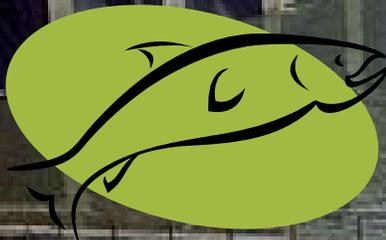
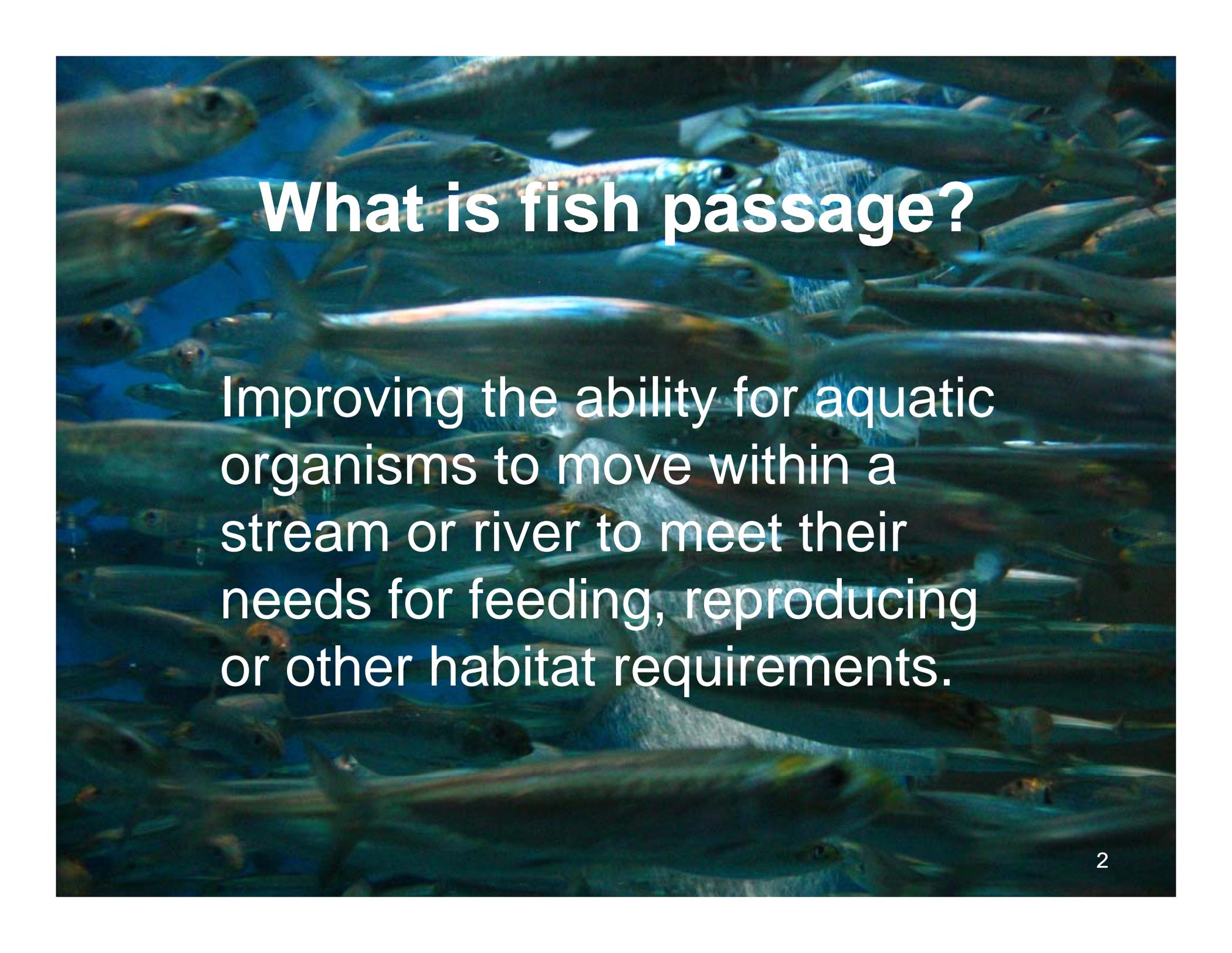




Introduction to Fish Passage



A large school of salmon swimming in clear blue water. The fish are densely packed, moving in various directions. The water is a deep, clear blue, and the fish have silvery scales with some darker spots. The overall scene is dynamic and natural.

What is fish passage?

Improving the ability for aquatic organisms to move within a stream or river to meet their needs for feeding, reproducing or other habitat requirements.

Why is fish passage important ?

- **Ecologically (integrity of the ecosystem)**
- **Recreational and Commercial fishing**
- **Eco-tourism**
- **High Quality Food**
- **Educational value**
- **Nutrient flow**

Examples of Migratory Fish



Blueback herring



American eel



**Atlantic
sturgeon**



Chinook salmon

Why do fish move?



Authorities for Fish Passage

1. **General Investigation**
 - **Water Resources Development Act (specifically authorized)**
 - **Otherwise Congressionally Authorized**
2. **Continuing Authorities Program (CAP)**
3. **Regional Authorizations**
4. **Estuary Restoration Act of 2000**
5. **Endangered Species Act**

Types of fish passage

1. Dam removal
2. Natural rapids / rock ramps
3. Natural bypass channels
4. Fish ladder / fishways
5. Fish elevators / lifts
6. Operational changes (i.e. locks or dams)

Dam Removal

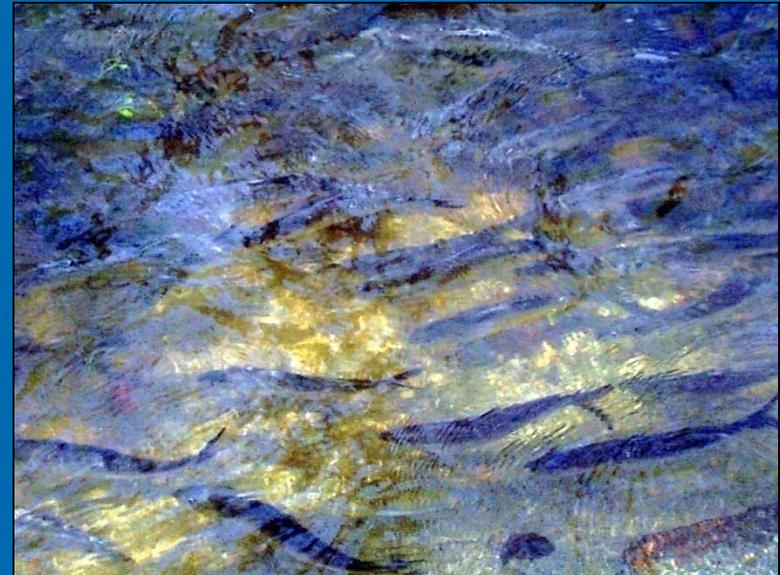
- Restore the stream to a “natural” condition. Often used to promote fish passage, but also allows movement of other communities (amphibians, reptiles, mussels, macroinvertebrates, etc.)



Cited reasons for removals

- Environmental--43%
 - Fish passage
- Safety--30%
- Economics--18%
- Failure--6%
- Unauthorized structure--4%
- Recreation—2%

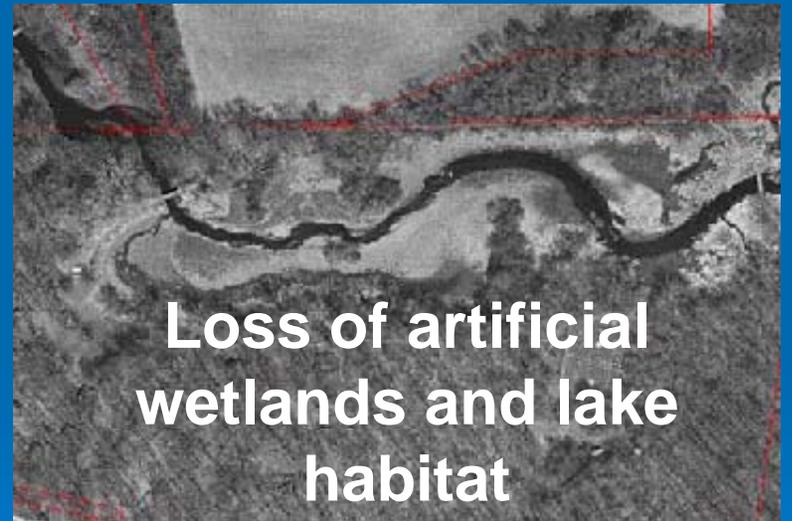
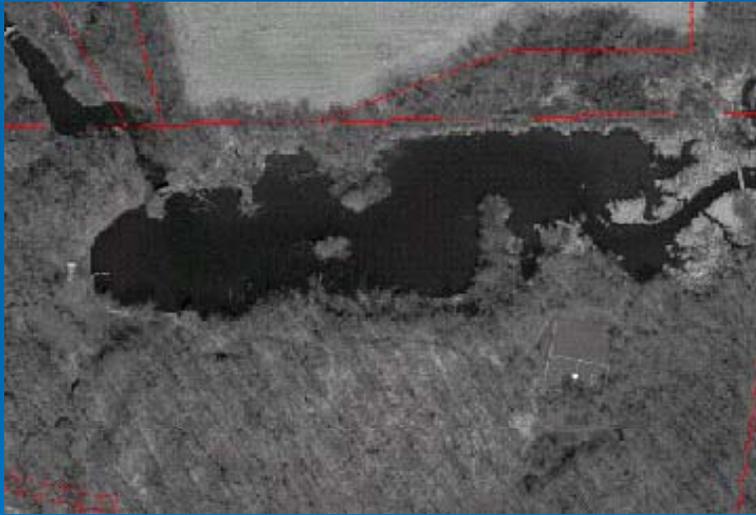
(American Rivers et al., 1999)



However:

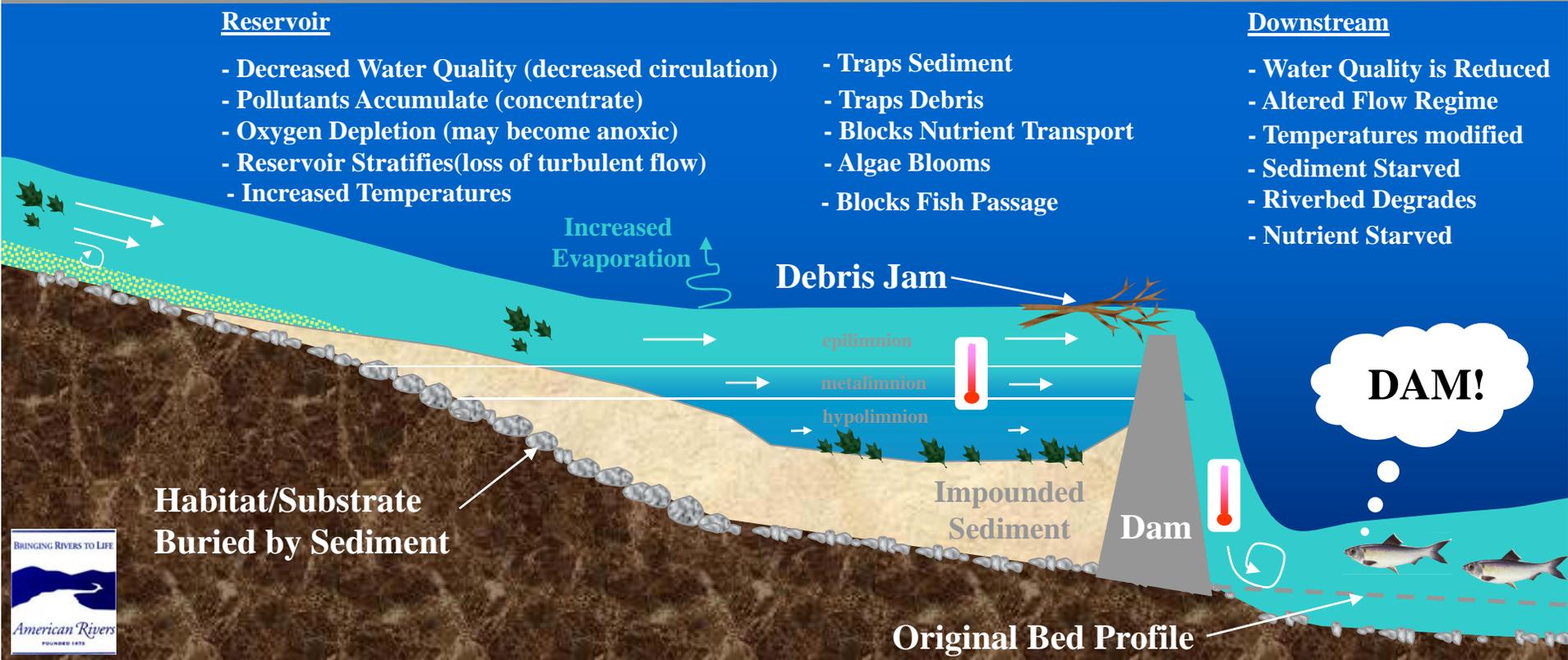
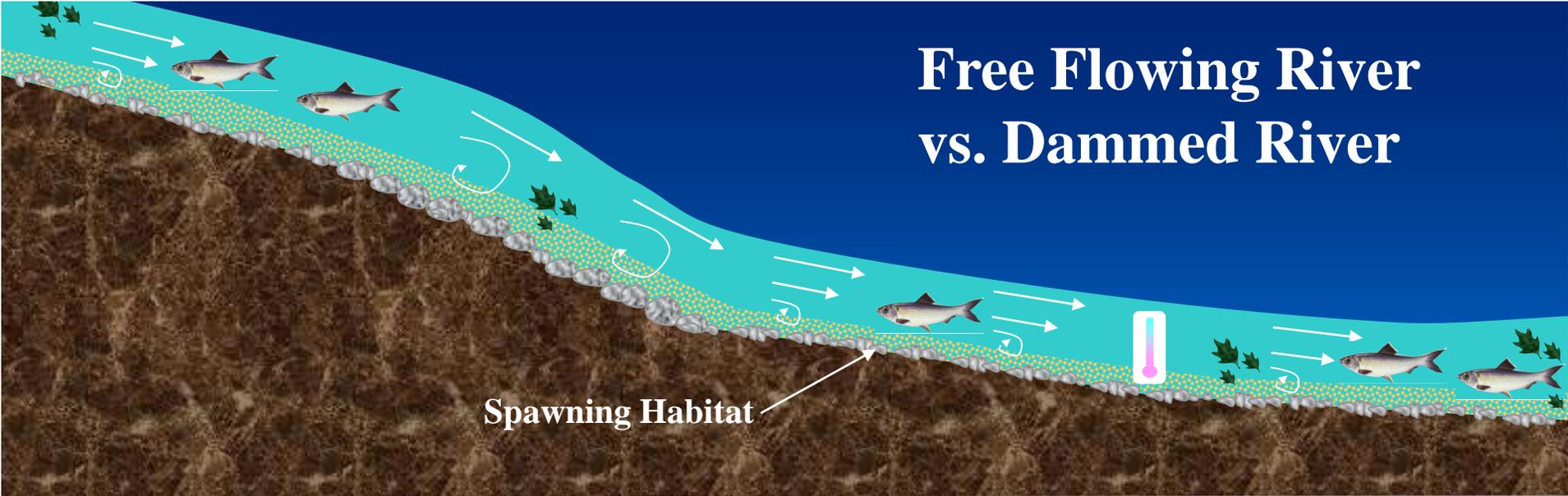
Public safety and desire to save costs of repair usually drive removal, not restoration goals (Born et al., 1998)

Habitat trade-offs



Loss of artificial
wetlands and lake
habitat

Free Flowing River vs. Dammed River



Cuddebackville Dam Removal

Benefits: migratory fish and federally-listed mussel



Before



After

Removal of Embrey Dam, VA

- **USACE and other partners worked with DOD and used project as training exercise**
- **Opened up 70+ miles of stream habitat**
- **Watch video:**
http://www.dgif.virginia.gov/fishing/embrey_dam.html



American Shad



Fish Ladder Types

- **Alaska Steeppass – River herring (blueback and alewife)**
 - **Least costly**
 - **Approx. \$10k per vertical foot**
- **Denil – American shad, salmon**
 - **Medium cost**
 - **Approx. \$30k per vertical foot**
- **Vertical Slot – American shad, salmon, all species**
 - **Most expensive**
 - **Approx. \$100k per vertical foot**

Alaska Steeppass Ladder



Denil Fish Ladder

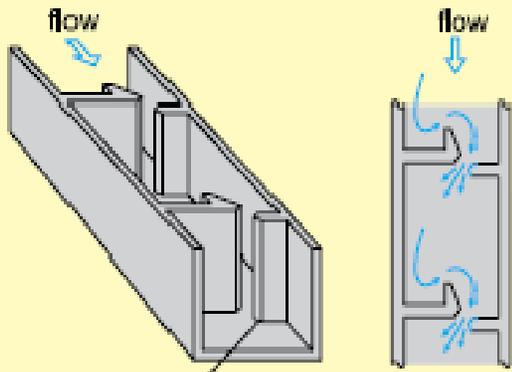


Vertical Slot Fish Ladder

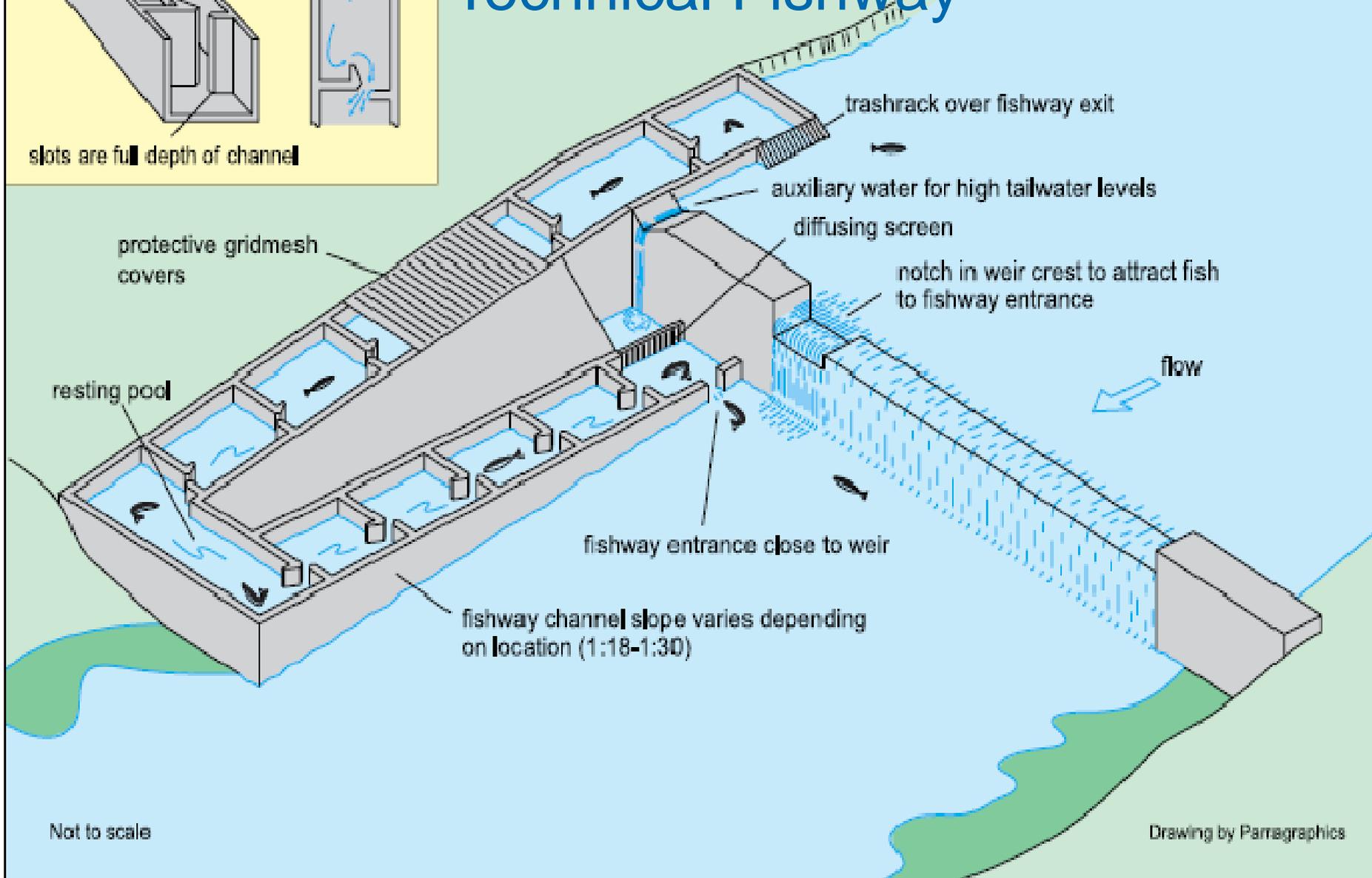


Conceptual layout of a vertical-slot fishway

Technical Fishway



slots are full depth of channel



protective gridmesh covers

trashrack over fishway exit

auxiliary water for high tailwater levels

diffusing screen

notch in weir crest to attract fish to fishway entrance

resting pool

flow

fishway entrance close to weir

fishway channel slope varies depending on location (1:18-1:30)

Not to scale

Drawing by Parragraphics

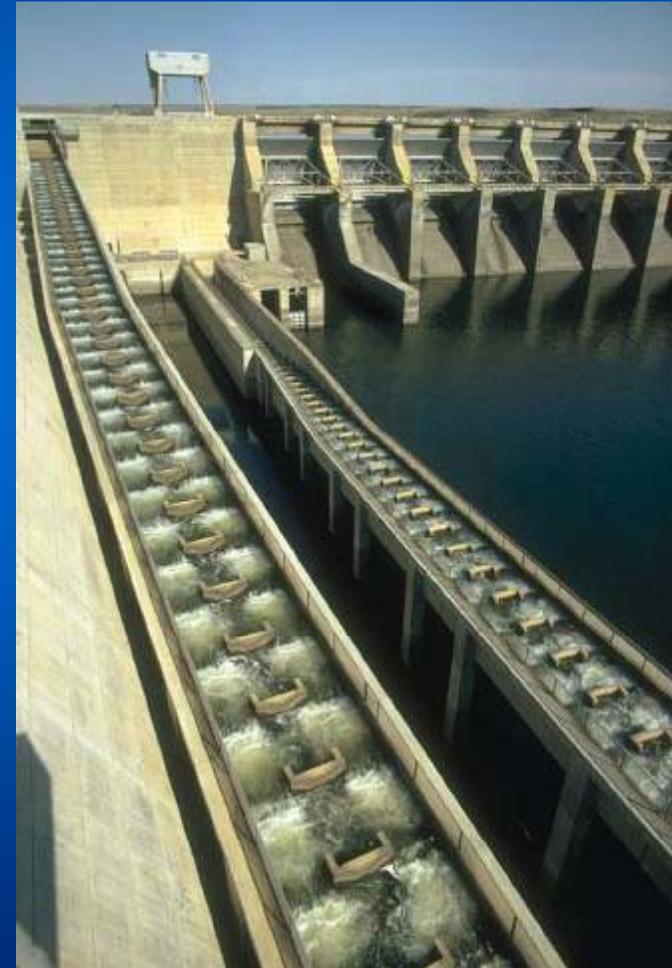
Fish Ladder Examples

U.S. Army Corps Fish Ladders Snake River, WA

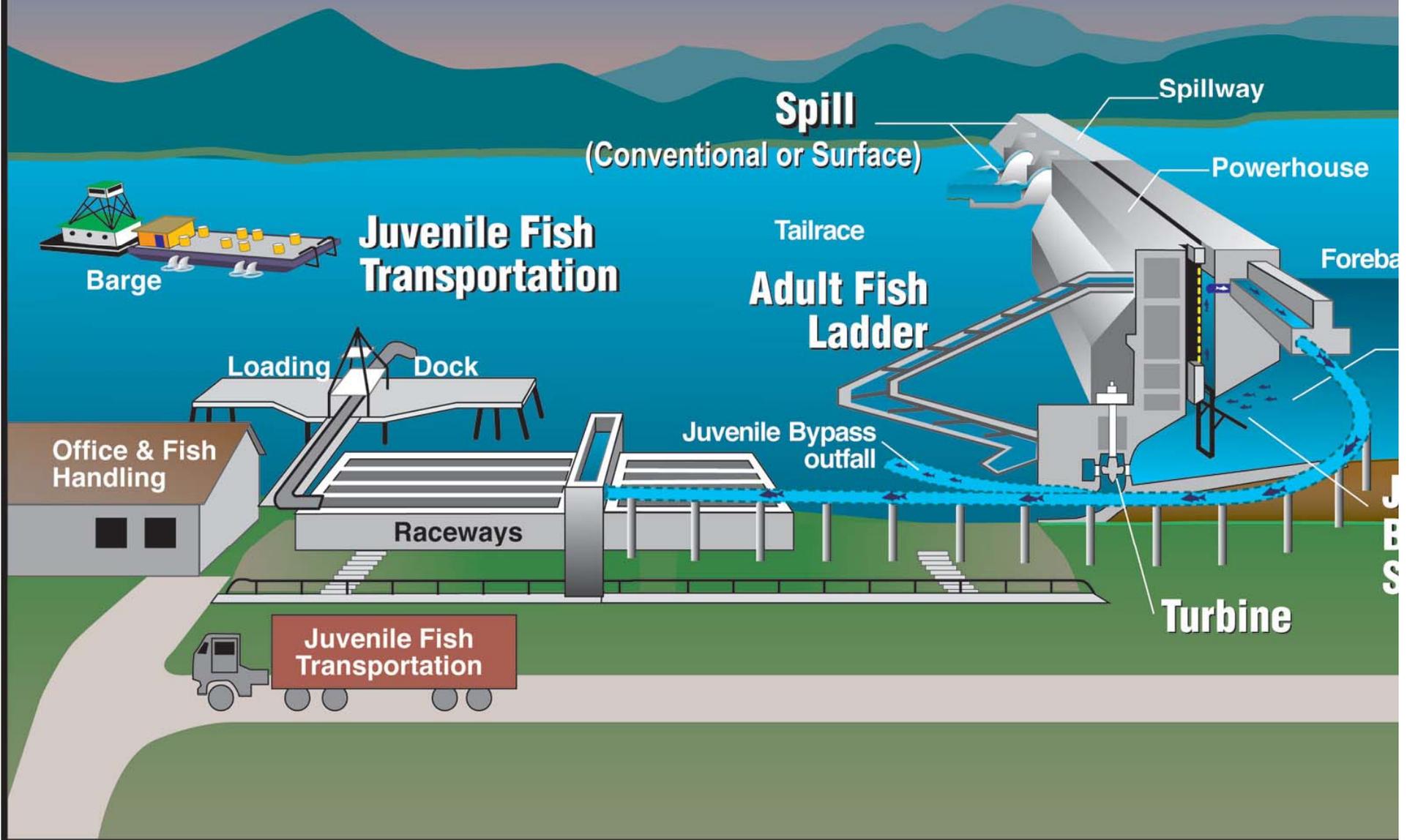
Little Goose Lock and Dam
Fish Ladder



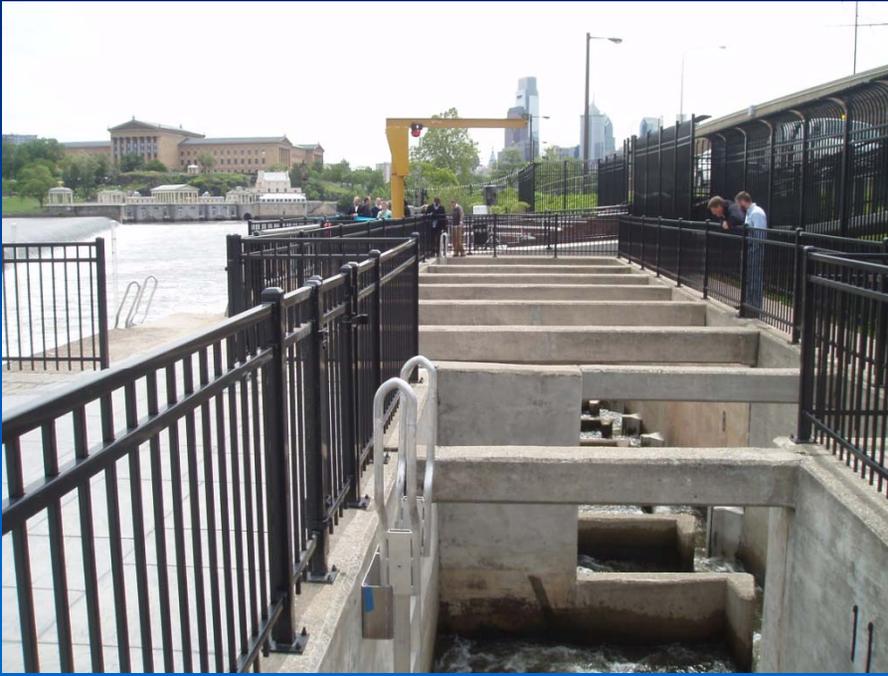
Ice Harbor Dam
Fish Ladder



Fish Passage Routes



Fairmount Fish Ladder Philadelphia, PA

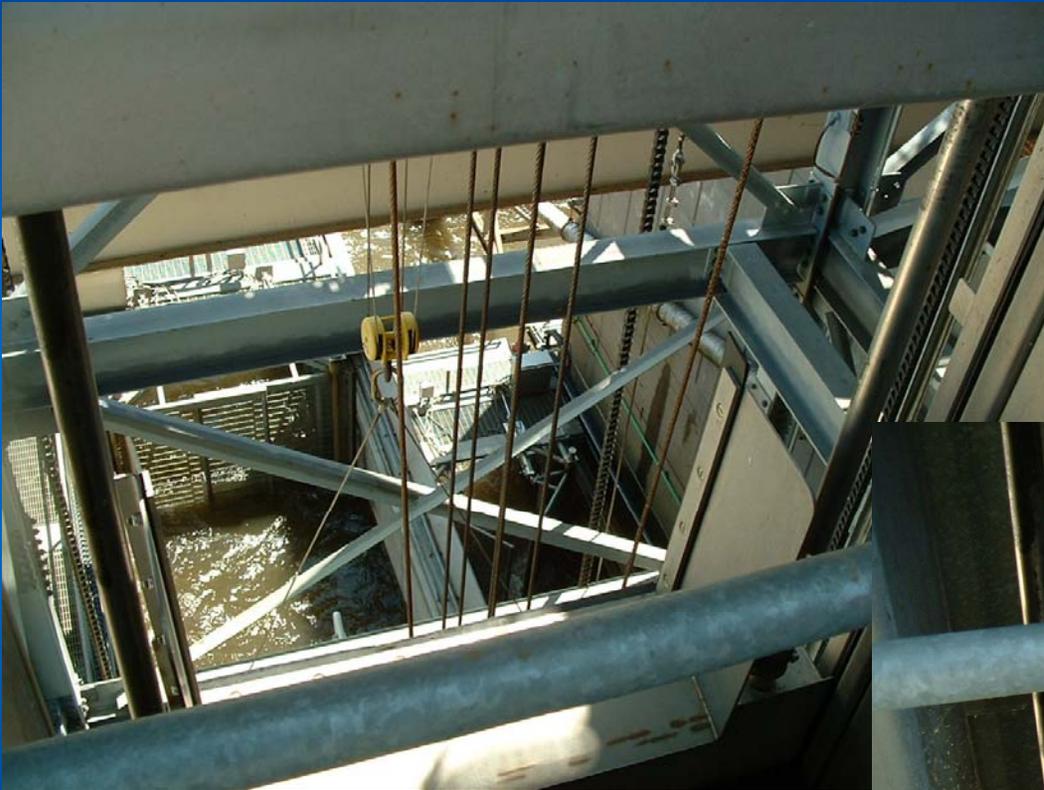


Batsto River Fishway Batsto, NJ

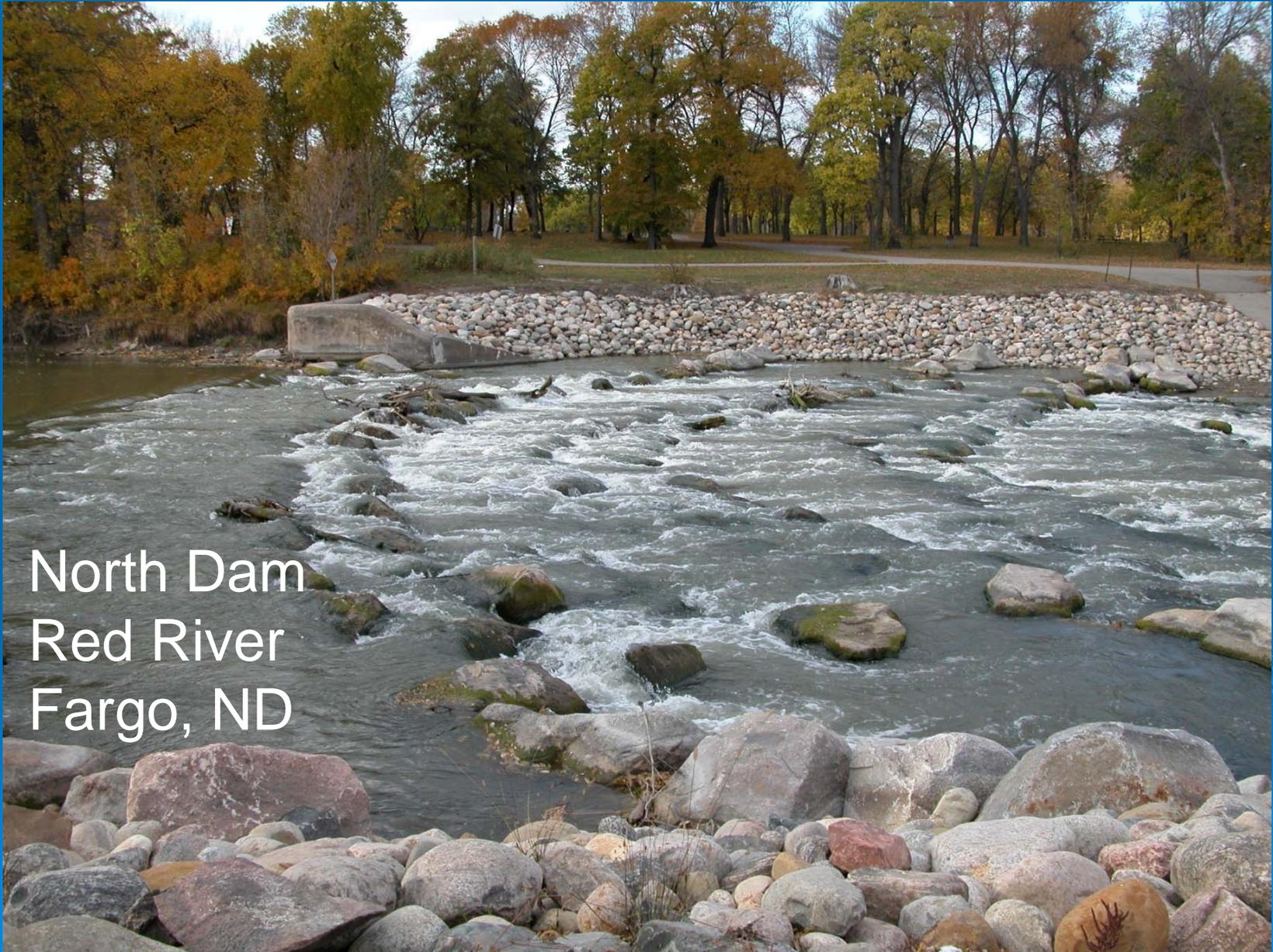


Opened approximately 8 miles of
habitat to migratory fish.

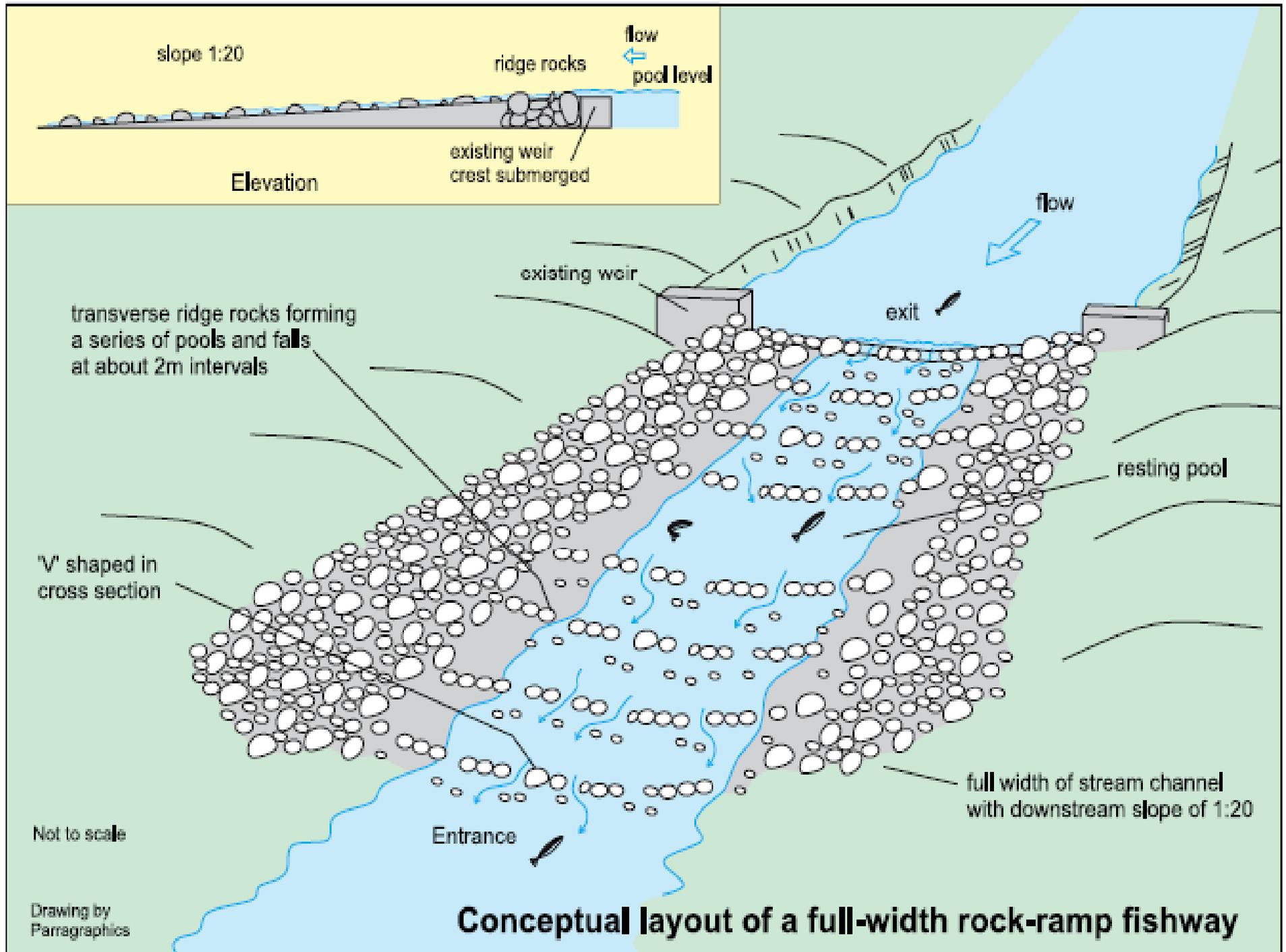
Fish Elevator/Lift



Natural Rapids



North Dam
Red River
Fargo, ND

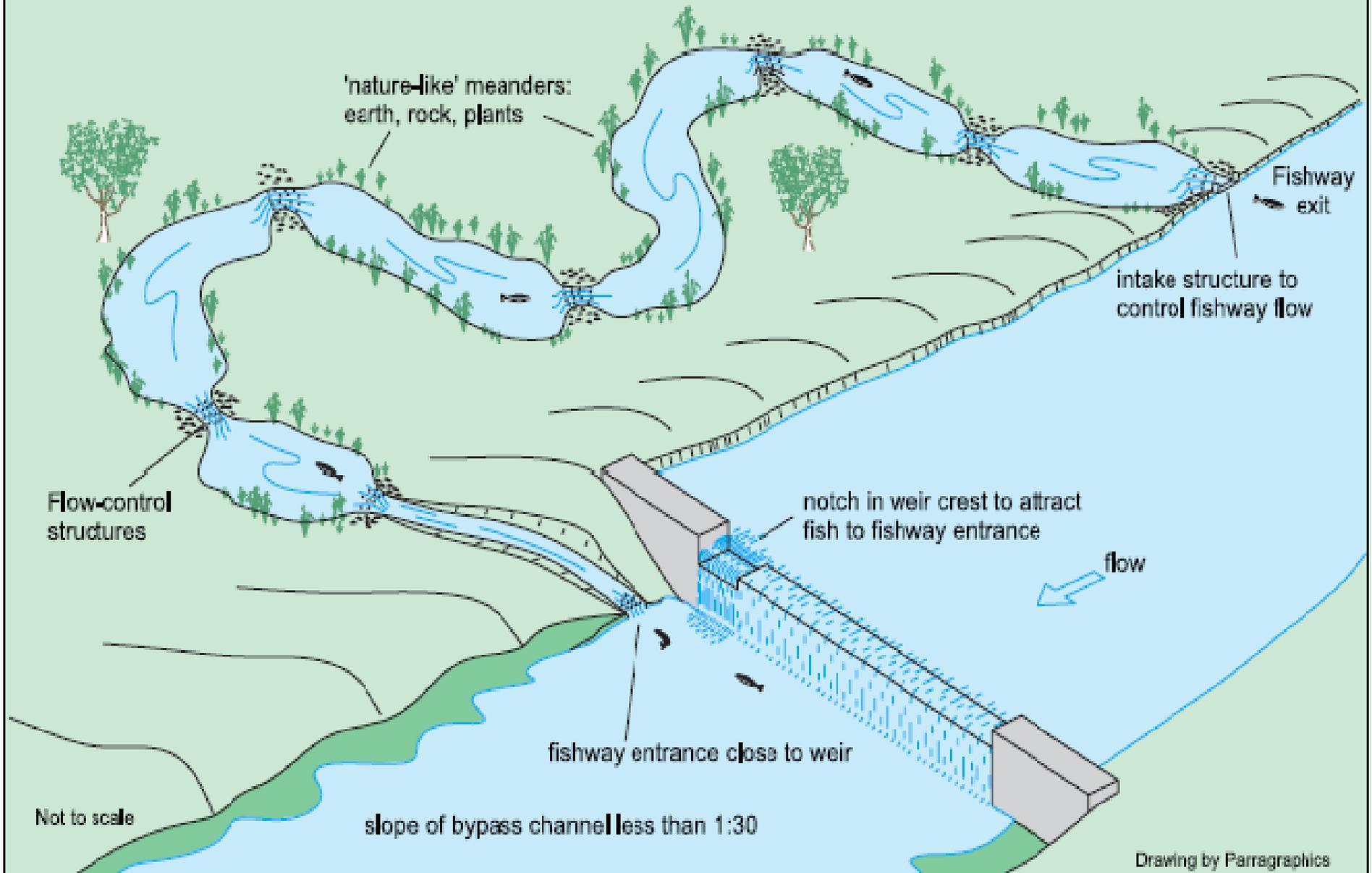


Fish passage video from
Minnesota Department of
Natural Resources

Natural Bypass Channel



Conceptual layout of a bypass fishway



Operational Changes (Lock and Dam)

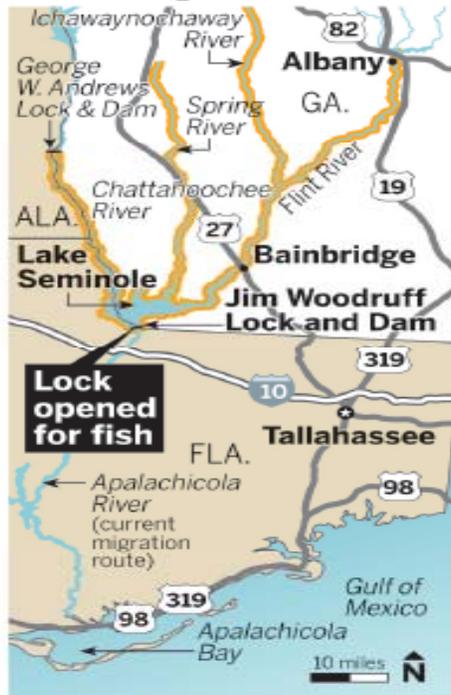
FISH ON THE MOVE

Georgia, Alabama and Florida worked together to reopen more than 200 river miles for the Alabama shad and Gulf striped bass. They had been blocked from migrating upstream for more than 50 years by the Jim Woodruff Lock and Dam at Lake Seminole.



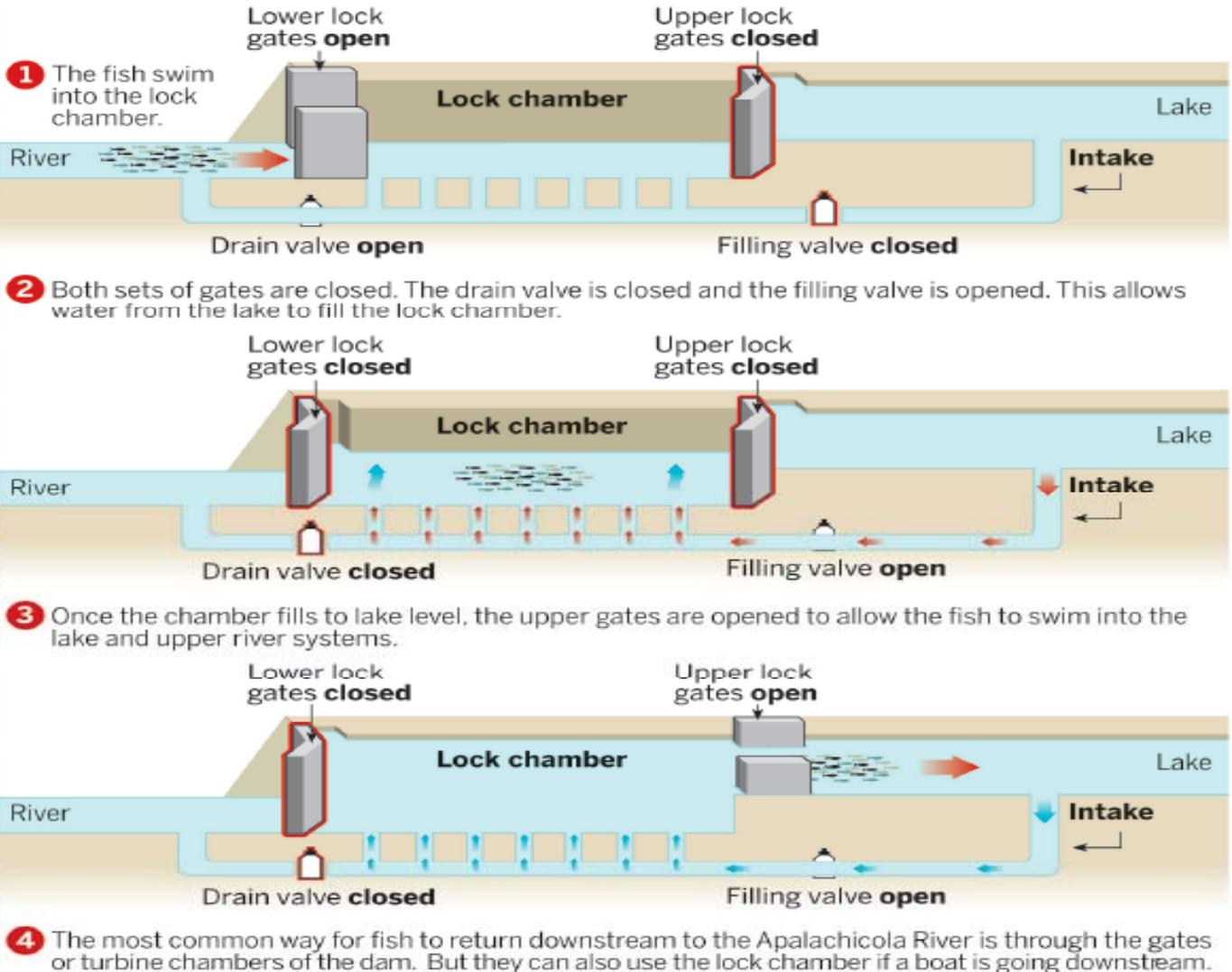
Alabama shad

Waterways reopened to fish migration



How it works

Fish move upstream into the lake and other rivers using a lock – a watertight basin that can let water in or out to raise or lower water to another level.



Note: Representative drawing, not to scale

Additional considerations for fish passage projects

- **Sediment (quantity and quality)**
- **Social (use of dam)**
- **Cultural resources (significance)**
- **Recreation (public use / fishing)**
- **Invasive species**
- **Hydrology**

**Want to learn more...peruse
the Gateway Fish Passage
www.gateway....**