Diadromous Fish Passage: Advancing Passage Restoration in the Northeast Based on Target Species Needs

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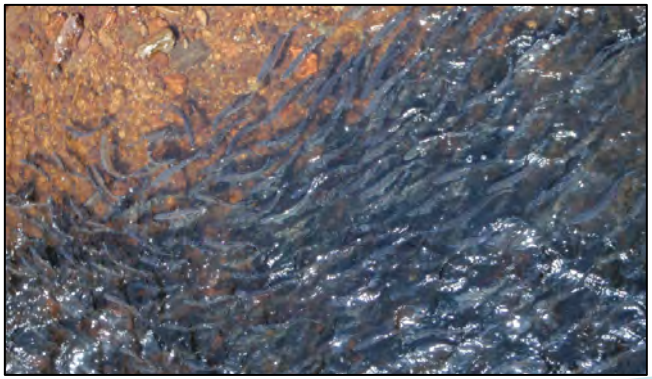
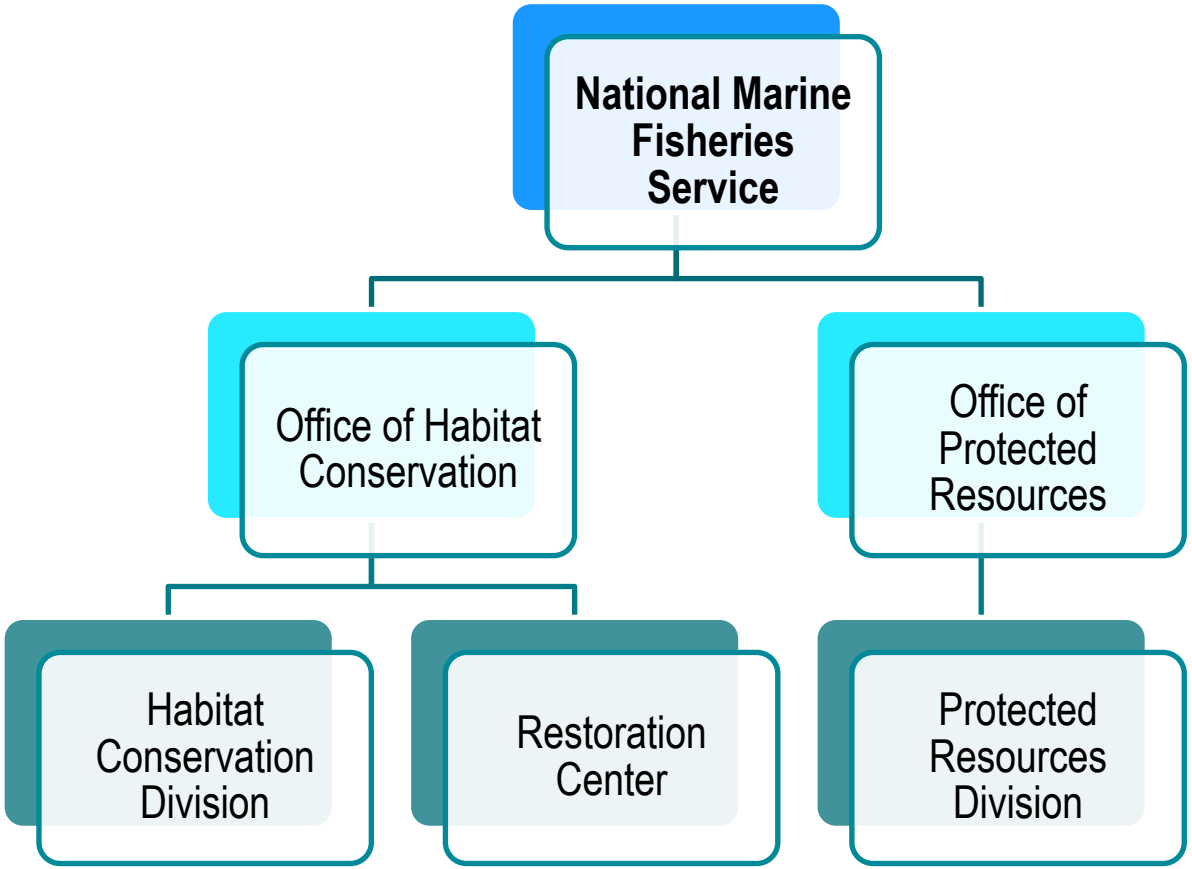


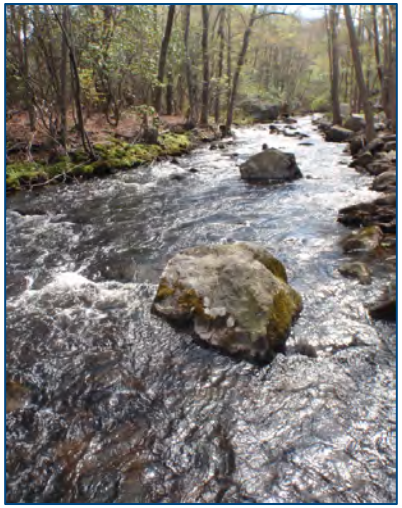
NOAA Fisheries Fish Passage Responsibilities



Existing Authorities:

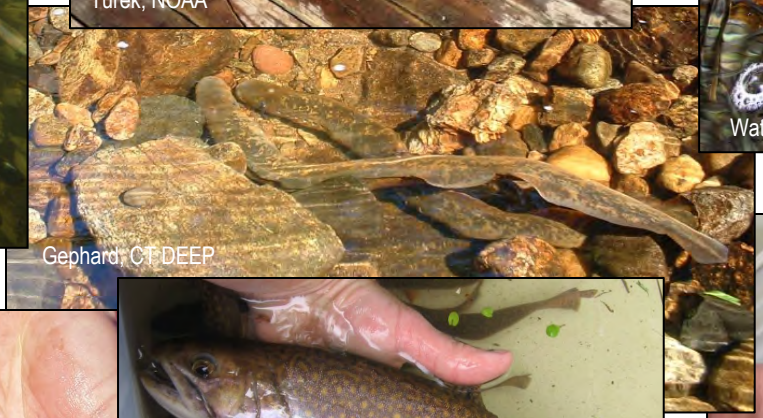
- Fish and Wildlife Coordination Act (FWCA)
- Magnuson-Stevens Fishery Conservation and Management Act (MSA)
- Endangered Species Act (ESA)
- Federal Power Act (FPA)

Presentation Outline



- Diadromous fish species biology, passage needs and passage design guidance
- Fish passage types and passage challenges
- Summary of RC-NER fish passage projects with focus on Maine activities
- Hydropower project considerations and HCD involvement and focus

A Diverse Fish Assemblage



A Diverse Fish Assemblage

East Coast Anadromous Fishes (13 species)

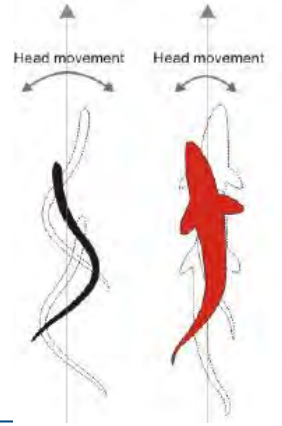
Alewife	*Alosa pseudoharengus*
Blueback herring	*Alosa aestivalis*
American shad	*Alosa sapidissima*
Hickory shad	*Alosa mediocris*
Gizzard shad	*Dorosoma cepedianum*
Atlantic salmon	*Salmo salar*
Sea lamprey	*Petromyzon marinus*
Atlantic sturgeon	*Acipenser oxyrincus oxyrinchus*
Shortnose sturgeon	*Acipenser brevirostrum*
Rainbow smelt	*Osmerus mordax*
Atlantic tom cod	Microgadus *tomcod*
Striped bass	*Morone saxatalis*
Sea-run brook trout	*Salvelinus fontinalis*

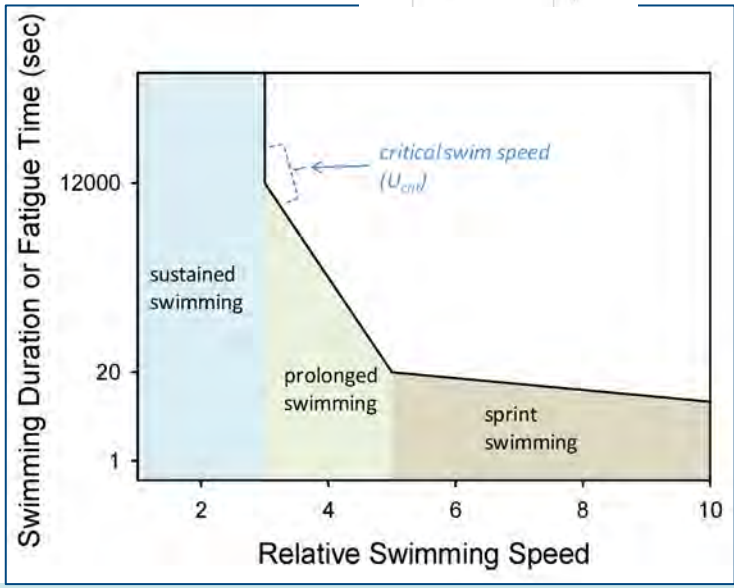
East Coast Catadromous Fish

American eel	*Anguilla rostrata*

Swimming performance based on:

- Body shape and swim locomotion:
  - Anguilliform
  - Subcarangiform
  - Carangiform
- Body length
- Fish behavioral traits





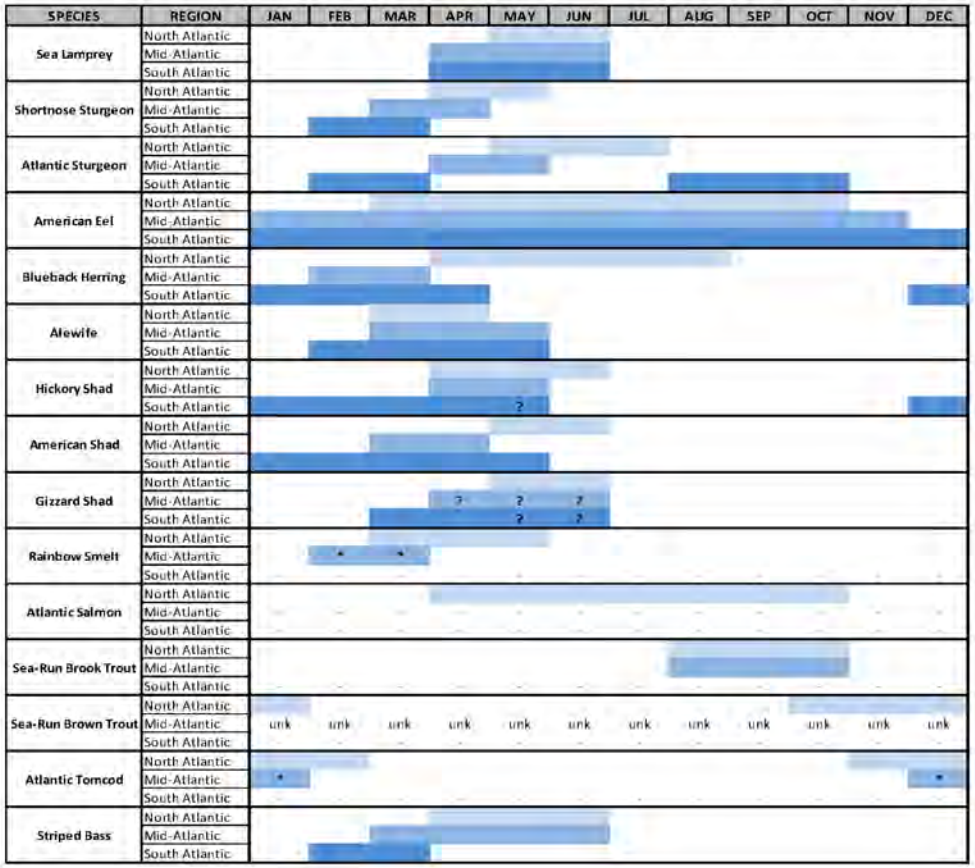
Relative Swim Speed versus Duration

Environmental Factors Affecting Fish Passage

Upstream migration and passage affected by:

- River flow
- Turbulence and hydraulics
- Water temperature
- Location of passage site

  site in the watershed
- Site conditions (e.g., bedrock)



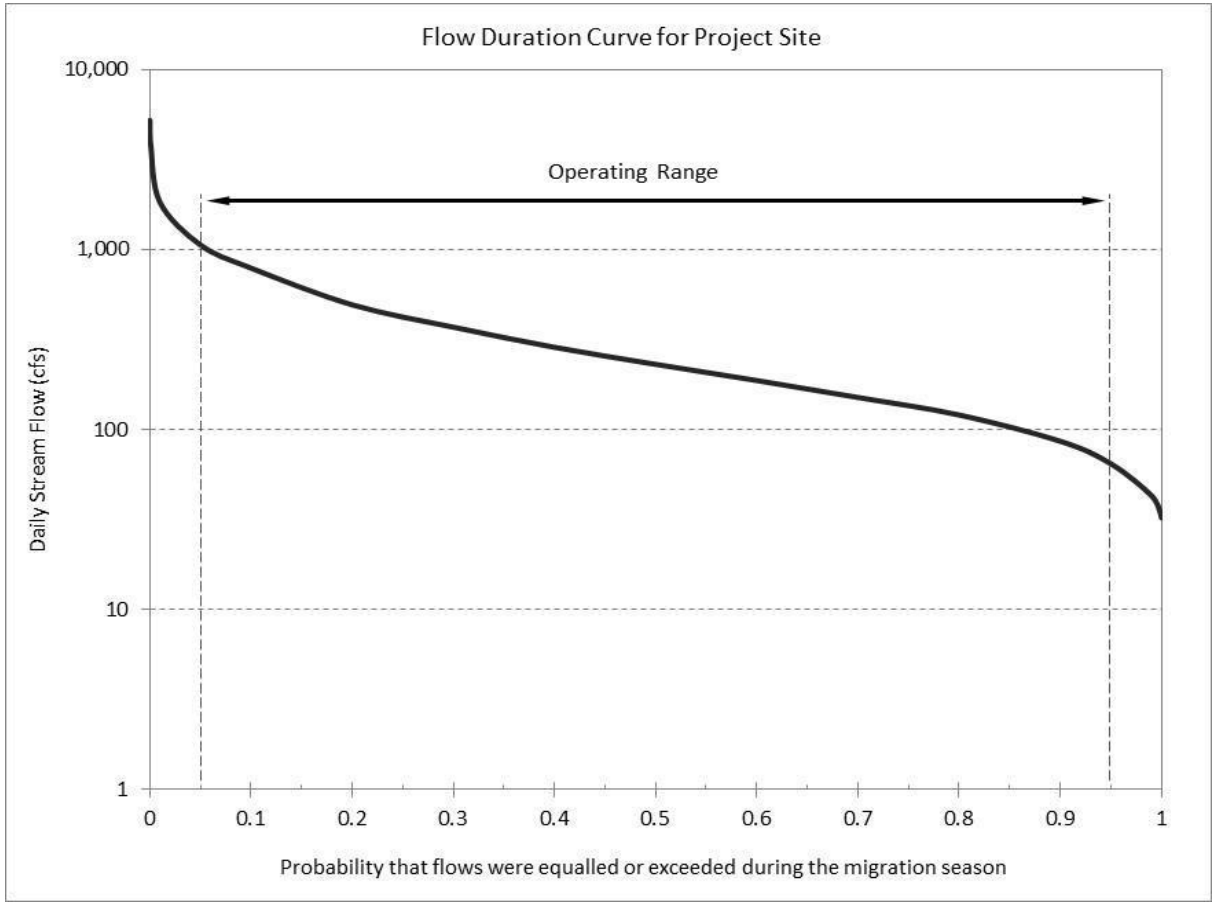
Run timing

Passage Flows

Hydraulics develop in response to the hydrology and geometry of passage site

Low (95% exceedence), normal (50% exceedence), and high (5% exceedence) run flows derived from flow duration curves or tabulated as ranked order

Hydraulics to provide safe, efficient passage over entire operating flow range



Passage Type: Dam Removal

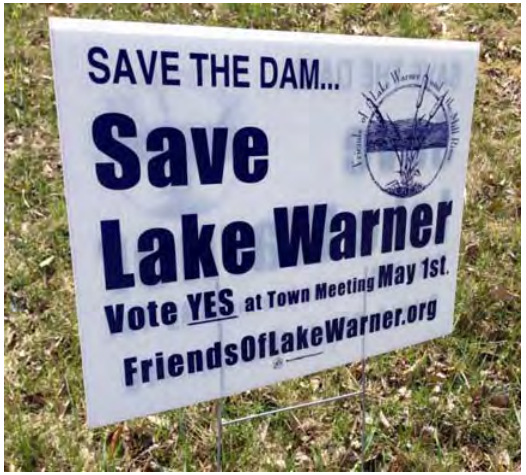
- Dam removal is preferred alternative for most passage barrier sites
- Often results in unimpeded passage and restores or enhances spawning and rearing habitats

Hopewell dam removal, Mill River, Taunton, MA

Passage Type: Dam Removal

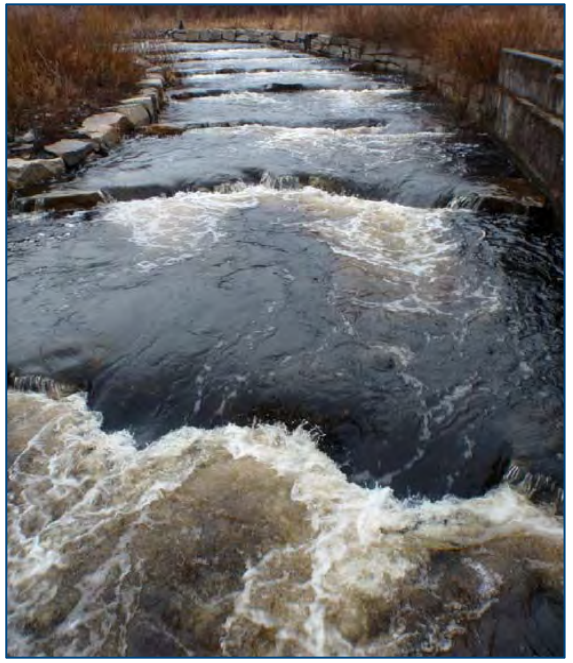
Project Constraints and Challenges

- Technical – bridges, utilities and other infrastructure, bedrock and other conditions
- Regulatory – wetlands, RTE species, contaminated sediments
- Cultural – recreation, iconic feature
- Social and Political – sentimental values, opinions



Passage Type: Nature-like Fishways

- Nature-like fishways (NLFs) may be a viable alternative when dam removal is not feasible due to one or more project constraints
- Layout and function:
  - In-channel alternatives
    - Full river-width
    - Partial width
  - Bypass alternative



Full River-Width
Step-Pool NLF
Acushnet River, Acushnet, MA

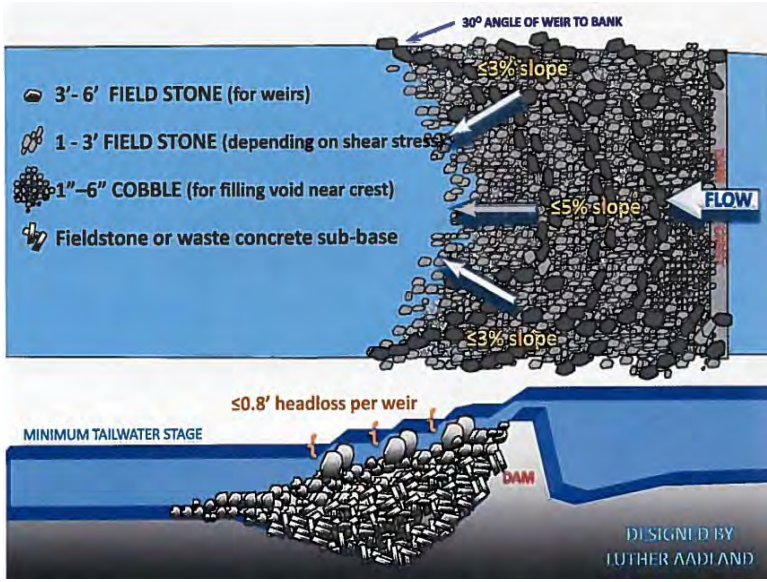
Tingue Dam (left) with Bypass NLF (above)
Naugatuck River, Seymour, CT

Passage Type:Nature-like Fishways

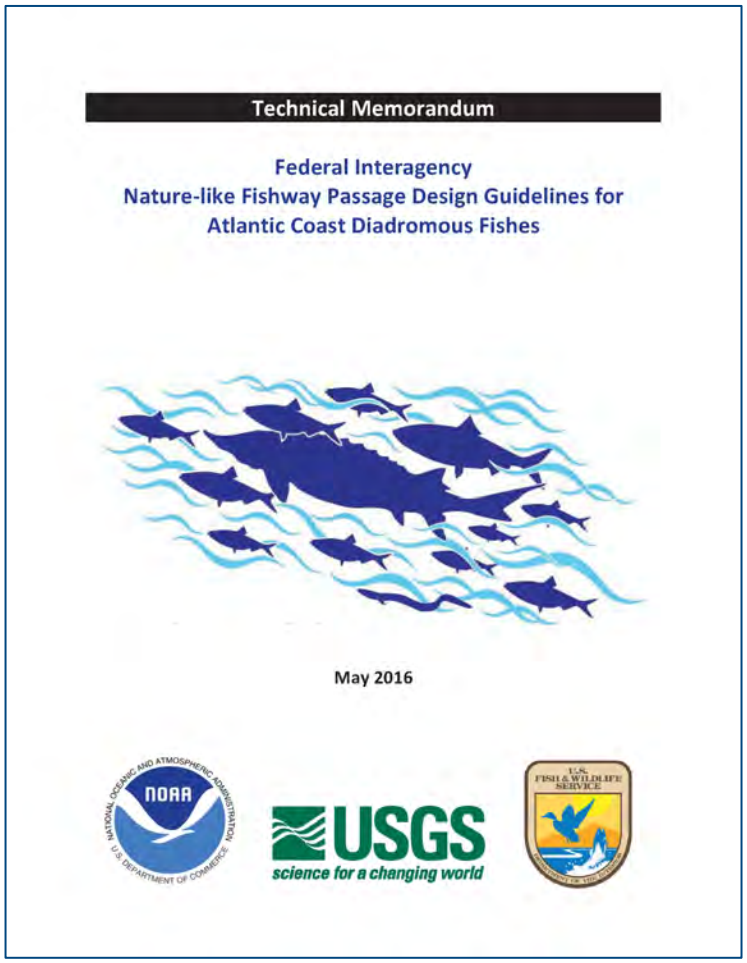
Hydraulic design alternatives:

Aadland, 2010

- Step-pool – pool-and-weir, rock arch rapids, cross vanes, backwatering weirs
- Roughened channel – rock ramp, rock riffle, perturbation boulder

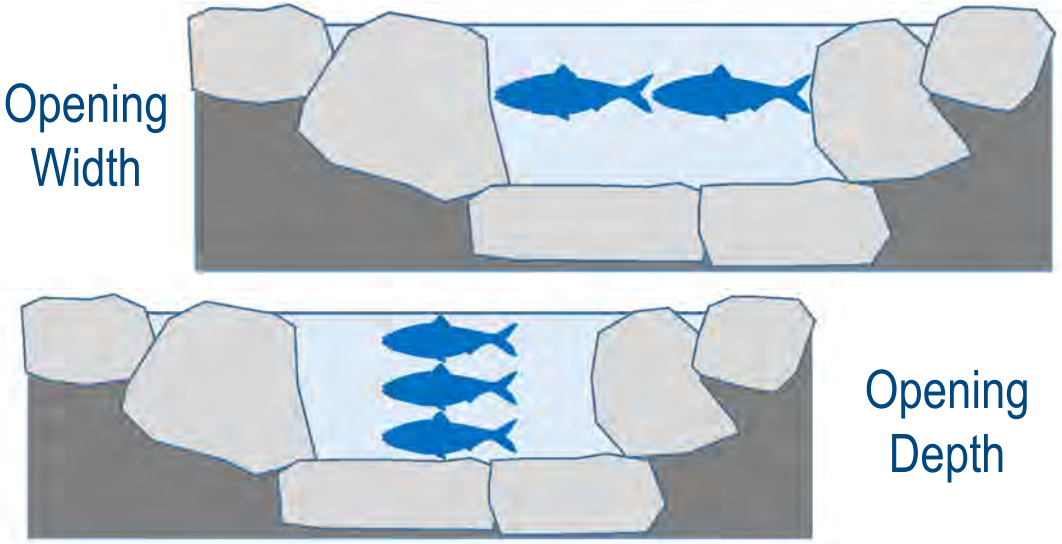


Nature-like Fishway Design Guidance

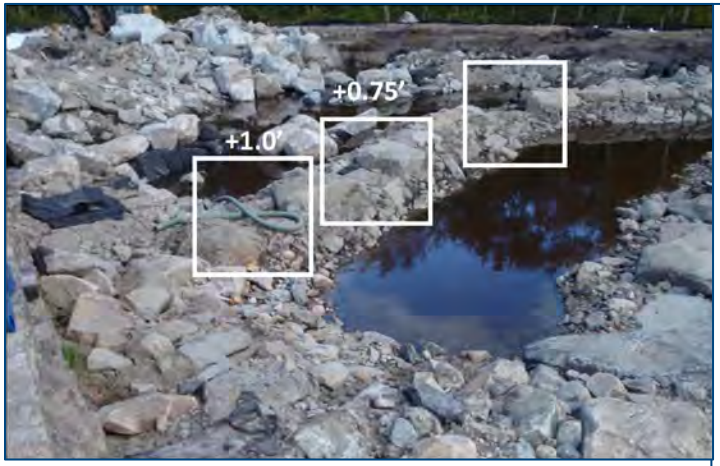


Biometric-based Guidelines

- Minimum pool width, depth, and length
- Minimum weir opening width and depth
- Fishway slope and maximum weir opening water velocity based on known U_{crit} or fish swimming mode and shortest body length

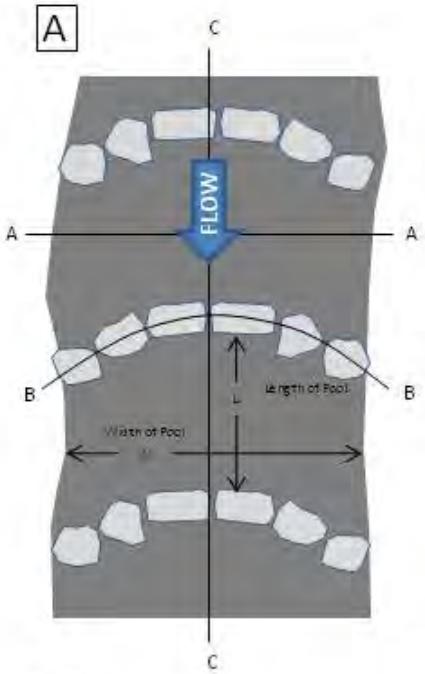


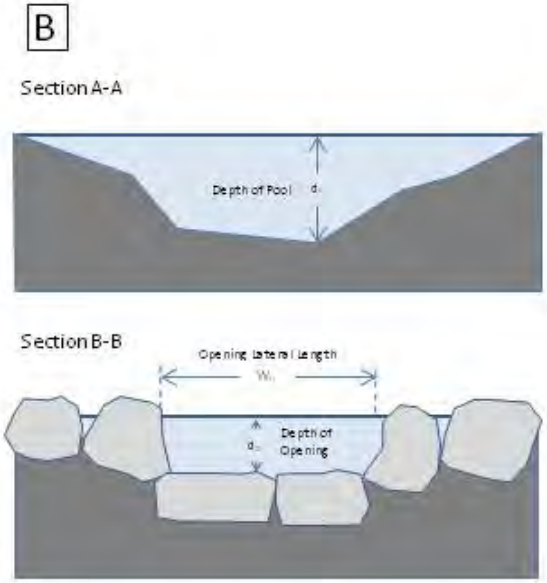
Nature-like Fishway Design Guidance



Primary and secondary passage weir openings

Central weir notch





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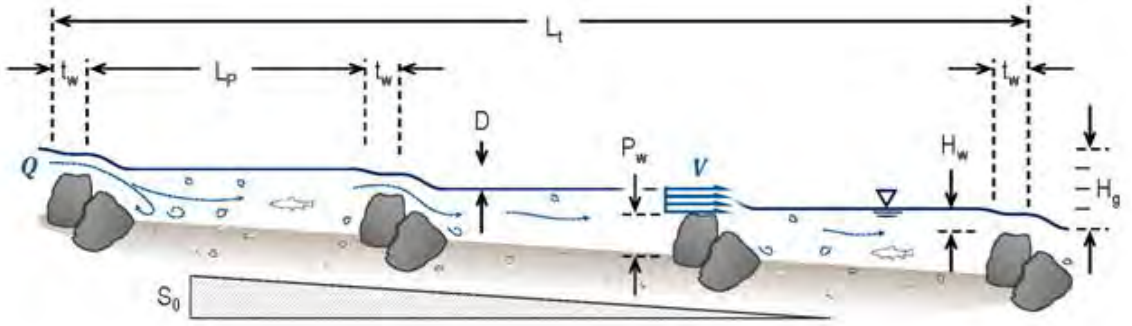
Passage plan view (A), cross section (B) and profile (C)



Nature-like Fishways

Bypass, roughened channel

Example: Howland bypass, Piscataquis River, Howland, ME

Flows: 09/28/15

10/22/15

10/01/15

10/07/15

Photo Source:
B. Lake, NMFS

Passage Type: Structural Fishways

- Entranceway location and attraction flows
- Watershed size and flows
- Invert elevations of entrance and exit way
- Fishway slope
- Resting pools/turn pools
- Operation and maintenance

Passage Type: Structural Fishways

Main Street Fishway, Saugatucket River, Wakefield, RI

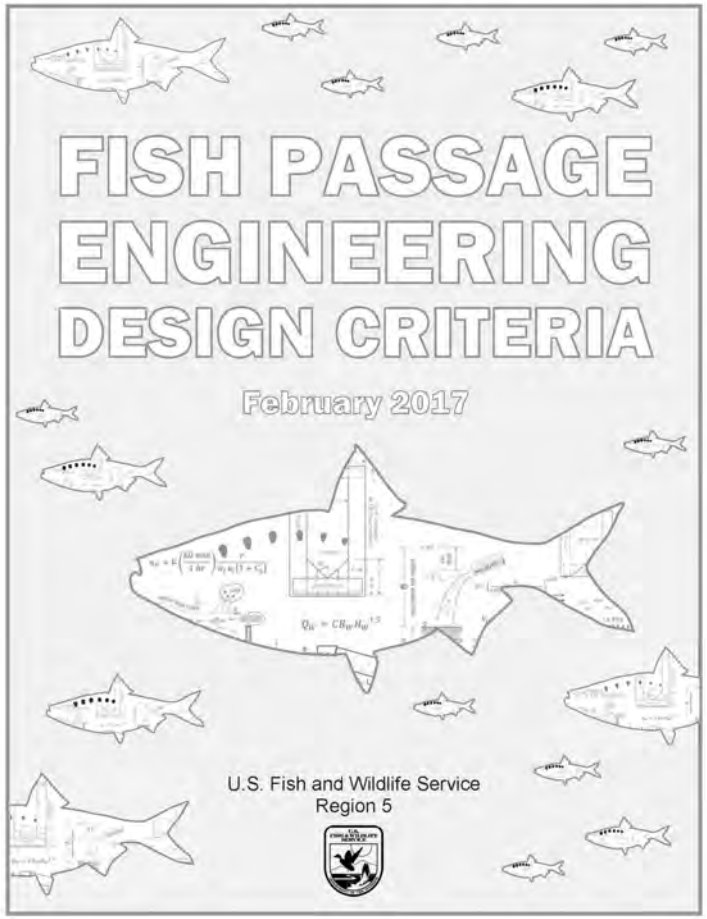
<Former Fishway and Spill Conditions

Poor Passage and Passage Efficiency

>Reconstructed Fishway and Channel Modifications

High Passage Efficiency

Structural Fishway Design



https://www.fws.gov/northeast/fisheries/fishpassageengineering.html

NOAA East Coast Fish Passage: 1992-2017

Project Type

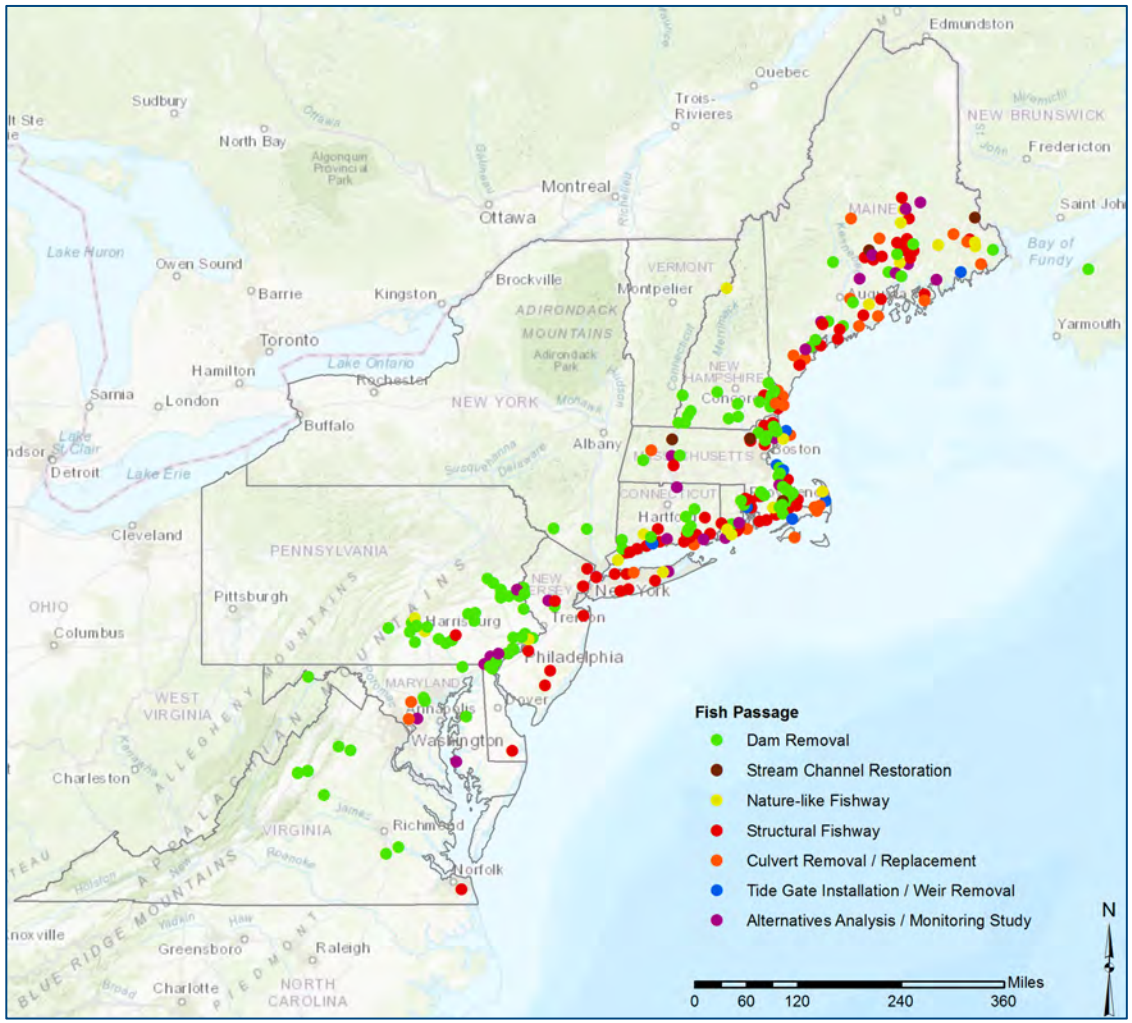
Dam Removals: **126** (40%)
Nature-like Fishways:**17** (5%)
Technical Fishways: **85** (27%)
Culverts: **34** (11%)
Stream Restoration: **6** (2%)
Tide Gates: **8** (3%)
Studies/FS: **38** (12%)
Total Passage Projects: **314**

Habitat Access Opened

River Miles: 2,036
Lake/Pond Acres: 29,823

Project Funds

NOAA Funds: **$90.3M**
Federal Leverage: **$12.7M**
Non-Federal Funds: **$52.5M**



Map prepared by R. King and A. Eba

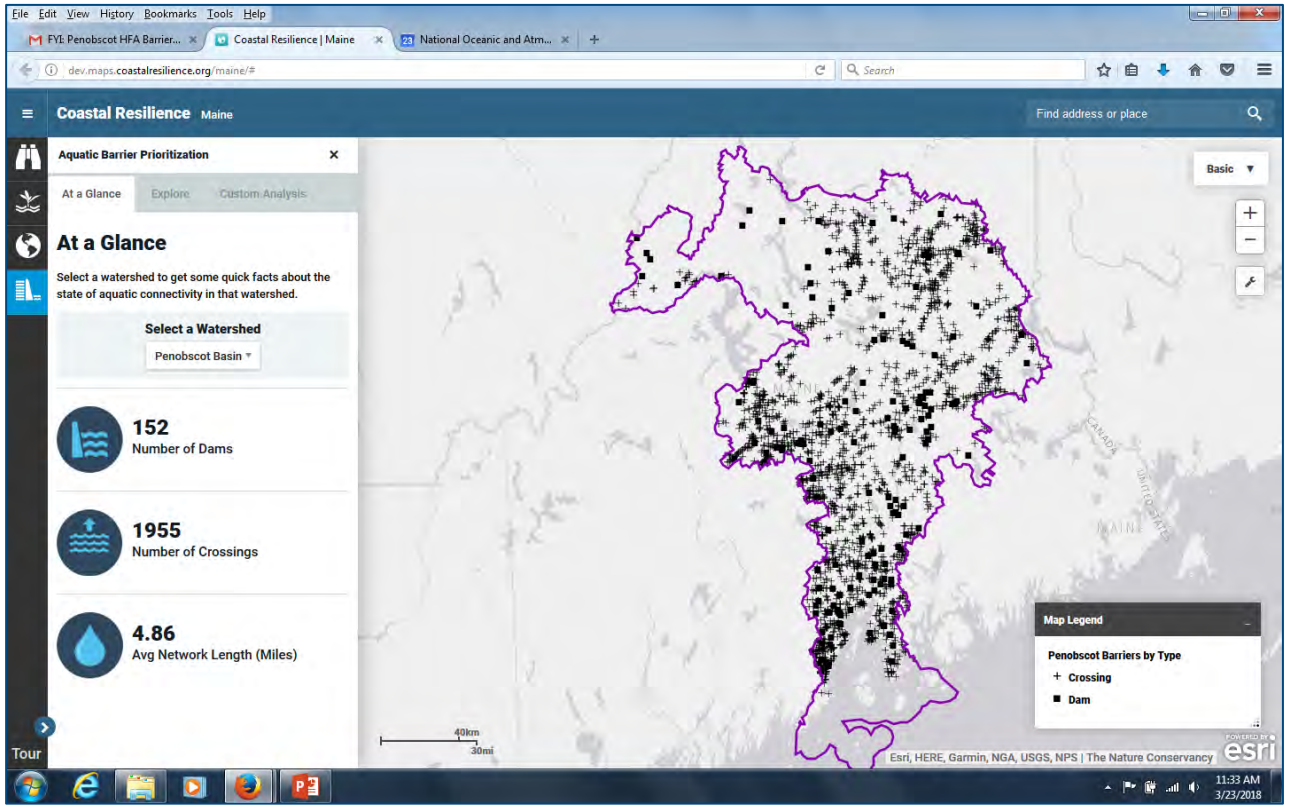
NOAA Habitat Blueprint: Penobscot River

- NOAA Penobscot River Habitat Focus Area (HFA) is one of 10 priority HFAs throughout the U.S.
- NOAA formalized a cooperative agreement with The Nature Conservancy in 2014 for various phases of planning, feasibility, design, permitting, construction and monitoring of fish passage projects

Penobscot HFA Accomplishments

TNC aquatic barrier prioritization tool:

customized, tiered rankings of dams and culverts



Available soon: https://maps.coastalresilience.org/maine

Penobscot HFA Accomplishments

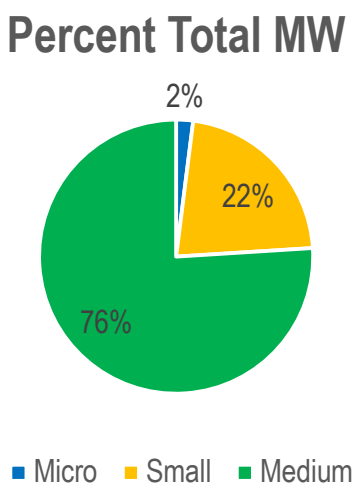
Nature-like fishways at outlets of East Branch Lake (1,100 acres) and South Branch Lake (2,035 acres)

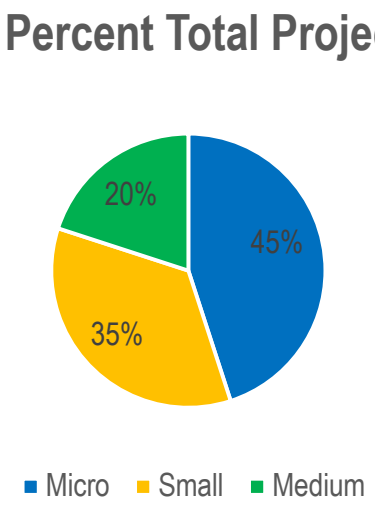
Culvert replacement
Ducktrap River tributary
Coleman Pond outlet

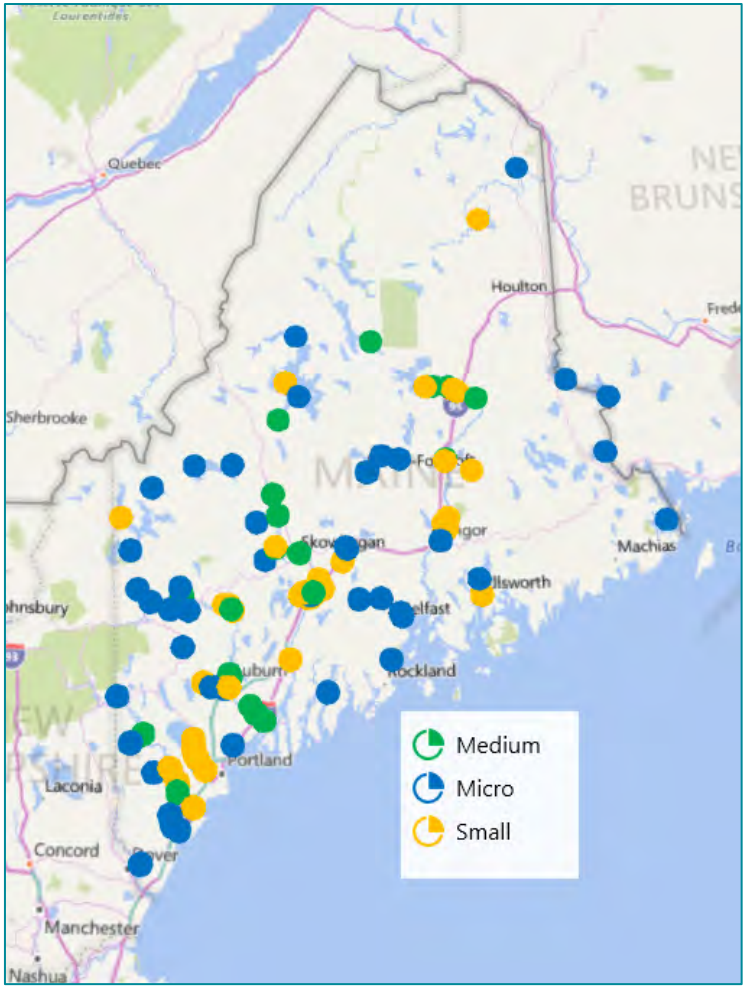
Frankfort dam
fish passage
feasibility study

Federally-Licensed Hydropower Projects in Maine

- 717 MW of Authorized Capacity
  - Medium = >10 -100 MW
  - Small = >1-10 MW
  - Micro = 0 -1 MW
- 106 Projects







Fish Passage and Hydropower

Source: Penobscot River Restoration Trust

Project Types

- Retrofit of existing dams with innovative turbine technology
- Small hydro-kinetic projects

NMFS-HCD Roles and Focus

- Prescribe fishways and minimize effects on trust resources
- Determine potential migration delays
- Understand fish behavioral cues to improve safe passage
- Support passage without O&M (NLFs where feasible)
- Improve outmigration bypass entrances and construct multiple outmigration entrances at varying water column levels
- Suggest and oversee post-license fishway effectiveness or environmental effects studies