term commitment of 50 years in design life. Records of design, drawings, and specifications for each barrier need to be retained as part of the barrier inventory. The preferred means of record retention is computerized files. During the lifetime of a barrier there may be a need to access the original design files in order to determine routine maintenance requirements, modifications, and/or contingency repairs. With engineering design there are different practices that can occur with the ownership of designs, which have implications with respect to long-term liability and licensing.

10. References

Grabowski, R., Lock up your Drawings, AutoCAD User Newsletter, V.6, No.3, Fall 1998, p 6&8.

Anon., Professional Engineers Ontario Guideline-Professional Practice, Assoc. of Professional Engineers of Ontario, North York, Ontario, 1988 (revised 1996), p 19.

11. Use of Other Protocols

Barrier Annual Work Plan

GLFC Secretariat Administration and Contract Management of Barrier Program

Preliminary Engineering Designs and Plans

Final Design and Engineering

DFO-SLCC Construction Contracting and Management

FWS Construction Contracting and Management

12. Protocol Authority

Protocols will be peer reviewed and final approval will rest with the GLFC. General direction may change as a result of changes to administrative policy by the GLFC.

USE OF CONSULTANTS BY THE GLFC

12.1. Allowance for Variations from Protocol

Interpretation and approval for variations of GLFC administration policy need to be obtained in writing from the GLFC Secretariat.

12.2 Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevance after two years of use. Subsequent revisions may include further consideration of the design-build process.

12.3. Authors and Date

T. McAuley and I. Ross, March 1999

1. Protocol Title: Final Design and Engineering

2. Protocol Business Need

The purpose of this protocol is to establish basinwide procedures for developing final designs and plans and specifications for lamprey barriers, fishways, and traps to be constructed by tender with the private sector. It does not include the final engineering design and plans process for U.S. federal projects that may be built by the FWS or the USACE.

3. Protocol Deliverables

Finalized barrier construction cooperative agreement (CA) with barrier owner including the completion of all realty arrangements. Also included in the CA are operations and maintenance plans, requirements, and budgets.

Engineered design plans (drawings, specifications, schedules, and contracts) ready for competitive tenders for construction of lamprey barriers, fishways, and lamprey traps.

4. Target Audience

Procedures described herein assume that the DFO-SLCC and/or consulting engineers that may be hired through the Use of Consultants by the GLFC protocol carry out the final engineering design process. When consultants are employed, the project direction and terms of reference will be prepared by one or both barrier coordinators with technical work and plans being reviewed by the engineering coordinator who also provides technical supervision and engineering oversight to the contract.

Intended audience for protocol deliverables is the barrier owner using their procurement process for general contractors.

5. The Jurisdiction for Protocol Use

This protocol applies basinwide with jurisdictional requirements. It does not apply to projects to be constructed under U.S. federal requirements by the USACE or the FWS.

This protocol applies to engineering plans prepared for sea lamprey barriers to be constructed by barrier owners in cooperation with barrier cooperators in Ontario and the states of New York, Michigan, Ohio, and Wisconsin under a cooperative barrier MOU. Each barrier project considered between the GLFC and a barrier owner is subject to a contractual agreement between the parties known as a barrier cooperative agreement (CA) or MOA. The CA/MOA are finalized between the parties prior to construction and cover the terms and conditions for the barrier agreement over its designed lifetime of 50 years.

This protocol can apply to other states should the request and need be there. The jurisdictional requirements will normally include:

- Professional state/provincial engineering licensure,
- Applicable health and safety codes for the project jurisdiction,
- Permitting and environmental requirements within the project jurisdiction, and
- Local construction and building codes.

6. Procedures

The prerequisite to final design and drawings is GLFC approval and capital allocation to the project and receipt of all required environmental assessment and other permits from regulatory agencies that have jurisdiction over the site. Drawings and plans in electronic form developed in the Preliminary Engineering Designs and Plans protocol are used and revised here. The following steps are to be followed:

1. Finalizing CA and realty arrangements between the GLFC and the barrier owner for the site and the works to be completed (lease, purchase, easements, etc. through use of realty protocols, policies and/or procedures of the barrier owner, barrier cooperator, and/or the control agent). The GLFC does not have a realty protocol.
2. Obtaining outside services, as required, of consulting engineers using the protocol Use of Consultants by the GLFC.
3. Based on previous engineering work done for the project using the Preliminary Engineering Designs and Plans protocol, review and amend these plans based on regulatory requirements received through permits. Use sound engineering practice when reviewing and amending design plans as required.
4. Preparing flow control cofferdam and sediment control plan as required in the environmental assessment permit.
5. Preparing final drawings with construction details:
   - Preparing site plans in CADD,
   - Preparing detailed construction drawings in CADD, and
   - Use of drafting standards by jurisdiction, i.e., metric for Canada and inch/foot measurement standards for U.S., drawing title blocks, size standards.
6. Preparing construction specifications:
   - Use of industry standards and local availability for materials and construction procedures,
   - Standards for steel sheet piling, and
   - Standards for reinforced concrete.
7. Preparing final cost estimates.
8. Preparing long-term operations and maintenance manuals and budgets.
9. Preparing emergency action plans if required by regulation or permits.
10. Preparing construction project management plan and GLFC oversight requirements during construction.
11. Final GLFC and barrier owner review, approval, and funding (if costs exceed original estimates, approval for additional funds is required from the GLFC which may take six months or more to obtain).
12. Draft construction tender documentation in accordance with practice of the leading party in the barrier project CA./MOA.

6.1. Skills Required

Generally, designs will be prepared by engineers and technicians qualified in the applicable disciplines, the principal one being civil engineering. Designs (text and drawings) shall be certified and stamped by a registered professional engineer for the

jurisdiction in which the barrier is to be built. This applies also to designs prepared by consulting engineers.

6.2. Level of Effort

Two to 12 months of work of one to five professionals depending on the size of project.

6.3. Definitions

CADD – generic term used to describe Computer Assisted Drawing/Drafting software.

7. Tools Required

Tools would include normal office equipment including computers, printers, plotters, photocopier, fax, and software associated with engineering applications, such as word processing, spreadsheet, CADD, Internet, and specialized hydraulic, structural, and geotechnical analysis.

Open standards for software are to be used when contracting for outside consulting engineering services. Outsourced plans and drawings provided are to be provided in AutoCad export formats (*.dxf or *.dwg) and are to be locked as "read only" files to protect the intellectual property of the creator.

Open standards are also required for selection of construction materials with the choice being at the discretion of the project engineer. Materials to be selected are to be based on best available materials that are locally available that will meet the 50-year design life of the structure and that conform to building codes.

8. Information Requirements

This protocol is dependent upon the use of information generated by the protocol Preliminary Engineering Designs and Plans.

Site plan, design, and drawings are usually in electronic format (.dxf, .dwg) while survey and discharge data are stored in spreadsheets. There are also documents, both electronic and paper. There may be a requirement to prepare final as-built drawings in some jurisdictions.

Upon completion of construction all final engineering designs and plans, both hard copy and electronic, are to be retained by the engineer responsible for the project and become part of the barrier inventory.

9. Contract Requirements

Cooperative agreement (CA)/MOA is required between GLFC and the barrier owner
Contracts for Consulting Engineers
Memorandum of Understanding (MOU) between the GLFC and barrier cooperators (state/province) is recommended

10. References

11. Use of Other Protocols

Preliminary Engineering Designs and Plans

Barrier Annual Work Plan

Use of Consultants by the GLFC

Environmental Assessments, Permits, and Approvals Required for Barrier Construction by jurisdiction

Hydrology and Hydraulics in Barrier Design

Fixed-Crest Barrier Design Criteria

Design Criteria for Permanent Traps

Design Criteria for Fish Passage

GLFC Secretariat Administration and Contract Management of Barrier Program

Use of barrier owner, barrier cooperator, or control agent realty protocols, policies, and/or procedures for realty arrangements such as land lease, purchase, easements, etc.

12. Protocol Authority

The authority for implementing this protocol on behalf of the GLFC will be designated to the barrier coordinators with the lead assigned to the engineering coordinator.

12.1. Allowance for Variations from Protocol

Intensity and level of detail of work vary with project size. The range of construction costs from small stream to large river cover a scale of 100 fold. On larger complex projects specific requirements for mechanical, electrical, and structural engineering will be contracted out as well as those requiring state registration for licensure.

In some cases such as electrical barriers, the technology may be patented with rights to use available by license through sole sources.

12.2. Protocol Status and Revision

This is a new protocol and should be reviewed for currency and relevance after two years of use or as experience dictates.

12.3. Authors and Date

T. McAuley and I. Ross, March 1999

1. Protocol Title: DFO-SLCC Construction Contracting and Management

2. Protocol Business Need

This protocol establishes procedures for property acquisition, construction tendering, awarding construction contracts, and construction phase engineering project management in support of the sea lamprey barrier program in Ontario where the DFO-SLCC is both the leading party for construction and the barrier owner.

3. Protocol Deliverables

These procedures are followed for all barriers to be constructed in Canada by the DFO-SLCC Engineering Unit under the annual MOA with the GLFC.

4. Target Audience

This protocol applies to professional engineers and contract specialists at DFO-SLCC.

5. The Jurisdiction for Protocol Use

This protocol is intended for barriers located within Ontario, Canada, where DFO-SLCC is the barrier owner and operator, and where contract documents are prepared by agencies or contractors of the Government of Canada. Government of Canada and DFO realty and procurement policies, procedures, and protocols take precedence in this protocol.

As barrier owner the DFO-SLCC has long-term obligations for operations and maintenance of barriers. Realty arrangements with landowners are to be made as long-term (50-year) commitments either through land purchase or lease. All realty arrangements (purchase, lease, and easements) are to require legal registration on title through the appropriate registration systems in Ontario for private lands, Ontario Crown lands, or Canada Crown lands. This includes perpetual easements on upstream and downstream properties for the purpose of flood plans (if required) and for site access.

6. Procedures

6.1. Finalizing Realty Agreements with Land Owners and Adjacent Riparian Owners

6.1.1. Property Search

The DFO-SLCC property and contract manager (PCM) or the barrier coordinator arranges title searches for the barrier site(s) of interest.

6.1.2. Municipalities

1. Contact the municipal realty official,
2. Propose DFO-SLCC needs for barrier site and request a land agreement for the site,
3. Follow up with covering letter,
4. The municipal representative would have to take the proposal before the next available council meeting for approval,
5. Following council approval, the municipality draws up a land agreement and forwards it to DFO-SLCC for approval and signatures,

6. Copies are returned for their files, and
7. Most of these agreements are for a nominal fee of $1.00 per annum.

6.1.3. Crown Land

The provincial and federal land processes are similar:

1. Contact the District office of the OMNR,
2. Propose DFO-SLCC land requirements for barrier site and follow up with covering letter,
3. Application will be forwarded through OMNR for approval which could take weeks to several months; however, on occasion verbal approval is given to proceed with construction,
4. The province will survey the required lands and prepare land title agreements at a cost to DFO-SLCC,
5. Final agreement prepared by the province will be forwarded for signature by DFO-SLCC. The agreement always reserves the right by the province for title to the land if the DFO ever removes the barrier, and
6. DFO-SLCC payment for costs involved in the agreement.

6.1.4. Native Lands

1. Barrier coordinator preconsults with band executive representative,
2. DFO-SLCC contacts area band council to request permission to present DFO-SLCC barrier requirement at a band meeting. Follow up with covering letter,
3. Given band council approval, the band would either prepare a land agreement or request DFO to prepare it,
4. Both parties sign and retain copies for file, and
5. If compensation was agreed upon, payment is undertaken.

6.1.5. Private Land

6.1.5.1. Preconsultation with Owners

Ownership by private owners in the site vicinity is verified through the local Land Registry Office. In the earlier preliminary engineering stage, the DFO-SLCC engineer, while asking permission to survey the stream site, informs the owner about the program and project purpose. Where the owner shows agreement in principle towards the project and potential lease, the engineer surveys the site. If the engineer's evaluation of the site during the survey is favorable, he informs the owner that the PCM will contact them regarding a possible leasehold agreement.

6.1.5.2. Finalizing Long-Term Leasehold Agreements with Private Owners

A draft lease agreement is prepared by the DFO-SLCC PCM, reviewed by the barrier coordinator and sent to the property owner. Minor negotiations regarding annual payment amounts, access, fences, gates, etc. may follow. Both parties sign once agreement has been reached. In the past, short-term renewable leases have been used. However, it is considered in the best interest of the program that all future land tenure and easements are for a period of 50 years. Periodic payment adjustments, guided by the cost of living

index or the local tax index, can be included in the leasehold agreement. Legal registration of all purchases, leases, and easements must be placed on title.

6.1.5.3. Flood Easements

The design of fixed-crest barriers in Ontario by DFO-SLCC engineering creates minimal impoundment and heads decreasing to less than 30 cm (11.8 in.) in flows greater than the two-year flood. To date, other than for the first Echo River barrier, flood easements have not been required. If and when the necessity arises, flood easements will be negotiated and arranged with the owner(s).

6.2. Methods and Constraints in Tendering and Contracting

Tendering for bids is required on all projects except for those with a) an estimated expenditure under $25,000; or b) where only one person or firm is capable of performing the contract (Government Contract Regulations 10.2.1, Treasury Board of Canada).

Two options are available for tendering and contracting a) DFO-SLCC, or b) Public Works and Government Services Canada (PWGSC). The first Echo River barrier was engineered and constructed by Public Works in 1970. It was replaced 16 years later due to ineffectiveness.

Since 1979, tendering for all barriers (greater than 20) has been carried out by DFO-SLCC using the tender document format adopted from the PWGSC Echo River project. In-house tendering and contracting has been possible at DFO-SLCC since the hiring of an engineer in 1978. This method has shown both monetary and time efficiencies since the major part of tendering preparation is already carried out by the DFO-SLCC Engineering Unit (see section 6.3). Local construction associations are often used in the DFO-SLCC tendering process.

DFO-SLCC also has the option of using Departmental Material Management in the process. The Departmental Financial Management System (ABACUS) will generate the contract when it is encumbered. Both Departmental Financial Management and PWGSC operate on cost for service, as would a consultant.

It has been assumed at DFO-SLCC that tendering and contracting let to administration outside of the SLCC, (i.e., through PWGSC or Departmental Material Management) would be impractical due to administration and cost double-ups and distance. PWGSC, whose offices are in Toronto and Ottawa, currently contracts out about 80% of engineering projects to consulting engineering firms-a process which could be even more complicated and costly. However, the DFO and PWGSC options should be further explored. It is also in the best interest of the program to have an updated review of the DFO-SLCC tender documents by the DFO Legal Branch.

6.3. Preparation of the DFO-SLCC Tender Package

The DFO-SLCC tender package that has been used for most barrier projects includes sections entitled “Information for Tenderers”, “Form of Tender”, “Specifications”, “Plans”, “Terms and Conditions”, and “Terms of Agreement”. It may also include addenda of additional pertinent information.

1. Engineering drawings and specifications, prepared by the engineering unit under supervision of the barrier coordinator, are incorporated as the core of the bid package. The construction work involved in the project is divided into units according to methods, materials, or timing (phases).

2. The engineering unit groups the work in the "Form of Tender" according to the bid methods that are most suitable for both the type of work and for accountability and flexibility for change orders and interim payments. The bid methods are unit price, lump sum, and time and materials. Project material quantities are specified in the "Form of Tender" for unit price items. The last page of the "Form of Tender" requires the contractor to sign below his/her summary of the total bid price (with tax amounts) and the agreement to complete all work by the date specified by the engineering unit.
3. A list of "Similar Completed Contracts" is also requested of the contractor in the 'Form of Tender'.
4. The "Information for Tenderers'" section indicates tender closing date, site location, access, work start and completion dates, insurance and bond requirements, and other information deemed necessary to the contractor.
5. The "Terms of Agreement" refer to all sections of the tender package and give additional information on accounting, invoicing, holdbacks, and payments. This is the part of the contract that is to be signed by the successful bidder (selected) and the DFO-SLCC Contract Manager.
6. The "Terms and Conditions" section covers items such as diligence, responsibility, supervision, work safety permits, interpretation, extra work, theft and losses, insurance, and final payment.

6.4. Tendering Projects

Tender packages are sent out to the one or two construction associations nearest to the site. Contractors who have constructed barriers in the past are also notified that plans are available at the Construction Association. Closing dates are selected that are not co-synchronous with other major bid closings at the Association.

DFO-SLCC may also tender by mailing out the packages to contractors who have constructed barriers in the past and to contractors in the project site area. To increase the number of potential bidders, the engineering unit also looks up contractors near the site from sources such as OMNR Regional Engineering and/or the Yellow Pages. Contractors are prescreened either by their reputation with OMNR, or through a telephone questionnaire about their history of instream construction work.

A common date, time, and location for receipt of bids are clearly written in each tender package.

Technical inquiries are directed to the barrier coordinator (engineer) or his project engineer assistant.

6.5. Selection Panel and Opening of Bids

A selection panel is assembled which includes DFO-SLCC staff: the barrier coordinator, the PCM, the control supervisor and the project engineer. One or more members of DFO-SLCC management team are invited to replace those who may be absent.

Bids are opened and verified by the panel for completeness and mathematical correctness. In situations where one of the unit rates or calculations of a low-bid contractor appears to be incorrect or unusual (as compared to normal rates known to the DFO engineers), the barrier coordinator questions the contractor (by phone) as to the basis of his/her calculations and whether the contractor wants to let the number stand.

The qualifications of the lowest bidder are verified. If the low bid contractor's competence and past works are acceptable to the DFO-SLCC engineers, the bid is accepted. A low

bid from a contractor whose work history is not known requires that the barrier coordinator question the contractor's past clients which are listed in the "Form of Tender". Decision to accept the bid is based upon favorable reports from the client references. If the contractor has no experience at similar projects, or appears to be mismatched for the task, or has a negative history with either past clients or DFO-SLCC engineers, the bid is set aside, and the next lowest bid is examined. The qualification verification process is continued until the panel is in agreement on which bidder should be awarded the contract. Past history has shown the contract going usually to the lowest bidder, and on occasion to the second lowest bidder.

Bonds and insurance of the successful bid contractor are verified for due diligence by the contract manager.

6.6. Award of Contract

The PCM and the selected contractor execute the contract in the 'Terms of Agreement' of the tender package.

The barrier coordinator (engineer) arranges a site meeting with the contractor as soon as possible after contract award. The coordinator or his assistant engineer runs through essential elements of the construction project with the contractor on site. This includes plans, specifications, schedules, environmental safeguards, site-specific details, methods, etc.

Notice to proceed is given by the barrier coordinator after verifying all permits, and when the planned construction window period has been reached.

Disclosure of successful contractor and bid prices: After opening of tenders, calls by bidders are directed to the property and contract manager or the barrier coordinator for disclosure of the bid process results. A "summary of bids" sheet is made available to be faxed for this purpose.

6.7. Construction Project Management and Inspection

Quality assurance is achieved through regular inspection of the different phases of construction by a DFO-SLCC engineer and/or by a delegated technologist. The barrier coordinator determines the number and duration of inspection checks necessary. These vary with project size and complexity and could entail three site visits for a small project and up to about 12 weeks of near continual presence in a site office trailer for larger projects.

Handling of contingencies involving changes to plans requires written authorization in the form required under the terms and conditions of the contract. Change orders or additional work requested are to be signed by the barrier coordinator (engineer).

6.8. Certification of Work Completed

Invoices from the contractor for work completed (at specified time periods or phase completions) is to be authorized (signed) by the barrier coordinator (engineer) or his delegated assistant before payment can be released.

The barrier coordinator or his delegated engineer notifies the contract and property manager when substantial completion of construction has occurred. He authorizes payment to the contractor for 90% of the total bid amount (adjusted by any change

orders). An amount of 10% is held back for a period of 120 days as construction lien surety.

6.9. Skills Required

Professional engineer(s) licensed in Ontario and contract specialists with training and experience in construction contracts carry out the realty securement, the preparation, solicitation, and award of construction contracts, and the quality assurance/inspection during construction.

6.10. Level of Effort

The calendar period for solicitation and bid reception usually incurs three to four weeks. The total work time involved in tender package preparation, solicitation, and construction management amounts to between ten and 40 days for two to three persons for most projects. Very large projects could double these amounts.

7. Tools Required

Computers, printers, plotters, and software (e.g., word processing, spreadsheet, and project management) are required. Survey equipment is also necessary for layout and verification to the structures throughout the construction phase. A lockable vault is needed for storage of bids until opening.

8. Information Requirements

Copies of tender documents and records of correspondence, along with construction plans and drawings, are to be retained at DFO-SLCC in paper and electronic format as part of the barrier inventory. Some materials may require disclosure as public information under Canadian federal freedom of information legislation.

9. Contract Requirements

Annual MOA between DFO-SLCC and the GLFC
Contractual agreement (CA)/MOA with barrier owners
Standard legal contract for construction contracts

10. References

Government of Canada realty and procurement policies and procedures

11. Use of Other Protocols

Preliminary Engineering Designs and Plans

Final Design and Engineering

DFO-SLCC Administration of Barrier Program

12. Protocol Authority

Government of Canada and DFO realty and procurement policies, procedures and protocols take precedence.

12.1. Allowance for Variations from Protocol

As mentioned in section 6.2. use of PWGSC and other federal arrangements should also be further explored as options.

12.2. Protocol Status and Revision

Revision of this protocol should occur upon results of a review of the standard DFO-SLCC tender documents by the DFO Legal Services Branch. Revisions thereafter should occur every three to five years.

12.3. Author and Date

Tom McAuley, March 1999

FWS CONSTRUCTION CONTRACTING AND MANAGEMENT

1. Protocol Title: FWS Construction Contracting and Management

2. Protocol Business Need

The purpose of this protocol is to establish what procedures will be followed to address the contractual requirements of FWS regulations, as required by U.S. law, if it is the contracting agent who is to deliver all or some of the functions of the sea lamprey barrier program in the U.S. These procedures are externally driven in terms of compliance. The current MOA, between the FWS and the GLFC, outlines the annual barrier program and will identify where contracts may be required. The FWS currently uses easements and special use permits to facilitate barrier trap management. All procedures for issuing bids and awarding contracts using the FWS system will be established by this protocol.

3. Protocol Deliverables

These procedures will be followed for all barriers designed by the FWS and all contractors involved in barriers designed by agencies of the U.S. Government under agreements with the GLFC. Reports and billings will be sent to GLFC as requested.

4. Target Audience

This protocol applies to all barrier designers, engineers, contract specialists, and FWS field personnel who are involved through contracts in any or all aspects of the barrier program in the U.S. portion of the Great Lakes.

5. The Jurisdiction for Protocol Use

This protocol is designed for use in the United States. Due to the variances in law, contracting procedures, and financial and accounting procedures, this limitation must apply. Under the MOA, all activities occurring in the U.S. by the GLFC are considered as activities of a federal agency. If the FWS is involved, all applicable U.S. laws and regulations apply.

6. Procedures

Contracts between the FWS and the GLFC, outside of the MOA itself, or with any private contractor must follow the FWS and U.S. Government guidelines and requirements.

All contracts and any participation by the FWS that involves realty, construction, or significant changes to our current arrangements would require legal review by the Department of Interior Solicitor in accordance with FWS policy. Section V of the MOA covers the liability and insurance issues. The GLFC (U.S. Section), under 16 U.S.C. 931 & 937 is deemed an agency of the United States covered under the Federal Tort Claims Act, 28 U.S.C. 2671, et seq. Volunteers used by the FWS in support of GLFC work sign a form, which covers them under the same Act.

6.1. Pre-Solicitation Notices

Commerce Business Daily
Local contractors

6.2. Prepare Bid Documents Including FAR Requirements

6.3. Solicit Bids

Local contractors
Existing bidder lists

Respondents to Commerce Business Daily notice

6.4. Open Bids

6.5. Verify Bids and Contractor Qualifications

References
Bonds
Insurance

6.6. Award Contract

6.7. Submittal Delivery, Review and Approval

6.8. Notice to Proceed

6.9. Post Award Construction Management

Policies and procedures are specifically addressed in the general contract provisions and technical specifications. These requirements are in accordance with the FAR.

6.10. Skills Required

Generally, skills will vary depending on the level of involvement. The sea lamprey coordinator will coordinate with the contracting officer on all issues related to FWS involvement in the barrier program. Contracting specialists are involved where the FWS is involved in any aspects of contracting for construction or services not on the staff, such as hydraulic experts. Contract specialists employed and warranted by the U.S. Government must accomplish the solicitation and award of construction contracts.

6.11. Level of Effort

The level of effort required here is based on the implementation of a new program above and beyond the current administrative burden in the current MOA. Costs must be determined based on each individual project and level of FWS involvement. New types of contracts may need to be developed. Since the FWS has not completed a full project from start to finish, the estimated time from initial planning through completion of construction will be two to three years.

6.12. Definitions

Contracting specialists use the FAR for definitions.

7. Tools Required

Tools for this protocol would include normal office equipment including computers, printers, plotters, and software, such as word processing, spreadsheet, and special contracting procedures.

8. Information Requirements

There are no information requirements other than that supplied by the Division of Engineering and information in the solicitations for bid. Copies of tender documents and records of correspondence, along with construction plans and drawings, are to be retained by the FWS as part of the barrier inventory.

9. Contract Requirements

9.1. Construction Contracts

1. Contracts greater than $2,000 must comply with the Davis-Bacon Act requiring that certain specified minimum wage rates and benefits be paid to workers based on the location of the work and the specific trades of the workers.
2. Payment bonds are required for all work greater than $25,000 and performance bonds are required for all work greater than $100,000.
3. Construction work is subject to several business preference programs:

   (a) Small Business Competitive Demonstration Program

   1) Up to $25,000 – All projects must be set aside for emerging small businesses. An emerging small business is one whose average annual sales for the past three years are less than half the small business size maximum standard listed by Standard Industrial Classification Code in Part 19 of the Federal Acquisition Regulations (FAR).
   2) > $25,000 – (a) The small business program for construction is evaluated each year to determine if small businesses are receiving a fair proportion of work. If not, small business set-asides using FAR Part 19 - are reestablished for contracts up to $100,000.

   (b) North American Free Trade Agreement (NAFTA) – Construction projects up to $5,000,000 must be set aside for American firms. Projects greater than $5,000,000 may be competed per NAFTA.

   (c) Disadvantaged Business Special Emphasis Program – Projects are open to all responsible firms but bids are evaluated to provide a 10% bid preference to firms owned by minorities and/or women.

4. All projects estimated to exceed $25,000 must be advertised in the U.S. Department of Commerce's daily publication of projects seeking bidders. All respondents must be considered as long as they have a good record of past performance and the capability and resources to perform the work. Consideration is subject to size standards listed in item 3.
5. Contract clauses contained in FAR vary according to the size and type of project and must be included in Invitations for Bid.

9.2. Service Contracts

1. < $2,500 – May be awarded without competition but must be set aside for firms of 15 or fewer people with annual receipts of less than $1,000,000.
2. >$2,500 but <$25,000 – Must be competed with a minimum of three vendors. Subject to wage rates stipulated by Service Contract Act. Minimum wages to be paid to various categories of labor similar to Davis-Bacon Act for construction work. Must set aside for small businesses as defined in FAR Part 19 for contracts up to $100,000.
3. >$25,000 – All projects estimated to exceed $25,000 must be advertised in U.S. Department of Commerce's daily publication of project seeking bidders. All respondents must be considered as long as they have a good record of past

performance and the capability and resources to perform the work. Consideration is subject to size standards previously listed.

4. Disadvantaged Business Special Emphasis Program – Projects are open to all responsible firms but bids are evaluated to provide a 10% bid preference to firms owned by minorities and/or women.

5. Contract clauses contained in FAR vary according to the size and type of project and must be included in Invitations for Bid.

9.3. Supply and Equipment Contracts

Purchases of supplies and equipment are subject to Commercial Items Acquisition Procedures in FAR, Part 12. Streamlined procedures apply to the acquisition process itself up to $5,000,000. Special definition exists for "commercial product".

1. < $2,500 – may be awarded without competition**.**

2. $2,500 to $25,000 – Very Small Business Program. Projects must be set aside for firms of 15 or fewer people with annual receipts of less than $1,000,000.

3. $25,000 to $100,000 – Small Business Set-Aside. Must set aside for small business concerns as defined by Standard Industrial Classification Code (SIC) in FAR Part 19.

4. < $50,000 – Limited to American Firms Under Buy American Act, except foreign firms may participate with differentials added to favor American firms.

5. > $50,000 – Canadian firms' bids evaluated on equal footing with American firms. Bid differentials per item 4 still apply to firms from other countries.

6. Disadvantaged Business Special Emphasis Program – Projects are open to all responsible firms but bids are evaluated to provide 10% bid preference to firms owned by minorities and/or women.

7. Clauses are kept to a minimum to mimic commercial item acquisitions in the private sector as much as possible.

10. References

Federal Acquisition Regulations (FAR)

11. Use of Other Protocols

Delivery of actions in most protocols may require contracts between the FWS or U.S. Control Agent and the GLFC or other agencies or private contractors.

Preliminary Engineering Designs and Plans

Final Design and Engineering

FWS Administration of Barrier Program

12. Protocol Authority

All changes to the MOA or specific contractual arrangements or realty issues would require review by the Department of Interior Solicitor, Twin Cities, Minnesota, in accordance with FWS policy, before approval of the Geographic Assistant Regional Director (GEO 1) is received.

12.1. Allowance for Variations from Protocol

If variances require a change in the MOA, an amendment must be developed and signed by the GLFC and the FWS.

12.2. Protocol Status and Revision

As needed based on mutual agreement of the participants

12.3. Authors and Date

Larry W. Sisk, John Mullins, James Kelley, February 1999

OPERATIONS PROCEDURES FOR BARRIERS

1. Protocol Title: Operations Procedures for Barriers

2. Protocol Business Need

Sea lamprey barriers are used as an alternative control method in the GLFC sea lamprey program. Barriers are built on streams to prevent adult sea lamprey from reaching spawning habitat upstream. This protocol is required to satisfy business needs internal to the barrier program. Failure to implement the protocol effectively could result in lamprey bypassing the barrier necessitating a costly lampricide treatment.

(Traps and fishways can be associated with all types of barriers. See Operations and Maintenance of Traps and Operations and Maintenance of Fishways protocols for details on the operation and maintenance of these facilities.)

3. Protocol Deliverables

This protocol describes the operating procedures for three types of barriers: **fixed-crest, adjustable-crest**, and **electrical**. The protocol will be implemented during the sea lamprey spawning run. Some hybrid barriers are now under development, e.g., the fixed-crest and electrical experimental barrier on the Ocqueoc River (electrical barrier will operate when fixed-crest barrier is inundated). When these become operational barrier operations and maintenance protocols will be revised.

4. Target Audience

The barrier operations protocol will be implemented by regular and/or seasonal employees of the DFO-SLCC (control agent) or designated field staff of the barrier owners, cooperating agencies and, in some instances, personnel under contract to one of the cooperating agencies.

5. The Jurisdiction for Protocol Use

This protocol will apply to all barriers that are built on streams tributary to the Great Lakes with funding from the GLFC and that are under direct operational supervision of staff of the control agents, barrier owners, or cooperators. (This protocol will not apply to instream structures (e.g., dams) built for other purposes by private individuals, companies, or other government or cooperator agencies, that may act as de facto barriers, whether or not the GLFC has spent funds on lamprey proofing the structure.)

The only jurisdictional variation in the application of this protocol will be in the area of compliance with health and safety regulations. Personnel operating barriers will be subject to the applicable health and safety regulations in the country and state/province where the barrier is located. Tribes and First Nations may have their own or additional health and safety regulations.

6. Procedures

6.1. Operations Start-up of Barriers Prior to Sea Lamprey Spawning Run

6.1.1. Inspections

The assumption is made that barriers of all types and barrier sites were left in readiness for the next spawning run season as a result of inspections and repair/maintenance work completed at the end of the previous season. Inspection sheets and maintenance records should be reviewed to ensure all required repairs were completed.

Where problems have been experienced before, fixed-crest barriers should be checked to ensure there is no winter ice or spring flooding damage or debris build-up and that, where required, stop logs and the mechanical gate at the Albany Creek barrier are set at

correct levels. Barrier coordinators will be responsible for designating when stop logs will be put in place and at what level. The DFO-SLCC Engineering Unit will carry out an inspection of the adjustable-crest barriers.

6.1.2. Electrical Barriers

The U.S. Barrier Coordinator will ensure Smith-Root Inc. (SRI) carries out the annual inspections of electrical barriers under contract. The U.S. Barrier Coordinator and the designated state representative should be present for these inspections. SRI will use the annual inspection as a time to train new barrier owner operating staff in the operation of the barrier and review safety procedures specifically dealing with electrical barriers. SRI should be notified in advance of the number of staff expected to be in attendance for the inspection. A copy of the SRI inspection report should be placed in the barrier coordinator's and the state representative's barrier files as well as on site in the control structure. Arrangements for needed repairs should be resolved at the time of the inspection. Any cost of repairs and the date completed are to be noted on copies of the SRI barrier inspection report.

(See Maintenance Procedures for Barriers protocol for inspection and maintenance procedures for adjustable-crest and electrical barriers.)

6.1.3. Operating Times

By March 1 of every year barrier coordinators will verify with control agent assessment staff, for the stream on which the barrier is located, the anticipated starting dates of the lamprey and fish migration spawning runs for that year. Consultation with local natural resource agency staff or fishing organizations may also be beneficial. The date barriers are to stop operating to prevent lamprey migration should also be agreed upon at this time. Based on this information barrier coordinators are to ensure those responsible for barrier operation are notified of barrier starting and anticipated stopping dates. (See Operating Times for Barriers protocol for guidance on spawning-run times.)

6.2. Barrier Operation during Sea Lamprey Spawning Run

6.2.1. Fixed-Crest Barriers

Conventional fixed-crest barriers normally require no attention during the spawning run unless stop logs have been added to control water levels or there are associated traps or fishways in operation (see 6.2.4. below). If stop logs have been affixed to the barrier, to adjust head for lamprey control or for other purposes (e.g., aid in fish passage or non-lamprey/fish use), they should be manipulated according to written agreements and directions provided by the barrier coordinator or operating agency.

6.2.2. Adjustable-Crest Barriers

Operation of adjustable-crest barriers should be monitored regularly by the DFO-SLCC Engineering Unit using the phone/computer monitoring system. They will follow the operating instructions outlined in the "Operation and Maintenance Manual for Inflatable Sea Lamprey Barrier Dams". Copies will be located at the DFO-SLCC and in the control building on site. The operation of these barriers can be monitored on site during the associated lamprey trapping and lift-and-sort fish passage activities.

6.2.3. Electrical Barriers

SRI, using a modem link-up from their Vancouver, Washington location, on a 24-hour a day basis, will monitor operation of electrical barriers. SRI has the capability to monitor many parameters (pulsator output, water temperature, water velocity, power, security, etc.) The parameters to be monitored are to be agreed upon at time of purchase and during the development of the SRI maintenance agreement. Barrier coordinators and, where applicable, the state district office staff responsible for the electrical barrier will, by phone or computer with necessary access codes, monitor the same parameters and request any required adjustments. Arrangements as to who will actually control operation of the barrier will be made by mutual agreement between SRI, the U.S. Barrier Coordinator, and the barrier owner. Electrical barrier owners are responsible for ensuring barrier operating staff are thoroughly familiar with all the safety precautions when operating electrical barriers, including the operation of associated traps and fishways. Those to be contacted when problems with the barrier arise will be agreed upon at that time. The necessary codes to access the control/monitoring system will be provided by SRI.

In the case of a malfunctioning electrical barrier SRI will be immediately phoned to be sure they are aware of the problem. Conversely, SRI will contact whoever is designated if that individual(s) has not responded to phone/or computer notification by the monitoring system (e.g., on a weekend or statutory holiday). The barrier alarm system is programmed to dial four numbers until it gets an answer. The U.S. Barrier Coordinator or designated agency representative and SRI will discuss what arrangements are required to make any barrier repairs. The agency responsible for the operation of the barrier will then write up a brief report on the problem and place a copy in their barrier file and forward a copy to the U.S. Barrier Coordinator. The barrier coordinator will add the cost and date repairs are completed to the incident report. Copies of the completed report (problem and solution) should also be kept in the control structure on site. This step is particularly important for advising new SRI servicing technicians of what work has transpired with the barrier to date.

6.2.4. Traps and Fishways

Any traps and/or fishways associated with a barrier (e.g., Brule River, WI) should be operated according to directions provided in the trap and fishway operations protocols (Operations and Maintenance of Traps and Operations and Maintenance of Fishways) or as per agreement with the control agent adult assessment supervisor. Control agent staff, designated cooperators, or volunteers working on-site with the trap or fishway should report any problems with the barrier immediately to the appropriate barrier coordinator and/or the designated agency responsible for operating the barrier. Examples of things to be aware of are:

- Undercutting of structure by water,
- Erosion of bordering stream banks,
- Adjustable-crest Inflatable bladder not rising or falling with changes in stream flow,
- Loss of electrical power to site or back-up generator not working,
- Adult lamprey found above barrier, and
- Evidence of significant non-target fish deaths.

6.2.5. Health and Safety

There are potential safety hazards when working around barriers during high and fast moving water where footing on and around the structures can be slippery, especially if ice or snow are still present at the beginning of the spawning run. Electrical barriers use electrical power so electrical shocks are a possibility, especially when working in water or wet conditions. Some work is labor intensive and may involve the lifting of heavy materials such as inserting and removing stop logs. This type of work often requires more than one individual. Operating staff should to be aware of potential hazardous working situations and what precautions must be taken.

6.3. Post Operation Activities

6.3.1. Fixed-Crest Barriers

If conventional fixed-crest barrier sites have been visited during the operating season, and everything was found in order, they need not be visited again that year. If an associated trap and/or fishway was not operated during the year, and/or the site was not visited at the beginning of the spawning run, the site should be visited at the end of the spawning run or before freeze-up to ensure everything with the barrier and at the site is in order to begin the next operating season. Any problems should be noted on the site inspection sheet (see Appendix 1 of Maintenance Procedures for Barriers protocol) and brought to the attention of the appropriate barrier coordinator, barrier owner, and/or cooperator responsible for the operation of the barrier and a report placed in the barrier file. These individuals then become responsible for seeing that any repairs required for next season are completed in a cost-effective and timely manner. Cost and the date repairs are completed are to be noted on inspection reports.

At least once every three years, and more frequently if barrier program coordination judges it necessary, all fixed-crest barriers are to be inspected by a qualified professional engineer to ensure structural integrity of the structure and the site. The U.S. Barrier Coordinator should be present for this inspection of all barriers in the U.S. Where desired, the cooperator responsible for the barrier operation may also be present at the inspection. Copies of the inspection report are to be placed in the barrier files. Decision authority for repairs/modifications of barriers rests with the barrier coordinators. All changes/modifications to the barrier structure or banks will require review by a barrier program engineer. The cost of repairs and when they are completed are to be noted on the inspection reports.

Where stakeholders wish to manipulate water levels outside of the spawning run the stop logs can now be positioned to the levels agreed upon in the written operating agreement with the control agents.

6.3.2. Adjustable-Crest Barriers

Adjustable-crest barriers are to be inspected every year by the DFO-SLCC Engineering Unit at the end of the migration run before freeze-up. They will arrange for any needed repairs. Inspection sheets will be placed in the barrier file and control structure on-site and the cost and date of repairs will be noted on the same form.

6.3.3. Electrical Barriers

All electrical barriers will have been inspected prior to the beginning of the spawning run by SRI as per terms of the maintenance contract. At the end of the operating season the

designated state representative will winterize the barrier according to arrangements made with SRI and the U.S. Barrier Coordinator. The need for any repairs determined at this time should be noted and SRI and the U.S. Barrier Coordinator notified accordingly so arrangements can be made to complete repairs prior to next season. (See protocol Maintenance Procedures for Barriers.)

6.3.4. Health and Safety

Any designated staff or contractors carrying out or assisting with barrier operation or repairs must comply with applicable federal and state/provincial health and safety regulations, including wearing a PFD when working in or near water. Where repair or maintenance work is carried out by others under contract, the barrier coordinator or, where applicable, the cooperator responsible for operation of the barrier, must ensure the GLFC and control agents are protected from liability.

6.4. De facto Barriers

Instream structures built by others on sea lamprey tributaries can serve as lamprey barriers. However, to effect lamprey control the structure may need to be repaired or modified. The GLFC refers to such repaired/modified structures belonging to others as defacto barriers. The barrier coordinator, in consultation with other control agent or cooperator staff, will work to determine if and how lampreys are bypassing the structure. While the determination may be self-evident, it sometimes may require involved studies, e.g., telemetry. When the work has been judged cost-beneficial by the barrier coordinator, compared to lampricide treatment costs, the DFO-SLCC Engineering Unit will prepare a project plan for modifications to lamprey proof the structure. Work in streams with a flow greater than 0.08 m^3/s (3 cfs) will require professional engineering.

Before going forward to secure GLFC funding for such projects, the barrier coordinator will ascertain if the owner of the structure is willing to enter into a cooperative agreement (CA) for modifying/operating the structure to stop lamprey. When proposed projects are to cost less than $2,000 U.S. they can be funded from maintenance funding subject to the approval of the GLFC's SLPM. Projects estimated to cost more must be submitted as part of the next year's BAWP. The barrier coordinator will arrange for any contracts, permits, and EA approvals required for carrying out the project. An inventory of such structures should be maintained by the barrier coordinators with individual structure files having copies of all activities carried out at the site – adult and larval assessments, cost and date of remedial actions, etc. The barrier coordinators should discuss with the owners the need for them, where practical, to control water levels at the structure during the lamprey migration run so as not to negate the lamprey proofing efforts. It is probably best if there are written agreements to confirm these arrangements.

6.5. Skills Required

Most existing fixed-crest barriers do not require any operational control during the spawning run, unless stop logs, traps and lift-and-sort fishways are part of the barrier structure. A qualified professional engineer should inspect all fixed-crest barriers once every three years for structure and site integrity.

Operation and inspections of the adjustable-crest barriers during the spawning run will be the responsibility of the DFO-SLCC Engineering Unit.

For the present, operating control of electrical barriers will be arranged between the U.S. Barrier Coordinator, designated individual from MDNR, and SRI. Annual inspections are the responsibility of SRI as long as a maintenance contract for the barrier is in effect.

Where there are any stop logs, traps, or fishways associated with any of the above types of barriers, designated control agent or cooperator staff, along with any private contractor employees, will be trained in how to operate these facilities by control agent barrier coordinators and adult assessment supervisors. (See Operations and Maintenance of Traps and Operations and Maintenance of Fishways protocols for details on the operation and maintenance of sea lamprey traps and fish passage facilities respectively.)

Plans for modification of instream structures (de facto barriers), where the discharge exceeds $0.08m^3/s$ (3cfs), will be prepared or reviewed by a qualified professional engineer.

6.6. Level of Effort

During the preparation of the BAWP barrier coordinators and cooperators that operate barriers will be asked to provide estimates of person days required for operating each of the barriers under their control.

6.7. Definitions

A **fixed-crest barrier** is a structure much like a small dam that stretches from one side of a stream to the other. This relatively simple barrier creates a two to four foot drop that stops sea lamprey from proceeding further upstream. A metal lip is often used to keep sea lampreys from using their suction-cup mouths to climb over the barrier. Inclusion of a jumping pool below the structure allows most salmonids to pass easily. Passage for non-jumping fish can be made possible with the addition of a variety of fishways. These barriers can be built of a variety of materials – wood timbers, gabion baskets, steel sheet piling, poured concrete, riprap, armor stone, or a combination of these materials (e.g., gabion baskets and sheet piling).

An **adjustable-crest barrier** draws upon the best aspects of the fixed-crest barrier design and adds improvements that make the barrier less intrusive, enhances fish passage, and still prevents sea lamprey passage. These barriers have air bladders that inflate an adjustable barrier crest. This crest is raised only during the sea lamprey spawning runs; it remains lowered on the river bottom during all other times of the year, permitting free passage of all species of fish. The air bladder is controlled by a computer, which automatically adjusts the barrier height based on specific water levels, thus minimizing the alteration of the river's natural flow. Adjustable-crest barriers operate with pools to pass jumping salmonids or with fishways.

An **electrical barrier** uses direct current (DC) electric power to deter sea lamprey from proceeding upstream without risk to other fish and animals. The electric circuit is made up of two or more metal electrodes submersed in water with a voltage applied between them. These barriers are built into the streambed and, in contrast to the conventional fixed-crest barriers, do not block the flow of a stream. Electrical barriers are used only during the sea lamprey spawning runs and, where required, can utilize improved fishways to enhance passage of fish. These electrical barriers are controlled and monitored by a computer system. Smith-Root, Inc. owns the patents for gradient-field electrical barriers currently used in sea lamprey control.

7. Tools Required

Usually, except for manipulating stop logs in fixed-crest barriers, no equipment is required to operate barriers. Where barrier or site repairs are required during the operating season see Maintenance Procedures for Barriers protocol for the tools required.

8. Information Requirements

The protocol itself does not generate information. However, the monitoring systems of the adjustable-crest and electrical barriers provide access to a variety of data necessary to effectively regulate the barrier to prevent lamprey escapement upstream. This information, as well as other available information, may also be useful to the agents' control and assessment programs and provide information to improve understanding of lamprey and fish behavior. The computer should be programmed accordingly and the information retrieved kept in the barrier file and other copies forwarded to those who can utilize the retrieved information. (See Maintenance Procedures for Barriers protocol for the information available from barrier inspection sheets and repair/maintenance records and Operations and Maintenance of Traps and Operations and Maintenance of Fishways protocols for the information generated from the operation and maintenance of traps and fishways.)

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Andrew Hallett, Assistant Barrier Coordinator, Sault Saint Marie, Ont.; phone (705) 941-2022; e-mail address halletta@dfo-mpo.gc.ca

9. Contract Requirements

Contracts and permits for operating barriers are normally not required. However, there may be commitments from original construction permits/approvals that need to be honored (e.g., hours of operation of fishways). Written agreements for water level manipulation should be negotiated as outlined above. If states wish to hire private individuals to assist with operation of barrier, and wish to have the GLFC pay for the cost, this should first be negotiated with U.S. Barrier Coordinator. If GLFC funding is agreed upon, joint consultation, including with the GLFC Secretariat, should take place on the terms and nature of the contract.

SRI has a maintenance contract with the owner of each electrical barrier it installs. They monitor and control the barrier to meet the requirements of the owner. If the owner or the GLFC wishes SRI to do anything outside of what is called for in the maintenance contract a separate contract may be required. Such a contract should be developed by the U.S. Barrier Coordinator in consultation with the designated cooperator representative and SRI, and initially approved by the GLFC Secretariat.

10. References

Some information in this protocol was obtained from Smith-Root, Inc.; the Ontario and U.S. Border States natural resource agencies; the USACE dam worldwide web sites on the Internet; and GLFC publications.

11. Use of Other Protocols

Maintenance Procedures for Barriers

Emergency Measures Advisory Services (for dealing with sudden failure of a barrier)

Operations and Maintenance of Traps

Operations and Maintenance of Fishways

Fixed-Crest Barrier Design Criteria

Operating Times for Barriers

FWS and DFO-SLCC Construction Contracting and Management

Operation and Maintenance Manual for Inflatable Sea Lamprey Barrier Dams

12. Protocol Authority

12.1 Allowance for Variations from Protocol

If control agents or cooperators feel they need to deviate from the operations protocol they should seek approval from the barrier coordinators. If the barrier coordinators feel there is a need to deviate from this operations protocol in an emergency situation they should seek the approval of the SLPM. The SLPM will decide if a higher level of approval is required. A memo covering the deviation request and its approval should be placed in the barrier file.

Where permanent changes to the protocol are considered necessary by the barrier coordinators, their request should be taken through the normal barrier approval route, SLBTF to SLIC to GLFC, if required. In some instances consultation on the proposed changes may be required with technical or engineering experts (e.g., SRI) prior to requesting a variation in the protocol. Justification for the change and any recommendations by specialists should be appended to the variation request. Once approved the protocol should be formally amended and copies supplied to all those who use it.

12.2 Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevance after two years of use.

12.3. Author and Date

M. S. Millar, March 1999

OPERATING TIMES FOR BARRIERS

1. Protocol Title: Operating Times for Barriers

2. Protocol Business Need

The timing of barrier operation (and associated traps and fishways) requires scheduling that is consistent and justified by data. This protocol satisfies internal requirements for defining the seasonal window for scheduling the operation of barriers and their appurtenant traps and fishways to satisfy both sea lamprey control needs and external requirements of fisheries management agencies regulating fishway operation.

A number of barriers in use today feature fish passage improvements, which require operation to prevent passage of lamprey while minimizing non-target impacts. Adjustable-crest and electrical barriers are operated only during the lamprey spawning run, and allow unobstructed fish passage during the balance of the year. These and other barriers may also include fishways, which may be screened and operated in a trap-and-sort fashion during the spawning run and opened at other times of the year to provide unobstructed fish passage. Timing of adjustable-crest and electrical barriers and fish passage operations is crucial in minimizing opportunity for lamprey escapement and maximizing passage of non-target fish.

3. Protocol Deliverables

Description of geographic zones of similar lamprey run-times to facilitate contract and operations scheduling throughout the Great Lakes Basin, and recommendations for scheduling operations in each zone.

4. Target Audience

Barrier owners, barrier cooperators, barrier coordinators, control agent staff, and barrier contractors will be the principal users of this protocol.

5. Jurisdiction for Protocol Use

This protocol may be implemented basinwide. Local jurisdictional requirements may apply to the operation of fish passage devices.

6. Procedures

6.1. Assumptions

For the purposes of this protocol, the following assumptions are made:

1. The sea lamprey spawning run follows a probability density function.
2. An acceptable level of control may be achieved by beginning and ending operations at the limits of the time boundaries of the above noted probability density function.
3. The level of operations effort may vary through the spawning run in response to the number of adult lamprey and/or fish present.
4. Initiation time of the spawning run in the spring varies with geographic location and is governed primarily by temperature. The timing of the spring temperature increase in Great Lakes tributaries follows a probability density function with temperature increasing first in the lower Lake Michigan and Lake Erie basins and occurring last in the Lake Superior basin. The Great Lakes Basin may be divided into zones with similar spawning-run times and thermal characteristics.

5. An acceptable level of control means that a barrier performs as planned when, over a 50-year amortized expected life, the cost of the barrier is less than the total cost of lampricide control for the affected upstream area. Barrier costs include any recurring upstream lampricide treatment costs required after barrier construction.

6.2. Zones

The Great Lakes Basin has been divided into four zones where the characteristics of sea lamprey spawning-run times are observed to be similar. The zone divisions were based on an Environment Canada map of degree-days and are subject to further refinement through the use of statistical methods to delineate boundaries. The zones are to be used as a general planning guide.

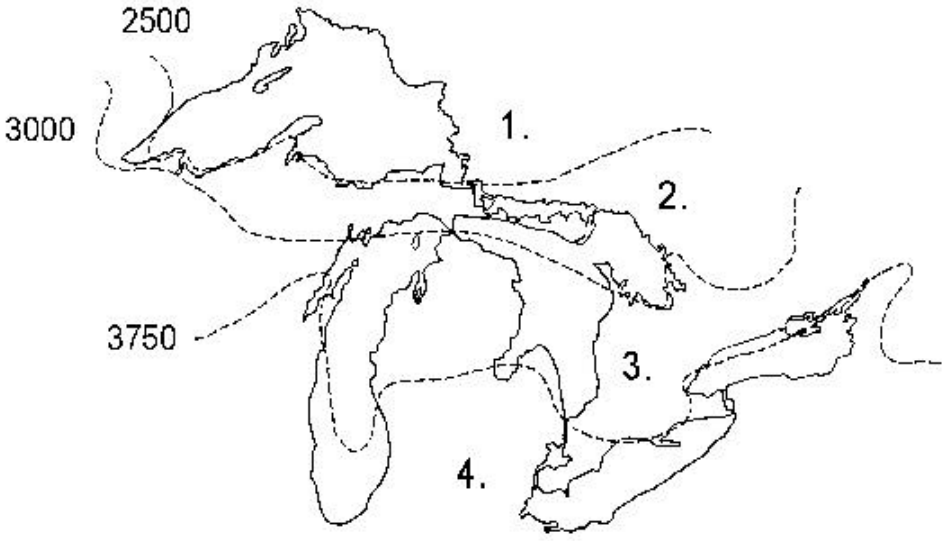

Figure 1. Zones for analysis of sea lamprey run times.
Isotherms represent mean annual growing degree days above 5.5°C (42°F).

6.3. Start /end Timing by Zones

The initiation of the spawning run in a stream in a given zone is related to temperature and generally starts when water temperatures exceed 10°C. Table 1 presents proposed start and end times for lamprey runs, that is the operation window for each zone based on trap catch data in each zone.

Table 1: Operation Window for Barriers and Fish Passage Devices

Zone	Lake/River Area	< 1% Catch	> 99% Catch	Operation Window
1	Superior North	May 7	June 25	May 6 – June 30
2	Superior South, Huron North & Georgian Bay	April 29	July 12	April 15 to July 14
3	Michigan North, Huron South, Ontario & Erie extreme North	April 27	June 17	April 1 to June 26
4	Michigan South , Erie, Ontario South	April 10	June 11	Mar 15 to June 30

6.4. Site Specific Run-Time Curves

The use of trap data alone for this purpose of defining the spawning run window has the potential to introduce error, as assumptions must be made regarding lamprey presence and motivation to pass a barrier prior to being trapped. Best management practice would incorporate spawning-run time curves calibrated for each barrier in the inventory. These would be modeled estimates calibrated to the thermal characteristics of the waters at the barrier site. Models for this purpose need to be developed and included in the barrier inventory.

6.5. Operational Use of Site Specific Spawning-Run Time Curves

The use of spawning-run time curves will vary based on the type and business purpose of operational activity that is planned and their respective protocols:

1. Based on the protocol Operations and Maintenance of Traps define trap operations and schedules for:
    - Statistical sampling purposes (adult assessment), or
    - Live animal capture for SMRT and alternative control research,
2. Based on the protocol Operation and Maintenance of Fishways define the operational schedule for fishways,
3. Based on the protocol Operations Procedures for Barriers define the operation of adjustable-crest barriers, and/or electrical barriers, and
4. Operations manuals for new barriers are prepared by using the Final Design and Engineering protocol. Once the barrier has been constructed these manuals become part of the barrier inventory and include operational spawning-run time curves.

7. Tools Required

Direct application of temperature and adult assessment data could shorten the necessary duration of contracts to operate these structures and thus, reduce environmental impact. When outside contracting is used for barrier, trap, or fish passage operation, it is easier to contract around barrier-specific calendar dates. More flexible contracting methods, allowing operations start-up to be triggered by remotely monitored temperature events could contribute to reductions in the operating window.

8. Information Requirements

Control agent data on adult lamprey catches, dates, and water temperature, from both traps and barriers. Additional proxy data on water temperatures used to derive stream temperatures at barrier sites.

9. Contract Requirements

Contract requirements are dealt with in operations protocols listed below.

10. References

Sea Lamprey Control Program Adult Assessment Trap Catch Data

Phillips, D.W. and J.A.W. McCulloch. 1972. The Climate of the Great Lakes Basin. Environment Canada Atmospheric Environment. Information Canada. Cat. No. EN57-7/20. U.D.C. 551.582(713)

11. Use of Other Protocols

Operations Procedures for Sea Lamprey Barriers

Operations and Maintenance of Traps

Operations and Maintenance of Fishways

Final Design and Engineering

12. Protocol Authority

The SLBTF is the protocol authority. This is an interim protocol. Additional work is required to refine the delineation of zones and to develop models to derive run-time estimates for all barriers in the inventory. SLBTF will review the revisions to this protocol and may recommend that it be subject to peer review.

12.1. Allowance for Variations from Protocol

The length of the safety margin at the start and ends (prior to 1% of catch, post 99% of catch) of the run is generally two weeks and is determined by the professional judgement of the barrier coordinators. Barrier coordinators require the authority to initiate operations earlier or later than stipulated in this protocol to accommodate an early or late spring, statutory holidays that may fall on the start-up date, or site specific conditions.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevance after two years of use.

12.3. Author and Date

A.G. Hallett, March 1999

MAINTENANCE PROCEDURES FOR BARRIERS

1. Protocol Title: Maintenance Procedures for Barriers

2. Protocol Business Need

Sea lamprey barriers are used as an alternative control method in the GLFC Sea Lamprey Program. Barriers are built on streams to prevent adult sea lamprey from reaching spawning habitat upstream. This protocol is required to satisfy business needs internal to the barrier program. It is important to recognize that barriers are man-made structures that are constructed of materials subject to erosion, corrosion, weathering, wear and tear, malfunctioning, and vandalism. Depending on many factors a barrier may either deteriorate slowly or quickly, but every barrier will deteriorate over time. If problems with a barrier go unnoticed, and repair and maintenance measures are not taken, the barrier can fail resulting in lamprey bypassing the barrier. This usually necessitates a costly lampricide treatment, barrier and/or site repairs, that could have been avoided had the barrier been properly maintained, or could possibly lead to injury or death in the vicinity of the site.

(Traps and fishways can be associated with all types of barriers. See the Operations and Maintenance of Traps and Operations and Maintenance of Fishways protocols for details on the operation and maintenance of these facilities.)

3. Protocol Deliverables

This protocol describes the maintenance procedures for three types of barriers: **fixed-crest, adjustable-crest**, and **electrical**. (For definitions of these barriers see Section 6.7 Definitions in the protocol Operations Procedures for Barriers.)

4. Target Audience

The barrier maintenance protocol will be implemented by regular and/or seasonal employees of the FWS and the DFO-SLCC (control agents) or designated field staff of cooperating agencies. In some instances maintenance may be carried out by personnel under contract to one of the cooperating agencies, with technical supervision being provided, not necessarily on site, by one of the barrier coordinators.

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5. The Jurisdiction for Protocol Use

This protocol will apply to all barriers built on streams tributary to the Great Lakes with funding from the GLFC and that are under direct operational control of control agents or cooperators. This protocol will not apply to instream structures, built for other purposes by private individuals, companies, or other government or cooperator agencies, that act as de facto barriers, whether or not the GLFC has spent funds on lamprey proofing the structure. Owners will maintain their own structures to their specifications and these regulations of the jurisdiction in which they are located.

The only jurisdictional variations in the application of this protocol will be in the areas of permitting, compliance with health and safety regulations, and signage of the site. Personnel maintaining barriers will be subject to the applicable health and safety regulations in the country and state/province where the barrier is located. Tribes and First Nations may have their own or additional health and safety regulations. In addition, private contractors hired to carry out repairs must have their own workers' compensation and liability insurance required within the jurisdiction where the barrier is located. Signage at barrier sites must meet applicable federal/state/provincial requirements. Appropriate signage should be decided upon at the time the barrier is constructed.

6. Procedures

6.1. General Application

In the U.S. local district office field staff from the natural resource agency in that state operate most barriers that have been constructed with financial support from the GLFC. In Canada staff from the DFO-SLCC operate most GLFC funded barriers. In the U.S. any repair/maintenance problems noted with the barrier or the site should be reported to the agency responsible for its operation and the U.S. Barrier Coordinator. In Canada report any such problems to the DFO-SLCC Engineering Unit.

Barrier inspections should be carried out by the DFO-SLCC Engineering Unit and its delegates, U.S. Barrier Coordinator, or designated individuals (e.g., state engineer for Brule River barrier, contract engineer, or engineering technician with knowledge of barriers). Any major repairs to the integrity of a barrier or adjoining stream banks should be under the direction of a qualified professional engineer. For the present, any problems with the controls and associated equipment of the adjustable-crest barriers should be repaired under the direction of the DFO-SLCC Engineering Unit. Smith-Root, Inc. (SRI) should be consulted concerning any repairs required to electrical barriers.

Barrier coordinators or designated cooperator representatives are responsible for securing any permits or EA approvals to carry out any repair/maintenance work. When practical such activity should be scheduled for when there is normally no in-water work restrictions (approximately July to September). Another situation to avoid is working in streams during high flows when spring flooding may occur.

Control agent or designated cooperator staff or a general contractor carrying out or assisting with maintenance or repair activities must comply with applicable federal/state/provincial tribal/First Nation health and safety regulations, including wearing a personal flotation device (PFD) when working in or near water. Electrical barrier owners are responsible for ensuring barrier operating staff are thoroughly familiar with all the safety precautions that must be taken when working with electrical barriers, including the operation of associated traps and fishways. Where repair/maintenance work is carried out by others under contract, the barrier coordinator and, where applicable, the designated cooperator representative must ensure the GLFC and control agents are protected from liability.

6.2. General Maintenance Considerations

6.2.1. Site Access

Roads providing access to barrier sites should be graded, graveled, and brushed as required to ensure safe vehicular travel. If a municipality, industry, or government agency maintains the road any road problems should be reported to them. Ramps needed for unloading and loading heavy equipment should be in a safe condition to support such activities. Where walking trails are the final access to a site they should be brushed and cleared of obstacles, such that safe passage is ensured for those who use them to carry equipment and supplies to and from the site.

6.2.2. Safety Floats and Signage

Safety floats and barrier trash protectors and cables should be painted/replaced as required. Sanctioned stream signage, warning downstream boaters that they are approaching a barrier, should be in place, where applicable, and in good condition.

6.2.3. Site Safety

Safety railings and walkways at the site and on barriers/traps/fishways should be securely fastened and painted as required. Where required ensure facilities meet federal disabled accessibility legislation as well as that of the jurisdiction in which the barrier is located. Any signage at barrier site, portages around barrier, and boat launching or docking facilities should be in good condition and meet agency regulations. Warning lights on electrical barriers should be inspected regularly as they have been subject to frequent vandalism. Report any problems to the appropriate authority.

6.2.4. Site Security

Ensure all locks on gates and fences preventing access to the site and on barriers/traps/fishways and buildings housing controls and monitoring equipment are secure. Where there is a security monitoring system for the building on site, ensure it is operational. Check that fire extinguishers in buildings are fully charged. Report broken windows or doors or water leaks in roof or walls. In general, public access to barrier sites should not be encouraged because they are potentially dangerous sites with liability implications for owners, control agents, and the GLFC.

6.2.5. Water Seepage/Erosion On Site

Check for water seepage/erosion around barrier structures (underneath, head wall, spillway, at ends, upstream and downstream along stream banks, etc.) Sinkholes and embankment slumpage often indicate a water problem at these locations. It is important to keep written records and photographs on points of seepage for later comparison – note points of seepage exit, quantity and content of flow, size of wet area, and types of vegetation growing there. Report any problems to the appropriate barrier coordinator or authority.

6.2.6. Vegetation and Rodent Control

The establishment and control of proper vegetation is an important part of barrier maintenance. Vegetation can help prevent erosion of embankments and aid in control of groundhogs and muskrats. Groundhog and muskrat burrows weaken the embankments and can serve as pathways for seepage. Beaver often build dams on top of fixed-crest barriers causing problems.

6.3. Fixed-Crest Barrier Maintenance

Fixed-crest barriers may be built of a variety of materials – wood timbers, gabion baskets (chain link baskets filled with 10 to 15 cm (4 to 6 in.) crushed stone), sheet piling, poured concrete, riprap, armor stone, or a combination (e.g., gabion and sheet pile dam) of these materials. Signs to look for which identify potential problems at barrier sites are:

- Shifting or rotting timbers,
- Gabion basket wire separating or baskets shifting,
- Cracks in concrete or sheet piling (note width, depth, and location of cracks on a diagram and photograph),
- Bank failure – slumping, geotextile/filter cloth exposed, etc.,
- Barrier lip and/or stop logs (used to maintain head) not serviceable or securely attached,

- Jumping pools below barrier not maintaining an adequate depth to accommodate species of anadromous fish that need to pass upstream, and
- Evidence of lamprey reproduction upstream.

Note potential problem(s), using a diagram or photographs if applicable, on-site inspection form (see Appendix 1 of this protocol) and forward to appropriate barrier coordinator and, where applicable, the operational authority. All fixed-crest barriers are to be inspected at least once every three years, and more frequently if barrier program coordination judges it necessary, by a qualified professional engineer to ensure barrier and site integrity. A barrier should also be inspected following any major storm event.

6.4. Adjustable-Crest Barrier Maintenance

Carry out maintenance of barrier working parts and controls, etc. as outlined in "Operation and Maintenance Manual for Inflatable Sea Lamprey Barrier Dams". Copies are located on site and at the DFO-SLCC. An annual inspection of these barriers is to be carried out by the DFO-SLCC Engineering Unit. The balance of these barriers will be inspected and maintained as other fixed-crest barriers. Report any problems with barriers as noted previously.

6.5. Electrical Barrier Maintenance

SRI holds the patent for gradient-field electrical barriers in Canada and the U.S. Each barrier is covered by an annual maintenance contract with SRI and includes an annual maintenance inspection. This inspection can be carried out at a mutually agreeable time arranged between SRI and the owner/operator but is normally done at the beginning of the lamprey spawning migration run. Where possible the U.S. Barrier Coordinator and the designated state representative should be present for this inspection. A copy of this annual SRI inspection report must be placed in the barrier file with another copy in the control structure on site. Most of the electrical parts for this barrier are of the plug-in variety and spare parts are left on-site or with the operator. SRI operations and maintenance manuals, structured for each barrier, are left on-site in the control building and copies can soon be found on their WWW page (http://www.smith-root.com). To deal with any site problems use the site inspection form (see Appendix 1 of this protocol).

6.6 De facto Barriers

Instream structures built by others on sea lamprey tributaries can serve as lamprey barriers. However, to effect lamprey control the structure may need to be repaired or modified. Such structures then are often called de facto barriers. Depending on the cost and circumstances the GLFC may agree to assist in funding required repairs or modifications. An assessment of what lampricide treatment costs would be needs to be carried out when deciding the maximum to pay for lamprey proofing a barrier. The upkeep and maintenance of the structure remains the owner's responsibility. Should maintenance be required to maintain the lamprey effectiveness of the structure the barrier coordinator will, provided it is still cost-effective, negotiate cost sharing with the owner. The barrier coordinator will then secure funding approval from the GLFC. Once approval is secured the barrier coordinator will make arrangements for the repair/maintenance with the owner and secure any necessary contracts and approvals. Maintenance or repair work done on these barriers to maintain lamprey proofing that is funded by the GLFC should be recorded and the information placed in the barrier file. (See 6.4 in the Operations Procedures for Barriers protocol for more details on de facto barriers.)

6.7. Skills Required

Any major repair/maintenance work affecting barrier or site integrity should be carried out under the direction of a registered professional engineer. Qualified trades' people or control agent and cooperating agency field staff who have the required skills for the task assigned can carry out general barrier or site repairs/maintenance. A qualified professional engineer should inspect all fixed-crest barriers at least once every three years for structure and site integrity.

For the present, annual inspections and the repair/maintenance of adjustable-crest barriers, including inflatable bladder operation, electronic controls, and the monitoring system, will be carried out by, or under the direction of, the DFO-SLCC Engineering Unit.

For the present, maintenance of electrical barriers should be carried out by or under the direction of SRI as per the maintenance contract. In an effort to keep maintenance contract costs down SRI will train local operating staff to make most repairs.

6.8. Level of Effort

The exact requirements (person days) will vary depending on the nature and extent of repairs that are required above and beyond routine maintenance. Routine maintenance should not require any more than one to three days per site per year exclusive of travel. Other repairs may require more extensive allocation of time involving a range of person days to several person weeks.

7. Tools Required

A variety of tools and equipment (power wrenches, welding torches, front end loaders, etc.) may be required to repair all three types of barriers or other problems (e.g., embankment erosion) at barrier sites. Most equipment should not be too difficult to obtain except possibly during peak summer construction periods. When specialized tools are required operating personnel must be qualified to operate them, including holding any applicable licenses, e.g., welding.

8. Information Requirements

Implementation of the protocol will generate information on regular inspections and needed repairs to, or maintenance of, barriers or barrier sites. Inspection forms and type of repair/maintenance, cost, and date completed should be noted on inspection forms retained in the barrier file to maintain a historical barrier record. One of the reasons for maintaining historical records is to spot possible trends in design or material faults or problems.

Personnel to contact:
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Andrew Hallett, Assistant Barrier Coordinator, Sault Saint Marie, Ont.; phone (705) 941-2022; e-mail address halletta@dfo-mpo.gc.ca

9. Contract Requirements

Cooperating U.S. agencies arranging to carry out minor barrier maintenance/repairs themselves, or have it done by others, can usually be reimbursed for the costs by the GLFC upon submitting required receipts to the U.S. Barrier Coordinator. Major repairs/maintenance will require prior approval of U.S. Barrier Coordinator and plans may need to be reviewed by the DFO-SLCC Engineering Unit. The project may require a contract between the GLFC and the cooperating agency. The U.S. Barrier

Coordinator in consultation with the barrier owner/operator will prepare the contract. The type of contract used in the past to work with a state on a barrier project (see GLFC Barrier Guidelines) will be satisfactory. Written agreement on any conditions not adequately covered in the contract should be appended to the contract. The GLFC also has a standard contract that can be used with private contractors.

DFO-SLCC control agent staff usually carry out repairs/maintenance on the Canadian barriers. Where practical, minor/routine maintenance will be carried out by control agent staff already visiting the site to service traps or for other purposes. DFO-SLCC contracts are issued to subcontractors if required to carry out any repairs.

SRI has a maintenance contract with the GLFC for each of the electrical barriers it has installed to date. In future these contracts should be between SRI and the barrier owner. The cost of the maintenance contract is paid by the GLFC.

Where contracts are required to effect major barrier or site repairs/maintenance the contracts should be similar to those used to build the barrier (see protocols DFO-SLCC and FWS Construction Contracting and Management).

10. References

Some information in this protocol was obtained from Smith-Root, Inc.; the Ontario and U.S. border state natural resource agencies; the USACE dam worldwide web sites on the Internet; and from GLFC publications.

11. Use of Other Protocols

Operations and Maintenance of Traps

Operations and Maintenance of Fishways

Emergency Measures Advisory Services

Fixed-Crest Barrier Design Criteria

Operating Times for Barriers

DFO-SLCC Construction Contracting and Management

FWS Construction Contracting and Management

12. Protocol Authority

12.1. Allowance for Variations from Protocol

If control agents or cooperators feel they need to deviate from the maintenance protocol they should seek approval from barrier coordinators. If the barrier coordinators feel there is a need to deviate from this maintenance protocol they should seek the approval of the SLPM. The SLPM will decide if a higher level of approval is required. A memo covering the deviation request and its approval should be placed in the barrier file.

Where permanent changes to the protocol are considered necessary by the barrier coordinators their request should be taken through the normal approval route, SLBTF to SLIC to GLFC, if required. In some instances consultation on the proposed changes may be required with technical or engineering experts (e.g., SRI) prior to requesting a variation in the protocol. Justification for the change and any recommendations by specialists should be appended to the variation request. Once approved the protocol should be formally amended and copies supplied to all those who use it.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevance after two years of use.

12.3 Author and Date

M. S. Millar, March 1999

Appendix 1 BARRIER SITE REPORT

NOTE: Required scheduled, engineering inspections of barriers is recorded on separate inspection sheets developed for this purpose.

Barrier Site Report to be completed by control agent, cooperating agency, contractor staff, or volunteers working at or visiting barrier site and they notice something not working properly or in need of repair. Provide photos or diagram to further clarify location of/or details of problem/repair. Give report to barrier coordinator or barrier operator. **Barrier coordinator must authorize repairs before work begins.** Once repairs are completed, the nature of the repairs, cost, and date of repairs are to be noted at the bottom of this page. The following should be looked for:

1. Does barrier appear to be working correctly – stop logs in place, inflatable bladder raised, power on at electrical barriers? Any signs of adult lamprey above barrier?
2. Are there any signs of water leaking around barrier (note where on barrier) or bank erosion or slippage (note which bank and whether upstream or downstream)?
3. Control building (adjustable-crest and electrical barrier sites) – is building secure or are any repairs needed?
4. Any problems noted with lamprey trap or fish passage device, if present – e.g., debris blocking attractant water intake or fishway exit?
5. What is condition of site or other facilities – docks; boat portage; signs; safety railings; access road or trail to site; any litter or vandalism?

Stream/River name of Barrier		
State/Province/Country		
Date of report		
Name of person completing report (print)		
Signature		
Name of agency		
Description of potential problem or repair (use other side of page if necessary)		
Description of repairs		
Date repairs completed		
Cost of repairs (materials and labor)		

OPERATIONS AND MAINTENANCE OF TRAPS

1. Protocol Title: Operations and Maintenance of Traps

2. Protocol Business Need

Sea lamprey traps are used to monitor spawning migrations of sea lampreys from spring to early summer. Traps at barriers can be portable, semi-permanent, or permanent (see Section 6.13 for trap definitions). Trap catch of lampreys is a measure of relative abundance. A percentage of trapped spawning lampreys are normally used for instream mark-recapture studies to obtain absolute measures of abundance. Spawning lampreys are also captured for use in the sterile male release technique (SMRT) program and for research purposes. This protocol is required to satisfy internal business needs of the barrier program.

Failure to implement the protocol as described could result in failure of the trap to meet its intended purpose (i.e., unreliable population estimates, insufficient supply of animals for the SMRT program and research needs, etc.). In addition, there could be a negative impact on non-target species incidentally captured in traps unless fish are provided adequate passage past the barrier or released in time and good condition from the trap.

3. Protocol Deliverables

This protocol describes the operations and maintenance procedures for traps at barriers. The time period for beginning and ending trapping operations normally ranges from early April to early August and can vary by stream, watershed, or lake. Weather and water temperatures also affect operation dates. Occasionally traps may be operated earlier or later than normal if additional lampreys or lamprey information are required. Specific criteria to assist with the timing of trap operations are provided in the protocol Operating Times for Barriers. When a barrier has a fishway, and the sea lamprey trap is located within the fishway, this protocol will be implemented for the same time period that the fishway is operated. Control agent personnel will negotiate with barrier owners/operators to maximize the potential for achieving the goal for which the trap is being operated.

4. Target Audience

Adult assessment employees of the DFO-SLCC and FWS-Marquette Biological Station, cooperators, and private contractors will carry out the operations and maintenance of sea lamprey traps.

5. The Jurisdiction for Protocol Use

This protocol will apply to all traps that are located on streams tributary to the Great Lakes. The operation and maintenance of most traps will be funded by either the adult assessment or SMRT programs, and trap catch data from all traps will be utilized in the planning and operation of the IMSL program.

The only jurisdictional variation in the implementation of this protocol will be in the area of compliance with health and safety regulations. Control agents and cooperative partners will ensure that employees adhere to the health and safety regulations that are applicable to their agency. Private contractors employed by the control agents and cooperators will be advised of hazardous situations at all trap locations for which they are contracted to service, however, the observance of health and safety regulations is the responsibility of the contractor.

6. Procedures

6.1. Background Information

Traps are most efficient when located next to, or are incorporated into, a permanent structure such as a barrier or fishway along with a sufficient flow of attractant water. The

adult assessment program operates approximately 75 traps annually. About 50 are located in the U.S. and 25 in Canada.

Canada uses mostly permanent concrete or steel plate traps incorporated into its fixed-crest and adjustable-crest barriers. The U.S. presently relies largely on portable and semi-permanent traps. Portable and most semi-permanent traps are removed at the end of the season and stored off site during the winter.

6.2. Securing Private Contractors

When there are insufficient control agent or cooperator staff to service all the traps, private contractors will be hired. By December or January prior to the next spawning season the number of contractors required for the next field season should be determined.

FWS assessment staff should develop potential contractor or bidder lists and forward them, along with scope of service, wage rate sheets, and preproject approval forms to Contracting and General Services (CGS) in the regional office in Minneapolis, MN. CGS will put the contracts out to bid in late January, early February. FWS contracts are normally awarded on the basis of low bid but past performance and experience should also be considered.

DFO-SLCC should develop and have authorized, following DFO regulations, their personal service contract proposals by late February. They should then be forwarded to the DFO-SLCC administration for release to the selected contractors no later than mid-March. To fill vacant private contractor trapping opportunities, DFO-SLCC will follow Treasury Board guidelines and try to secure three bids for each vacancy where possible. DFO regulations do not stipulate that the lowest bid need be accepted.

If the contract is to be between the GLFC and the contractor, the secretariat's administrative officer must first approve it. Contracts must identify the contractor as an independent contractor and that they are responsible for providing their own coverage for workers' compensation, income tax, liability insurance, etc. The contract must include a clause that indemnifies and holds harmless the GLFC or control agents for acts and omissions and any claims by third parties arising from the contractor's actions in carrying out work under the contract.

A contractor chosen strictly on the basis of price alone could, if he/she finds he/she is not covering his/her expenses, cut corners and as a result a whole season of data could be lost. Prior to training sessions and/or the beginning of the trapping season , the contractor should sign the type of contract stipulated by each agency.

6.3. Training and Safety

Prior to the beginning of the trapping season FWS, DFO-SLCC, and cooperator staff, new to the adult assessment program, along with new trap contractors, will be given training by control agent staff at the trap site(s) they are to service. Training will include how to operate and service the trap and complete the required paper work. Worker safety will be stressed, especially when working around traps in high and fast moving water where footing is usually slippery. The wearing of a PFD by contractors when servicing a trap is required. All control agent staff must wear a PFD where the hazardous circumstances as defined by their regulations occur. Some work is labor intensive and may involve the lifting of heavy materials, such as containers or nets full of lampreys, traps, trap doors, and fishway grating while standing in the water. These activities may require more than one individual.

6.4. Procedures

Three standard operating procedures (SOP) have been prepared by the FWS for standard portable assessment traps and some permanent and semi-permanent traps: 1) portable assessment traps, 2) Cheboygan and Manistique Rivers (semi-permanent traps), and 3) Ocqueoc River (permanent trap). New traps constructed that are not addressed with current standard operating procedures (for permanent and portable traps) will have a new SOP developed.

Wisconsin Department of Natural Resources (WDNR) has their own procedure for operating the trap incorporated into their methods for operating the fishway at the Brule River barrier.

DFO-SLCC has written procedures for the operation of portable traps, permanent traps, and permanent traps incorporated in fishways (Cobourg Brook, Big Carp Creek, and Big Creek).

Copies of applicable procedures will be provided to all those responsible for servicing traps.

6.5. Data Collection and Recording

Operating procedures identify the need to count and record biological information on lamprey and fish found in the traps during servicing. Other information such as date, time, weather and water temperature and conditions (e.g., turbidity) is also recorded. This information is required for the adult assessment and SMRT programs.

Adult assessment staff of the control agent will train all people who service the traps how to correctly record this information on the trap daily report and biological data forms. They will also provide direction on how to deal with tagged lamprey found in traps as well as how to carry out mark-recapture studies at specific locations.

All individual traps must be sampled separately. Where there is more than one trap at a site the lamprey sampled from each will be recorded separately.

As well as mailing in the recorded forms weekly, the numbers caught the previous week must be called in on the first workday of the following week. The adult assessment program will provide details on this process.

6.6. Sorting and Disposition

Control agents, cooperators, and contractors will make their own arrangements for disposing of lamprey and dead fish taken from traps. All live fish and native lamprey, other than specimens required/requested by authorized fishery agencies and researchers will be released unharmed. Where local landfill sites are used for dead fish and lamprey disposal, all waste disposal regulations must be followed. Any operators that are required to collect lampreys for research purposes will be provided with specific written instructions by the researcher requiring the lamprey.

6.7. Male Lampreys for SMRT

Where male lampreys are required for the SMRT program they need to be carefully handled and transferred to holding tanks if they are to be retained prior to being shipped to the sterile male facility at the HBBS. Of particular importance is the temperature and

dissolved oxygen content of the water in the holding tanks. Instructions on how male lampreys are to be handled and stored prior to shipment are contained in the written procedures for servicing the traps where the males are collected for this purpose. Truck drivers taking the lampreys to the HBBS are provided with their own written procedures for this operation. During the busy part of the spawning run male lampreys can be delivered to the HBBS seven days per week.

6.8. Trap Service Schedules

Traps are normally serviced once a day five to seven days per week depending on site. Five days per week is the average because this length of time is sufficient to obtain the required assessment data. Some traps that consistently capture large numbers of lamprey, or tend to build up with debris, or portable or semi-portable traps that have a high likelihood of being moved out of place (by high water or vandalism) will be checked six days per week. Net sites are also checked six days per week because they need to be cleaned more frequently to reduce the potential for wash out. Control agents or cooperators may service traps in which males are harvested for SMRT up to seven days per week. The Brule River trap will be serviced every time the fishway is serviced by WDNR the number of times per week varying depending on their schedule. Servicing schedules of permanent traps may vary in order to comply with any environmental assessment conditions originating from barrier or fishway construction approvals.

6.9 Supervision

Supervision of all trap sites is to be provided by adult assessment staff of the agents. A minimum of two visits per trapping season should be scheduled for each contractor serviced trap site. The first visit will involve setting portable and semi-portable traps and providing initial instruction to new contractors or refresher instruction to returning contractors. A second visit, when possible and considered necessary, should serve as a contract check where adult assessment staff meet with the contractor and service the traps with them to observe that they are correctly following all procedures. A final visit may be required at contract termination to recover equipment provided to the contractor.

If problems in the work are suspected additional visits should be scheduled. Where concerns are verified, and contractor compliance with terms of the contract is unacceptable, their service should be terminated in writing noting the reason(s) for dismissal. An alternate contractor should then be arranged for immediately if sufficient time remains in the trapping season.

The nature of supervision of adult assessment and cooperator staff will be at the discretion of the respective control agent adult assessment supervisor.

6.10. Trap and Site Maintenance

On the first visit to the trapping site in the spring, portable and semi-portable traps will be put in place. Permanent traps will be inspected for ice and spring freshet damage and silt and debris build-up and funnels/sliding panels/water inlet controls will be installed. Any repairs required to permanent traps before the trapping season begins should immediately be reported to the adult assessment supervisor. Trapping sites should be assessed for required repair/maintenance work at the same time. Any problems noted with barriers or associated fishways should be immediately reported to the barrier coordinator.

Any further trap repair/maintenance noted during the servicing of the traps should be carried out as required. Site maintenance will be done on an as needed basis. A final

visit is required at the end of the season to effect minor trap repairs, assess the need for further maintenance, remove portable and semi-permanent traps, and remove funnels/sliding panels/water inlet controls from permanent traps. Portable and semi-portable traps should be stored for the winter where they cannot be vandalized or damaged by winter weather. If stored outside, funnels should be removed or blocked so small animals/birds cannot be trapped in traps.

Repairs to all traps and site maintenance will be done by agency personnel or designated contractors with the requisite skills. The Tittabawassee River trap is maintained cooperatively by the FWS and Dow Chemical. Repairs requiring additional expertise (e.g., welding) will be contracted out at the closest location possible. WDNR maintains the Brule River trap and site. The USACE has prepared a checklist for the St. Marys River trap (Michigan side) and the FWS will annually complete the form or phone in the required information to the USACE engineer responsible for that site.

6.11. Skills Required

Personnel servicing traps must have the following skills:

- Basic understanding of the fundamentals of the biological sciences,
- The ability to identify fish found in Great Lakes tributaries, including native lamprey,
- A suitable mechanical knowledge to be able to operate and maintain equipment associated with lifting traps and containers full of lamprey,
- The capability of keeping statistical records on fish, of summarizing data, and of submitting a weekly progress report,
- The ability, as part of a two-person team where required, to set and lift portable lamprey traps which, when filled, may occasionally exceed 68kg (150 lb.) in weight,
- The perseverance to perform repetitive tasks with a high degree of accuracy, and
- The physical ability to perform the above duties in adverse weather conditions.

6.12. Level of Effort

The amount of time that will be spent at a site servicing the traps will depend on trap purpose, daily catch, river conditions, etc. This usually ranges between one to four hours. Where two person crews are employed this could average two to four person hours for most trap sites. Repair/maintenance time would be additional, as would the time required for transferring male lamprey for the SMRT program to holding facilities. The trapping season usually lasts about eight to ten weeks on average.

While trap construction is a barrier cost, the operating costs are not currently associated with traps at barriers and, thus, are not attributed to the life cycle costs of barriers. The adult assessment and the sterile male release technique budgets of the agents account for these costs.

6.13. Definitions

Portable trap – rectangular steel mesh cages hung by chains from a structure in a stream, or hoop or fyke nets

Semi-permanent trap – a steel mesh cage or steel plate box, usually square or rectangular, held in a fixed position on a structure in a stream by permanent attachments

Permanent trap – a concrete or steel trap, usually square or rectangular, built into a permanent barrier and/or fishway

7. Tools Required

A vehicle capable of accessing trap locations and transporting lampreys to disposal sites is required for servicing traps. Servicing some sites may require a stable boat (rowboat, motorboat) outfitted for holding containers of lampreys. Specialized equipment used by adult assessment staff for moderate repairs, maintenance, cleaning sites and access roads (e.g., high pressure pumps for silt and sand removal, chain saws, generators, welding units, compressors, hammer drills, heavy winches). Waders and rain gear are also required and contractors must supply these at their own at their expense.

The control agents will supply the following specialized equipment to contractors: small hand tools, replacement repair items (nuts, bolts, cable, wire, etc.), weigh scales, thermometers, instruction manual, identification key for lampreys and fish, measuring board, dissecting instruments, preservative, lamprey containers and tags, lamprey marking equipment, nets, field catch and biological information forms, and self addressed envelopes.

8. Information Requirements

This protocol generates information on the number and biological characteristics (gender, length, weight) of lampreys and coincidentally captured species. Physical information is tabulated, summarized, and analyzed to provide an estimated number of spawning-phase sea lampreys or other life stage (transformer, parasitic) targeted by individual studies. This information is then extrapolated to provide a population estimate of adult lamprey for each of the Great Lakes and is used to measure the success of the lampricide control program. Other information may be obtained from trap data that will contribute to GLFC sponsored studies on lamprey behavior around traps or the potential environmental impacts of barriers.

9. Contract Requirements

Service contracts are required when independent contractors are hired to service traps. Contracts issued by the GLFC or the agents follow the protocols GLFC Secretariat Administration and Contract Management of Barrier Program, FWS Administration of Barrier Program, or DFO-SLCC Administration of Barrier Program.

10. References

11. Use of Other Protocols

Standing Operating Procedures (SOPs) prepared by WDNR, FWS and DFO-SLCC for the operation of traps in general and for specific trap locations along with recording requirements.

HBBS procedures required for handling and holding male lampreys destined for SMRT facility.

Operating Times for Barriers

Design Criteria for Permanent Traps

Performance Measures for Traps at Barriers

GLFC Secretariat Administration and Contract Management of Barrier Program

FWS Administration of Barrier Program

DFO-SLCC Administration of Barrier Program

12. Protocol Authority

Adult assessment supervisors have the authority to amend this protocol as required.

12.1. Allowance for Variations from Protocol

Control agent and cooperator staff and independent contractors should be able to deviate from this protocol with full concurrence from the appropriate adult assessment supervisor or his/her assistant.

12.2. Protocol Status and Revision

This is a new protocol and should be reviewed for currency and relevance after two years of use.

12.2. Author and Date

M. S. Millar, March 1999

OPERATIONS AND MAINTENANCE OF FISHWAYS

1. Protocol Title: Operations and Maintenance of Fishways

2. Protocol Business Need

This protocol is driven by both external jurisdictional permitting/approval requirements and by internal GLFC commitments to minimize the environmental impacts of sea lamprey barriers.

3. Protocol Deliverables

This protocol is intended to provide direction on the operation and maintenance of fishways associated with sea lamprey barriers and/or traps. Permitting/approval requirements may dictate operating procedures, including periods of fishway operation.

4. Target Audience

Fishways may be operated and maintained by the FWS and the DFO-SLCC Control Agent adult or fisheries assessment staff. At some locations, and in some instances, staff from cooperating agencies or volunteers may operate or assist with operating fishways.

5. The Jurisdiction for Protocol Use

The protocol will apply to all fishways associated with barriers located on streams tributary to the Great Lakes. Due to differences in environmental assessment permitting or direction/permitting from cooperator agencies, the operation of fishways may vary by jurisdiction or agency, e.g., length of season or hours/day a fishway must operate.

6. Procedures

6.1. Background

In rivers and streams fish migrations involve completing a cycle of upstream and downstream movements. Generally, downstream migration is a feature of early life stages, while upstream migration is a feature of adult life. Fish migrate to spawn, to feed, and to seek refuge from predators or harmful environmental conditions. Should a natural (e.g., waterfall) or man-made (e.g., barrier) obstruction block the stream, fish migration may be slowed or stopped altogether. A fishway is a waterway or fish passage device designed to allow the passage of a species, or a number of different species, of fish past a particular obstruction in a stream.

Over the years many fishways have been designed and built to divert or pass target species of fish for a variety of reasons. In the Great Lakes Basin most fishways have been built to pass anadromous species of fish. Unfortunately, few fishways have worked as planned and insufficient investigation has been done to determine why they have not worked. It is really only in the 1990s that a concerted effort has been made to address this situation. The GLFC and their control agents need to request research in this area, as adequate fish passage is the primary issue that will influence the acceptance of new barriers. Future advances in fishways will depend on fish behaviorists working with hydraulic engineers to design appropriate fishways. Both they and researchers should not lose sight of the need for fish passage downstream as well as upstream.

6.2. Existing Situation

6.2.1. General

Fixed-crest barriers – one or more jumping pools below the barrier permit the passage of jumping fish. Non-jumping fish cannot pass at any time of the year without some

other type of fish passage device or when the barrier is inundated during the early spring. There are over 40 fixed-crest barriers in Canada and the U.S. that provide jumping pools for fish passage.

Adjustable-crest barriers – all fish can pass when the barrier is not activated to stop lamprey. Jumping pools can be associated with these barriers to accommodate jumping fish during the lamprey spawning run. Non-jumping fish require some type of fish passage device to get past the barrier during the spawning run.

Electrical barriers – all fish can pass when the barrier is not activated to stop lamprey. All fish require some type of fish passage device, usually of a pumped storage variety, to move around an electrical barrier when it is operating. Fishways associated with electrical barriers are much more expensive to design, build, and operate than those associated with fixed-crest and adjustable-crest barriers.

6.2.2. United States

Brule River (Wisconsin-Lake Superior) lamprey barrier/fishway – the fishway is a combination vertical slot and pool and weir fishway with the augmentation of attractant water. The lamprey are separated out when they meet an adjustable three section metal gate with an overhanging metal lip. Jumping fish simply swim over the adjustable gate and continue upstream. Non-jumping fish are not accommodated at any time of the year with this fishway.

Betsie River (Michigan-Lake Michigan) – the barrier itself is a fishway – half of the crest length is a single vertical drop and half is a two-step pool and weir fishway. This fishway only accommodates jumping fish.

Pere Marquette River (Michigan-Lake Michigan) – electrical barrier with a pumped water-source pool and weir fishway now under construction. Both jumping and non-jumping fish can negotiate this fishway.

West Branch-Rifle River (Michigan-Lake Huron) – Flowage Lake dam was recently reconstructed with a pool and weir fishway with submerged orifices to pass brown trout. The primary purpose of the dam is to create a recreational impoundment but it also serves as a de facto barrier. The fishway is designed to be operated in the spring to block and trap lamprey by closing the lower orifices and installing a lamprey trap in the lowermost pool.

6.2.3. Canada

Fishways in Canada are required under permit to be operated 7 days per week.

Big Creek (Ontario-Lake Erie) and Big Carp River (Ontario-Lake Superior) – are adjustable-crest barriers with built-in trap/fish passage devices with attractant water. A valve adjusting water flow through the trap/fishway creates attractant water. Fish and lamprey swim into a concrete trap through a vertical slot where lamprey and fish are separated into different chambers. Chambers are fitted with wire baskets that are lifted or winched out (if depth of trap is over 1.5 m (5 ft.)). Lampreys and fish may also be netted out. Fish are deposited upstream of the barrier.

Cobourg Creek (Ontario-Lake Ontario) – fixed-crest barrier with a conventional vertical slot fishway-screen at the top end of the fishway which diverts lamprey and fish into a concrete trap as described above. At the end of the spawning run the screen is removed

so the fish can swim right through for the balance of the year. Most species of fish can negotiate this fishway.

6.3. Operations and Maintenance Procedures

6.3.1. Staffing

Barrier coordinators are responsible for ensuring sufficient staff (control agents, cooperators, contractors, or volunteers) are available to operate fishways at all times during the lamprey spawning run. There should be a contingency plan in place to get extra help if the size of the migrating fish run is such that passage is being delayed.

6.3.2. Fish Studies and Performance Evaluation

Approvals and permitting for new barriers often entail pre- and post-construction fish studies. On many Great Lakes tributaries fisheries information is incomplete. The operation of fishways by control agent staff and biologists from cooperating agencies provides an ideal opportunity to collect fisheries information on the stream.

The design of a fishway is both an art and a science. Experience indicates that fishways require ongoing adjustment to optimize their performance. Fishway performance should be constantly evaluated to check both the fishway impact and its efficiency. Any modifications to improve its performance should be documented. Performance evaluation may consider additional visual observations such as snorkeling or using an underwater video camera to observe fish behavior in the fishway.

6.3.3. Operating Times

Fishways are operated along with barriers to stop lampreys and pass fish during the lamprey spawning run. Fishway operators are to check with barrier coordinators to verify barrier operation starting and stopping dates. At the end of the spawning run, where applicable, barriers and/or fishways are to be adjusted/modified to pass fish for the balance of the year. Special adjustments may need to be made to some fishways for winter operation, especially to prevent complete freeze-up (e.g., Brule River fishway).

6.3.4. Routine Operations and Maintenance

Consistent performance of a well-designed fishway is largely based on maintenance and regular observation of operation. Without proper maintenance even perfectly designed fishways can be rendered useless. At the beginning of the season all upstream water intakes, screens, etc. should be cleared of any accumulated debris. Upstream exits from some fishways need to be constantly checked to ensure debris is not preventing fish from leaving the fishway. If debris is a constant problem a trash rack or boom should be considered. A spring inspection of the fishway should be made to ensure that there is no winter damage from ice flows, silt build-up from spring freshets, etc.

The crest height at barriers, where jumping fish are passed by using jumping pools, may need to be fine-tuned to ensure they are high enough to effectively block lampreys and yet still accommodate the jumping fish. On a fixed-crest barrier this usually involves adjusting the stop logs and on the adjustable-crest barrier the height of the inflatable bladder. With other fishways a flow of sufficient water must be maintained to act as an attractant to the fishway entrance and ensure safe passage through the fishway. Fishways that require pumped storage or flows must have a standby pump and generator on site.

6.3.5. Daily Operations

Fishways should be checked and emptied daily. Temperature stress and injury due to crowding may otherwise result. At busy times, morning and evening servicing may be required. Two-person crews should be used where necessary to remove fish from trap-and-sort fishways, especially where the inner steel cage needs to be removed by hand or winch. Care should be taken with fish when removing them from the fishway and depositing them upstream of the barrier/fishway in order to minimize stress and pre-spawning mortality. Possibly a release site, 6 to 9 m (20 to 30 ft.) upstream, should be designated which permits a resting location for the fish to complete their recovery and thus avoiding fallback on the barrier. Arrangements for disposal of lampreys and any dead fish are discussed in the protocol Operations and Maintenance of Traps.

6.3.6. Training and Safety

The control agents or cooperating agency responsible for the operation of the fishway will provide training for the operation of the fishway and the handling of fish to all those involved in servicing fishways. Written fishway operating and fish handling procedures should be supplied where required. This training will include fish identification and how to record the necessary numbers and biological information requested by the control agents or cooperating agencies. Data entry can be undertaken either on site, using portable computers, or transferred from field notes in the office.

Worker safety will be stressed during training. PFD and other safety equipment will be used, when servicing a fishway located in or adjacent to high or fast flowing water, according to the safety regulations of the organization for which the employee/volunteer is working. At some fishways (e.g., trap-and-sort) the work could be labor intensive and may involve lifting heavy dip nets or containers/cages, traps, trap doors, or fishway grating. These activities may require more than one individual.

6.3.7. Inspections and Repairs

Any minor repairs to fishways noticed during their servicing should be completed at the time of servicing if practical (e.g., necessary materials and tools available). Major repair requirements should be reported to the appropriate barrier coordinator and/or the cooperator responsible for its operation.

All fishways should be inspected at the end of the season and arrangements for needed repairs made accordingly. Such repairs/maintenance should be done by control agent/cooperator personnel or designated contractors with the requisite skills. Where required internal steel cages, removable funnels, screens, etc. will be removed and stored where they are out of the weather and safe from vandalism.

Personnel servicing fishways should advise natural resource agency conservation officers when they note any pooling of fish below barriers or potentially serious violations of fishery regulations at barrier/fishway sites. Requesting the prohibition of fishing at barrier/fishway sites during the lamprey run should be considered where it is felt this action is advisable.

6.4. Skills Required

Personnel servicing fishways must have the following skills:

- Basic understanding of the fundamentals of the biological sciences,

- The ability to identify fish found in Great Lakes tributaries,
- A suitable mechanical knowledge to be able to operate and maintain equipment associated with lifting traps and containers full of fish,
- The capability of keeping fish statistical records, of summarizing data, and of submitting a weekly progress report if required,
- The ability, as part of a two-person team where required, to set and lift portable containers which, when filled with fish, may occasionally exceed 68kg (150 lb.) in weight,
- The perseverance to perform repetitive tasks with a high degree of accuracy, and
- The physical ability to perform the above duties in adverse weather conditions.

6.5. Level of Effort

An estimated one or two hours of work per two-person crew is required daily at most fishways, excluding travel time, except at the peak of the fish spawning run. Then two or more trips per day may be required to the fishway, or possibly a ten hour stint during the peak of the fish run, which could last a week or longer. The duration of fish migration runs varies by species and river.

6.6. Definitions

Trap-and-sort fishways – fish are guided into traps (with or without steel cage inserts) and then removed manually (in most instances) from the trap and deposited upstream of the barrier. (Lamprey may or may not be trapped with or separately from the fish.) These fishways can be used by all species of fish.

Jumping pools – are the simplest form of fish passage used at barriers and consist of providing pools of sufficient depth for a fish to accelerate to a speed necessary to jump high enough to clear the barrier crest.

Pool and weir fishways – are fishways in which pools are arranged in a stepped pattern and are separated by overflow weirs each of which is slightly higher than the one immediately downstream. These fishways are sensitive to fluctuating water levels and require adjustment accordingly. This type of fishway, when used with barriers, is designed for jumping fish. However, they can be designed to pass non-jumping fish.

Denil fishways – are rectangular chutes with closely spaced baffles or vanes extending from the sides or bottom that are angled upstream. There are variations of the Denil fishway. These fishways can accommodate most species of fish.

Vertical slot fishways – are similar in construction to pool and weir fishways except that the water flows through a vertical opening in each weir rather than over the crest. These fishways can accommodate most species of fish.

7. Tools Required

A vehicle capable of negotiating access to barrier/fishway locations and carrying containers of lampreys and dead fish to disposal sites. Dip nets to remove fish from enclosures or winches to lift steel cage inserts. Small tools to make minor repairs to fishways. Waders and rain gear may be required in some situations. The control agents will supply biological information forms. Portable

computers or electronic counters would allow on-site data entry, thereby reducing time requirements for data entry in the office and chances for error in transcription of data.

8. Information Requirements

The implementation of this protocol can generate information on the number, species, sex, size, etc. of fish trapped and passed. Additional information could also be recorded at the same time – water temperature, levels, turbidity, and flow conditions; size of fish run; tagged fish; condition of fish; upstream or downstream movement; whether hatchery or wild fish; etc. This information will assist the GLFC in meeting any post-construction permitting/approval requirements (e.g., barrier impact on non-target species) and provide data useful for performance evaluation of the fishway. In addition, such information will be useful for future barrier/fishway construction applications (e.g., there should be a reduced need for fisheries assessment data due to a greater fishery knowledge base), and it can be added to a the fishery database for the particular agency responsible for the management of the stream.

9. Contract Requirements

Cooperating agreements may be required with the cooperating agencies for the operation and/or maintenance of the fishway.

Service contracts issued by the GLFC or the agents follow the protocols GLFC Secretariat Administration and Contract Management of Barrier Program, FWS Administration of Barrier Program, or DFO-SLCC Administration of Barrier Program.

10. References

Katopodis, C. 1992. Introduction to Fishway Design (unpublished working document), 68 pp.

11. Use of Other Protocols

Design Criteria for Fish Passage

Operating Times for Barriers

Operations Procedures for Barriers

Operations and Maintenance of Traps

FWS Construction Contracting and Management

DFO-SLCC Construction Contracting and Management

GLFC Secretariat Administration and Contract Management of Barrier Program

12. Protocol Authority

Barrier coordinators, with concurrence of appropriate control agent or cooperating agency fishery biologists, have the authority to amend this protocol as required.

12.1. Allowance for Variations from Protocol

Personnel servicing the fishways can deviate from this protocol on site where required upon consultation with the appropriate barrier coordinator or fishery biologist. The deviation and the rationale should be documented in writing where it may influence the biological information being recorded.

12.2.Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3. Author and Date

M. S. Millar, March 1999

PERFORMANCE MEASURES FOR TRAPS AT BARRIERS

1. Protocol Title: Performance Measures for Traps at Barriers

2. Protocol Business Need

This protocol is required to provide the framework for determination of whether a trap built in conjunction with a barrier performs as planned. It will be used to annually measure trap performance in newly built or redesigned/modified traps for the first three spawning seasons following construction that the trap is operated (some traps may not be operated immediately following construction).

3. Protocol Deliverables

The protocol provides guidance and advice to the Barrier Annual Work Plan protocol and the analysis of data generated by the Operations and Maintenance of Traps protocol.

4. Target Audience

Control agents, cooperators, and contracted operators who will be assigned to measure trap performance.

5. The Jurisdiction for Protocol Use

This protocol applies across the Great Lakes Basin. Data analysis will be conducted by an agent assessment fishery biologist.

6. Procedures

Trap purpose will set the criteria a trap must meet in order for it to be deemed successful. Currently, a trap has three potential purposes: assessment, harvest of male lampreys for the sterile male release technique (SMRT) research program, and control in the St. Marys River.

6.1. Measuring Performance of a Trap Operated for Spawning-Phase Assessment

A trap operated for the assessment of spawning-phase sea lampreys performs as planned when it provides a statistically reliable estimate of the total number of lampreys present in a stream. A statistically reliable estimate is achieved when a certain number of lampreys are marked and a certain number of lampreys are subsequently examined for marks. Robson and Reiger (1964) provide a series of charts for determining the appropriate number of animals that must be marked and the subsequent catch that will be examined for marks. When these guidelines are met and the computed mark-recapture estimate has a coefficient of variation below about 65 (Assessment Task Force, 1996), it is considered statistically reliable.

The mark-recapture method used to estimate the number of spawning-phase sea lampreys in a stream is a modification of the Schaefer (Ricker 1975) method (Sea Lamprey Management, Marquette Biological Station, Adult Assessment Standard Operating Procedure for Spawner Mark/Recapture).

6.2. Measuring Performance of a Trap Operated for Sterile Male Harvest

A trap operated for the harvest of male lampreys for the sterile male release technique performs as planned when the cost per male lamprey is less than about $15.00 U.S. (1998). Cost per lamprey is determined by:

$$\frac{[(\text{operations} + \text{maintenance} + (\text{capital}/\text{predicted years of useful life})]}{\text{number of male lampreys captured}}$$

Operations represent the combined costs of personnel, contracts, equipment and supplies to service the trap and transport lampreys. Maintenance is the combined costs of personnel, contracts, and equipment to maintain the trap and trap site. Capital costs are the original cost to build the trap and associated features (see protocol Design Criteria for Permanent Traps) and are amortized over the predicted useful life of the project.

6.3. Measuring Performance of a Trap Operated for Control

A trap operated for control performs as planned when the cost, including operations and maintenance, to reduce the production of sea lamprey transformers, by trapping spawners, is less than the cost of lampricide control for the affected stream area downstream of the trap. All costs are amortized over the expected life of the trap (projected in 1998 as 50 years).

The number of spawners that would need to be removed to reduce the production of transformers has not yet been defined. As understanding of the stock recruitment relationship increases, the percent of the stream spawning population that would need to be removed could be defined. A stock-recruitment model developed for the St. Marys River showed the population of the present spawning run (~25,000 annually) would have to be reduced by about 90% to eliminate recruitment of 75% of the larval population in that river. If this 90% level applies to other streams, then to begin to change treatment patterns and costs is likely much greater than 90%. Achievement of this high capture is not attainable with the current approach to trapping.

Once the level of spawner removal is defined, measurement of trap performance is represented by trap efficiency. Trap efficiency is defined as the number of lampreys captured in the trap divided by the total number estimated in the stream.

An additional consideration related to control is the effect of spawner removal by traps and its relation to potential barrier inundation. As lamprey congregate below a barrier, there is potential for them to bypass the barrier during high water. If the congregated lampreys were removed by trapping, then there would be fewer lampreys available to pass the barrier should it become passable. However, there is no data to support what level of removal would be required and when it would need to take place to have a measurable effect.

6.4. Traps Not Performing as Planned

In the event a trap does not meet its intended purpose, an analysis to identify problem sources will be conducted. There are several reasons why a trap may fail. The problem may be structural, operational, or environmental.

6.4.1. Structural Problems

Structural problems include (but are not limited to):

- Entrance/funnel out of water,
- Attractant water inadequate,
- Escapement,
- Improper location of trap entrance, and
- Water volume in trap inadequate.

Barrier coordinators are responsible for structural problems. In cooperation with adult assessment staff, barrier personnel will assess the role of structural features on trap performance and rectify identified shortcomings to improve trap performance to the extent that they are feasible and cost-effective.

6.4.2. Operational Problems

Operational problems include (but are not limited to):

- Contractor inadequate/unreliable,
- Servicing schedule inadequate, and
- Servicing equipment inadequate.

Adult assessment personnel are responsible for any operational problems. Adult assessment staff will assess the year's operation, identify problem sources, and modify procedures to improve trap performance.

6.4.3. Environmental Problems

Environmental problems include (but are not limited to):

- Extremely high/low water,
- Clogged funnels, and
- Clogged water intakes.

Some problems that arise from the natural environment cannot be avoided. Others may be addressed through modifications to structural design and/or operational procedures. To the extent possible, adult assessment and barrier personnel will address ways to avoid or at least reduce the negative effect of environmental influences when they result in trap failure.

6.5 Skills Required

The field procedures for measuring trap performance require personnel to possess the following knowledge and capabilities:

- An understanding of the fundamentals of the biological sciences and fish health,
- The skill to perform repetitive tasks with a high degree of accuracy,
- The ability to perform duties under adverse weather conditions,
- The ability to identify fish found in Great Lakes tributaries,
- The skill in keeping fishery statistical records, and
- The ability to summarize data and submit weekly reports.

The computation procedures for measuring trap performance require personnel possessing the following knowledge and capabilities:

- An understanding of the fundamentals of fishery science and the concept of stock assessment,
- An understanding of statistical concepts,
- An understanding of mark-recapture estimation assumptions and procedures,

- The ability to translate raw data into a modified Schaefer mark-recapture estimate, and
- The ability to effectively use Excel or Lotus spreadsheets.

6.6. Level of Effort

The field procedures for this protocol will require traps be serviced each week of the spawning migration and are defined in the protocol Operations and Maintenance of Traps.

6.7. Definitions

Coefficient of variation-a dimensionless value that expresses sample variability relative to the mean of the sample.

7. Tools Required

In addition to traditional trap servicing equipment (see protocol Operations and Maintenance of Traps), the following items are required for implementing the field procedures for measuring trap performance of traps operated for spawning-phase assessment and control: small v-notch tool or paper punch, five-gallon bucket(s), and mark-recapture schedule and forms.

8. Information Requirements

This protocol requires information for implementation provided in the: Sea Lamprey Management, Marquette Biological Station, Adult Assessment Standard Operating Procedure for Spawner Mark/Recapture, Modified Schaefer Estimate, and the Operations and Maintenance of Traps protocol.

The product of the protocol will generate data required to perform the analysis described in Section 6.

9. Contract Requirements

See protocol Operations and Maintenance of Traps

10. References

Assessment Task Force. 1996. Minutes from the June 26, 1996 meeting.

Ricker, W.E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Bull. Fish. Res. Board Can. 191.

Robson, D.S. and H.A. Reiger. 1964. Sample size in Petersen mark-recapture experiments. Trans. Am. Fish. Soc. 93:215-226.

11. Use of Other Protocols

Barrier Annual Work Plan

Design Criteria for Permanent Traps

Operations and Maintenance of Traps

Sea Lamprey Management, Marquette Biological Station, Adult Assessment Standard Operating Procedure for Spawner Mark/Recapture. Modified Schaefer Estimate

Sea Lamprey Management, Marquette Biological Station, Adult Assessment Standard Operating Procedure for Trap Servicing, Portable Assessment Traps

12. Protocol Authority

The lead adult assessment biologists of the sea lamprey management program in both the U.S. and Canada are the approval authority for all processes and actions of trapping at barriers that relate to this protocol. The lead adult assessment biologists also are the approval authorities for amendments to this protocol.

12.1 Allowance for Variations from Protocol

The procedures for measuring trap performance all require servicing of the trap to collect the data necessary for the analysis. Although there are variations in how success is defined for each purpose, the service procedures will all follow the guidelines listed in Section 6 Procedures of this protocol and the protocol for Operations and Maintenance of Traps.

12.2 Protocol Status and Revision

This is a new protocol and it will be reviewed for currency and relevance after two years of use.

12.3. Author and Date

Katherine Mullett, March 1999

PERFORMANCE MEASURES FOR ESCAPEMENT AT BARRIERS

1. Protocol Title: Performance Measures for Escapement at Barriers

2. Protocol Business Need

This protocol is required to provide the framework for determination of whether a barrier performs as planned. This protocol provides the process for monitoring the performance of all barriers in the barrier inventory.

3. Protocol Deliverables

The protocol provides guidance on the process to determine whether a barrier and/or remedial action has performed as planned in blocking the sea lamprey spawning run. The primary resource management response to a barrier failure likely will be a lampricide treatment for the river or its acceleration in the cycle of lampricide treatment frequency.

4. Target Audience

Larval assessment personnel from the control agents of the sea lamprey management program assigned to measure barrier performance.

5. The Jurisdiction for Protocol Use

This protocol applies throughout the Great Lakes Basin.

6. Procedures

Barrier performance, as represented by evaluation of the escapement of spawning-phase sea lampreys upstream of barriers, is measured using current larval assessment techniques. The techniques are fully contained in protocols currently in use by the control agents. The protocols are referenced in the annual work plans of the control agents and are identical. These techniques apply to all barriers within the barrier inventory, irrespective of whether the barrier is a fixed-crest, adjustable-crest, or electrical. There are three considerations to this assessment: 6.1) type of evaluation, 6.2) timing of evaluation, and 6.3) frequency of evaluation.

6.1. Type of Evaluation

6.1.1. Detecting a Larval Population

Larval assessment surveys, designed to detect sea lamprey populations upstream of barriers, are conducted using assessment program protocols Larval Assessment Sampling Protocol using the AbP-2 Backpack Electrofisher in Great Lakes Streams and/or Larval Assessment Sampling Protocol for Non-Wadable Waters of the Great Lakes and its Tributaries. The protocols are not included in this report and are on file with the GLFC and the control agents.

The survey type for this investigation is described in the protocols as a detection survey. Discovery of sea lamprey larvae that were hatched after any lampricide treatment upstream of the barrier indicates that escapement has occurred. Survey results will be forwarded to the appropriate barrier coordinator by the larval assessment supervisor. Barrier coordinators may invoke the protocol Remedial Measures for Barrier Escapement to determine the cause of escapement and remedial actions.

6.1.2. Quantifying a Larval Population

Once a larval sea lamprey population is detected, regardless of the level of abundance, the stream is added to the list of streams considered for a quantitative assessment survey (QAS). This reach of stream is handled as any other stream for the purpose of determining if, or when, a lampricide treatment would be necessary. Guidelines for this survey are given in the Larval Assessment Sampling Protocol using the AbP-2 Backpack Electrofisher in Great Lakes Streams and/or Larval Assessment Sampling Protocol for Non-Wadable Waters of the Great Lakes and its Tributaries.

A QAS survey is scheduled and conducted one year prior to the time when larvae would first be expected to metamorphose and migrate from the stream, based on larval growth projections in that stream. This reach of stream is considered for lampricide treatment with all other streams in the basin at that time through the stream selection process of IMSL. A determination to treat this area is based on that analysis. An assessment fishery biologist makes this determination. If the stream reach does not warrant treatment based on this analysis, the barrier is performing as planned.

Survey results will be forwarded to the appropriate barrier coordinator by the larval assessment supervisor. The presence of multiple year classes of larvae will invoke mandatory site inspections as outlined in the protocol Remedial Measures for Barrier Escapement to determine the cause of escapement and remedial actions.

6.2. Timing of Evaluation

Surveys are conducted when success is expected to be the highest for determining presence and abundance of larvae; all surveys will be conducted in late summer or early fall when water levels are usually lower. Surveys to detect populations are intended to assess presence and abundance of yearling larvae; yearlings are most easily detected in the latter months (August and September) of the field season when they have dispersed throughout the reach and physically are the largest.

In the case of barriers that are operationally open to escapement during portions of the year (adjustable-crest barriers, barriers with fish passage, and electrical barriers) surveys will be made that target young-of-the-year larvae during the same year as the potential escapement. This will provide barrier coordinators with immediate information so that, if needed, they can change the operational characteristics of the barrier.

6.3. Frequency of Evaluation

After the initial installation of a barrier in a stream and subsequent lampricide treatment of the infested area upstream of any barrier, larval assessment is conducted to verify removal of the existing larval sea lamprey population. The river upstream of the barrier will be surveyed for the presence of larval sea lampreys each year of three consecutive years after the initial barrier installation to determine if escapement has occurred since the lampricide treatment. Thereafter, the upstream area will be surveyed based on the historic treatment cycle of that specific stream.

6.4. Skills Required

The field procedures for measuring barrier performance require personnel to possess the following knowledge and capabilities:

- Operator certification by qualified examiners for AbP-2 electrofishing gear,

- An understanding of the fundamentals of the biological sciences and population dynamics with regard to quantitative fishery assessment techniques,
- The skill to perform repetitive tasks with a high degree of accuracy,
- The ability to perform duties under adverse weather conditions,
- The ability to identify fishes and lampreys found in Great Lakes tributaries, and
- The skill in keeping fishery statistical records.

The computation procedures for measuring barrier performance require personnel possessing the following knowledge and capabilities:

- An understanding of the fundamentals of fishery science and the concept of stock assessment,
- An understanding of statistical concepts,
- An understanding of sampling gear corrections,
- The ability to translate raw data into estimates of transformer production, and
- The ability to effectively use Excel or Lotus spreadsheets, DOS text files, and database management software.

6.5. Level of Effort

6.5.1. Detection Surveys

This is the first level of performance measure that is done as a product of this protocol. The amount of effort to conduct this work is specified in the control agents' protocol but is slightly more intensive for this investigation. Using the electrofishing guidelines in the protocols, a minimum of four and maximum of ten sites (preferentially selected) are examined for the presence of sea lamprey larvae. The number and locations are adjusted by the assessment fishery biologist based on several factors including access points, available larval habitat, method and duration of escapement (if known), and other pertinent considerations. About six staff days would be required to fulfill this level of effort for each barrier that is evaluated.

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6.5.2. QAS Surveys

This is the second level of performance measure that is done as a product of this protocol. When larvae are found in a detection survey (see sections 6.1 and 6.5.1), then the scheduling and conduct of a QAS survey is triggered. The amount of effort to conduct this work is specified in the control agents protocols but generally a minimum of six and maximum of ten access sites (randomly selected) are electrofished to determine the transformer production level in the upstream reach of a stream. Additionally, habitat evaluations will be necessary when the habitat for the reach has not been inventoried within a ten-year period. About 16 staff days would be required to fulfill this level of effort for each barrier that is evaluated.

6.5.3.Water Level Data Loggers

Water level data loggers will be used as standard operational equipment at all future barrier sites. The leveloggers primary purpose will be to record water stage. When detection (see 6.5.1.) and QAS (see 6.5.2.) surveys show recruitment of larvae upstream of a barrier, the data from the leveloggers will be used to determine if escapement by spawners occurred because of a known increase in river stage above crest height. If

recruitment of larvae occurs upstream of a barrier and the leveloggers show inadequate river stage for adult lampreys to have swum over the barrier, then escapement occurred by some other means. This would necessitate the determination of other causes for escapement using the protocol Remedial Measures for Barrier Escapement.

6.5.4. Budget

While water level data loggers (6.5.3) is a barrier cost, the operating costs of detection surveys (6.5.1) and QAS surveys (6.5.2) currently associated with barriers are not attributed to the life cycle costs of barriers. The larval assessment budgets of the agents account for these costs including staff time for data analysis.

6.6. Definitions

Detection survey - a survey that is the most efficient in examining the best larval habitat in a stream to search for the presence or absence of larval sea lampreys.

QAS survey - a survey that uses unbiased techniques to sample larvae and their habitat in streams to make estimates of density of the population of larval sea lampreys.

7. Tools Required

In addition to traditional larval assessment equipment, the following items are required for implementing the field procedures:

- Qbasic software program written by U.S. control agent (currently being incorporated into the Lamprey Control Selection System (LCSS) software which is under development by the GLFC Secretariat) to estimate transformer production, and
- Larval assessment workbook with standard operating procedures and data forms.

8. Information Requirements

This protocol requires information for implementation provided or referenced in the:

- BAWP,
- Annual Report by the Agents to the GLFC, and
- MOA between the control agents and the GLFC.

9. Contract Requirements

10. References

11. Use of Other Protocols

Remedial Measures for Barrier Escapement

This protocol requires the use of other protocols (not included in this report) from the assessment program:

Larval Assessment Sampling Protocol using the AbP-2 Backpack Electrofisher in Great Lakes Streams (on file with the GLFC and control agents)

Larval Assessment Sampling Protocol for Non-Wadable Waters of the Great Lakes and its Tributaries (on file with the GLFC and control agents)

12. Protocol Authority

Larval assessment biologists of the sea lamprey management program in both the U.S. and Canada, working in conjunction with the team leader of this task, have authority to amend this protocol.

12.1. Allowance for Variations from Protocol

The procedures for measuring barrier performance require conducting larval assessment surveys to collect the data necessary for analysis. Variations from protocol are not allowed.

12.2 Protocol Status and Revision

This protocol should be considered current unless the larval assessment techniques referenced within it change. Larval assessment techniques are reviewed annually by the control agents and those protocols are updated accordingly. Therefore, this protocol should be reviewed annually to determine if any revision is necessary.

12.3. Author and Date

Michael Fodale, March 1999

ENVIRONMENTAL EFFECTS EVALUATION

1. Protocol Title: Environmental Effects Evaluation

2. Protocol Business Need

This protocol is required to provide the framework for decision making when consideration of the environmental effects of barriers is desired. This protocol will satisfy primarily an internal business need to assist the GLFC in determining the direction of the barrier program. It could also serve external business needs where determination of barrier impact is requested by cooperating agencies.

3. Protocol Deliverables

The protocol provides guidelines to be used in the form of options (degree of acceptable environmental effect) when considering any barrier for placement in a Great Lakes stream. It will be used annually during the decision process and development or revision of strategic barrier implementation documentation.

4. Target Audience

SLBTF, SLIC, and the GLFC will use the protocol as each undertakes their respective role in development of the sea lamprey barrier program.

5. The Jurisdiction for Protocol Use

Basinwide without jurisdictional requirements

6. Procedures

The procedures for this protocol are still under development. A draft set of environmental criteria was proffered by the SLBTF in October 1998 for SLIC and GLFC review and comment. These will form the basic outline for procedural guidelines of this protocol in the future. Additionally, the results of the Noakes et al study, designed to evaluate the environmental effects of fixed-crest barriers on aquatic communities, is on a parallel time frame with the development of this protocol; information from this study is required to fully develop the environmental effects evaluation protocol.

Results from the Noakes, et al. study to date indicate both positive and negative effects from barriers on aquatic communities; negative effects appear minimal but may be greater than lampricide treatment effects over a projected barrier life span. In some cases effects may be mitigated so there is no effect, in other circumstances this perhaps may not be possible. The draft environmental criteria address issues such as these.

Anticipated completion of the Noakes, et al. study includes a planned April 1999 workshop where parts of this protocol may be further developed. The protocol will be finalized subsequent to this workshop and submission of their project completion report.

6.1. Skills Required

Ability to critically examine environmental concepts and make determinations if predicted effects will significantly alter aquatic environment or be in opposition to stated GLFC environmental criteria policy.

7. Tools Required

8. Information Requirements

It is anticipated that the completed protocol will require the use of the fish database compiled by Noakes, et al., and other fishery data from agency sources that may supplement existing database information and results of barrier environmental assessments.

9. Contract Requirements

Contracts needed to implement this protocol are envisioned should existing data be insufficient and fieldwork for collection of additional information become necessary.

10. References

11. Use of Other Protocols

Preliminary Engineering Designs and Plans

Fixed-Crest Barrier Design Criteria

Environmental Assessment, Permits, and Approvals Required for Barrier Construction by jurisdiction

12. Protocol Authority

The appropriate level of approval authority for amendments to the protocol rests with the GLFC.

12.1. Allowance for Variations from Protocol

The GLFC may direct further development of this protocol through the appropriate GLFC task force structure (SLBTF and SLIC).

12.2. Protocol Status and Revision

This protocol is new and once complete, should be reviewed every three years for currency and relevance based upon use of the protocol to that time.

12.3 Author and Date

D. Lavis, March 1999

REMEDIAL MEASURES FOR BARRIER ESCAPEMENT

1. Protocol Title: Remedial Measures for Barrier Escapement

2. Protocol Business Need

This protocol is required to determine the cause of escapement of spawning adult sea lamprey at a barrier. Once the cause is determined the next step is to determine and implement remedial actions to limit further escapement if it is considered of a recurrent nature. This protocol deals only with escapement and the determination of its cause from a barrier perspective. Other resource management actions may be initiated as a result of escapement; namely lampricide treatments that are covered in protocols for stream treatments.

3. Protocol Deliverables

This protocol applies to all barriers in the barrier inventory including de facto barriers. Investigations are triggered on evidence of escapement and remedial action plans are developed and implemented to reduce further risk of escapement.

4. Target Audience

Assessment staff of the control agents, barrier owners, barrier coordinators, and barrier engineers.

5. The Jurisdiction for Protocol Use

The protocol has general application throughout the Great Lakes Basin. This protocol deals only with escapement of sea lampreys upstream of barriers and the determination of its cause from a barrier perspective. Depending on their extent, some repairs and/or modifications may require permit application with dam regulatory bodies.

6. Procedures

6.1. Causes for Lamprey Escapement

Known causes of escapement include:

- Dam leakage such as holes in masonry abutments, rock gabions, seepage beneath dams,
- Accidental passage through a fishway or lamprey trap,
- Accidental spillage or escapement from containers while trap is being emptied,
- Flood events exceeding the designed barrier crest height during the adult lamprey run,
- Barrier washout,
- Beaver dams built on top of barriers,
- Passage through animal burrows, ditches or drains, and
- Vandalism (people placing lampreys upstream of the barrier).

6.2. Monitoring for Potential Escapement Events

There are several means of detecting whether escapement may have occurred. These include:

- Routine upstream larval detection surveys as described in protocol for Performance Measures for Escapement at Barriers,

- Routine maintenance inspections (see Maintenance Procedures for Barriers protocol), and catch records from traps (see Operations and Maintenance of Traps protocol),
- Routine monitoring of water levels from gauges for events when river stage exceeds crest height during the lamprey spawning run (gauges operated by other agencies and the control agents at recently constructed barrier sites),
- Random reports of state/provincial conservation officers regarding public activity and vandalism at sites, and
- Random reports of barrier owners and adjacent riparian owners as to changes to site conditions.

High flow events that result in the inundation of a barrier that are concurrent with the annual lamprey spawning run (see Fixed-Crest Barrier Design Criteria protocol) are considered to be a greater risk than high flow events that occur during other times of the year.

6.3. Notification of Escapement

Reports of any potential escapement from barriers should be provided as soon as possible to the barrier coordinators. All available detail on the nature and circumstances of escapement will be provided to assist in determining an appropriate response.

6.4. Barrier Coordinator Response

It is not possible to describe all responses to all circumstances in this protocol. Professional judgement of the barrier coordinators is required to evaluate the risk and determine an appropriate response based on specific circumstances. This may require site evaluations by the barrier coordinator(s) or their designates.

The barrier coordinators will maintain records of all escapement incidents and their outcomes as part of the barrier inventory.

The barrier coordinators are expected to apply due diligence to all reports of barrier escapement and to determine, to the best degree possible, the cause for escapement and whether such escapement is considered recurrent. If determined to be recurrent then a remedial action must be considered. For example, a flood inundation occurring during the lamprey spawning run would be considered a potential escapement event, which the barrier was not designed for. If no damage occurred to the structure then no remedial action to the barrier would be considered. The normal course of action in this situation would be that this was an accepted risk for which a larval assessment survey would be carried out to determine the need for a lampricide treatment.

6.5. Remedial Actions for Recurrent Escapement

Recurrent escapement can be defined as presence of multiple year classes of larvae upstream of the barrier as determined by larval assessment surveys under the protocol Performance Measures for Escapement at Barriers. Such data indicate that the barrier has permitted escapement to spawning adult lamprey over several consecutive years and that serious issues pertaining to the performance of the barrier exist.

All causes for recurrent escapement at a barrier site will be investigated and determinations made with respect to remedial actions. Site visits by the barrier coordinator(s) and/or their designates are required. A review of the barrier design by an

engineer should consider all aspects of the design that would relate to a failure in performance.

Special inspection procedures and services may need to be undertaken such as underwater video surveillance of the complete structure, dye studies, telemetry, and other means to detect seepage and escapement channels.

The barrier coordinator will prepare a remedial action plan that identifies the problem(s) and the means to rectify barrier performance. This could require minor or major repairs. An engineer may need to review the proposed plans. The planning and approval requirements for repairs are discussed in the protocol Maintenance Procedures for Barriers. Major repairs may require engineering design (appropriate components of the protocols for Preliminary Engineering Designs and Plans and Final Design and Engineering) and permits for construction from state/provincial dam regulatory bodies.

6.6. Skills Required

Personnel are to be familiar with the barriers they are inspecting and have experience, skills, and knowledge pertaining to the causes for barrier escapement and the ability to read and analyze engineering design plans. Major repairs will require an engineer to prepare plans and undertake contracts for remedial works.

6.7. Level of Effort

Estimates are on a contingency basis to be determined on a case-by-case basis.

7. Tools Required

8. Information Requirements

Access to the barrier inventory and original engineering design files.
In house instrumentation for water level measurements at selected barrier sites
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9. Contract Requirements

The control agent or barrier owner protocols for construction tendering and project management are to be followed (see control agent protocols DFO-SLCC Construction Contracting and Management and FWS Construction Contracting and Management). Use of consulting engineering services may be required using agent procurement procedures or by the GLFC using the protocol Use of Consultants by the GLFC. Information services contracts for access to agency stream flow data).

10. References

11. Use of Other Protocols

Performance Measures for Escapement at Barriers

DFO-SLCC Construction Contracting and Management

FWS Construction Contracting and Management

Use of Consultants by the GLFC

Maintenance Procedures for Barriers

Operations and Maintenance of Traps

Fixed-Crest Barrier Design Criteria

Preliminary Engineering Designs and Plans

Final Design and Engineering

12. Protocol Authority

Reference authority is designated to the barrier coordinators.

12.1. Allowance for Variations from Protocol

Use of significant professional judgement by barrier coordinators in the determination of potential escapement recurrence.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3. Author and Date

I. Ross, March 1999

EMERGENCY MEASURES ADVISORY SERVICES

1. Protocol Title: Emergency Measures Advisory Services

2. Protocol Business Need

There are a variety of causal agents that could lead to the failure or alteration of the integrity of sea lamprey barriers beyond their design capacity. Examples are severe storms, forest fires, upstream dam breaches (hydroelectric, beaver dams), earthquakes, upstream chemical spills, and acts of vandalism. The failure of barriers represents limited risks to life, property, and the environment. There is a need for a protocol that will address technical advice to barrier owners and emergency measures agencies in the event that natural or man-made disasters affect the integrity of barriers.

3. Protocol Deliverables

Emergency measures technical advisory services, which are activated in the event of a loss of barrier integrity by acts of nature or man.

4. Target Audience

Barrier coordinators, barrier owners, and local emergency measures agencies. Barriers are not owned by the GLFC. In the event of the failure or significant damage to a barrier, the GLFC control agents can only provide timely technical assistance to the barrier owner.

5. The Jurisdiction for Protocol Use

The protocol is basinwide. Efforts are to be coordinated with barrier owners and local emergency measures agencies such as police, fire departments, and flood control agencies.

This protocol deals only with the provision of technical advice to barrier owners and emergency measures agencies. It is not an emergency measures plan for barriers. Barrier owners should have separate emergency measures plans for their structures as required by jurisdiction.

The DFO-SLCC owns and operates the barriers it constructs in the Canadian portion of the Great Lakes Basin. These barriers are subject to separate emergency measures plans developed by DFO-SLCC.

6. Procedures

It is not possible to describe all possible scenarios for emergency response in the case of barrier failure. The protocol refers to communications and risk assessment for which technical assistance is provided to barrier owners and emergency measures agencies on a case-by-case basis.

6.1. Chain of Command

The barrier coordinators have lead responsibility based upon their knowledge of the barrier inventory. Depending upon on the jurisdiction of occurrence the U.S. Barrier Coordinator will lead on occurrences in the U.S. portion of the basin and the Canadian Barrier Coordinator will lead on occurrences in the Canadian portion of the Basin. Should either of the coordinators be absent the lead will fall to the coordinator or designate who can be contacted.

6.2. Risk Assessment

On receipt of information indicating a potential emergency situation, the designate barrier coordinator will obtain further details from the barrier owner and local contacts to

determine the nature and extent of structural damage to the barrier and the site. A determination will be made to establish the potential immediate risks to:

1. Human life,
2. Property, and
3. Environmental values.

If any more than one of the above are of immediate concern, then a technical assistance plan will be developed with the barrier owner and local emergency measure agents based on their immediate needs.

6.3. Mitigation Measures

Technical advice on recommended short-term measures will be developed on a case-by-case basis, e.g., erosion control, cleanup of debris.

Once immediate concerns have been addressed, an assessment of the structure and the extent of damage will be made by a registered professional engineer. A remediation plan will be developed which addresses the requirements for site restoration and rehabilitation and/or decommissioning of the barrier. The impact of a loss of barrier function will be detailed including the need if any for alternative control measures in the event that repairs cannot be made in sufficient time prior to the next adult lamprey spawning run.

6.4. Skills Required

A registered professional engineer is required to assess the extent of damage to a barrier structure and the site and the requirements for barrier repairs, designs, and/or replacement and site restoration.

7. Tools Required

This is an unplanned activity. It would typically require engineering services, be they internal or external. Also, construction equipment will be required, typically, a medium-sized excavator is the single most useful piece of construction equipment available. They are essential for pile driving, coffer damming, restabilizing banks, transferring concrete to areas which may not be reached by mixer trucks, - all aspects of dam construction. These cost approximately $1,000/day U.S. plus materials in 1998. Posting of emergency phone numbers at sites along with site location information is required.

8. Information Requirements

Access to original engineering drawings and designs from the barrier inventory. These should be located in the barrier files in the offices of the barrier coordinators or barrier engineers in each country.

9. Contract Requirements

The engineer requires an expeditious method of contracting a construction company/excavating company. The engineer needs to be afforded the discretion to make relatively large budget decisions on the spot, as the engineer is solely responsible for safety, etc. caused by the structure's condition and the assessment of the level of repair required

Also, where the barrier coordinator is not an engineer, a means for this coordinator to quickly contract engineering services is essential through agent procurement or the use of the protocol Use of Consulting Engineers by the GLFC. It should be noted that this engineer could assume liability for the repairs and, therefore, requires complete financial cooperation from the control agent/barrier coordinator.

10. References

Examples where emergency measures have been undertaken:

1. Little Otter, 1998 - Big Otter Tributary, Lake Erie - seepage through gabion basket structure and sinkholes on banks, potentially caused by beaver dam built on barrier, increasing head and seepage forces. Excavator used to drive piles.
2. Gimlet River, 1994 - tributary to Pancake River, north shore of Lake Superior - seepage beneath piles at far bank had caused loss of soil and resulted in 1-2 foot diameter piping. Excavator used to drive new piles.
3. Still River, 1996 - Lake Huron tributary near French River - sheet pile structure started to lean, due to accumulation of sediment upstream and decreased water levels downstream, structure stabilized using excavating company.
4. Wolf River, 1997 - Lake Superior - high flows (blew out Trans-Canada Highway bridge also) washed out west abutment. Excavating contractor contracted to rebuild abutment and access.

From this we see that such situations require the ability to contract with an excavating company. It should be noted that most of the above situations were corrected for under $10,000 each. For emergency measures, barrier coordinators should advise authorities that they are undertaking works and thus avoid the risk of any charges for lack of communication.

11. Use of Other Protocols

Use of Consulting Engineers by the GLFC

12. Protocol Authority

Discretionary authority of barrier coordinators to prioritize this protocol in the face of other work priorities.

12.1. Allowance for Variations from Protocol

Significant technical engineering judgement is to be exercised in a timely manner.

12.2. Protocol Status and Revision

This is a new protocol and it should be reviewed for currency and relevancy after two years of use.

12.3. Author and Date

I. Ross, March 1999

APPENDIX 1 References

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