Applying Engineering Solutions to the Science of Invasive Aquatic Species Control – Asian Carp and Sea Lamprey

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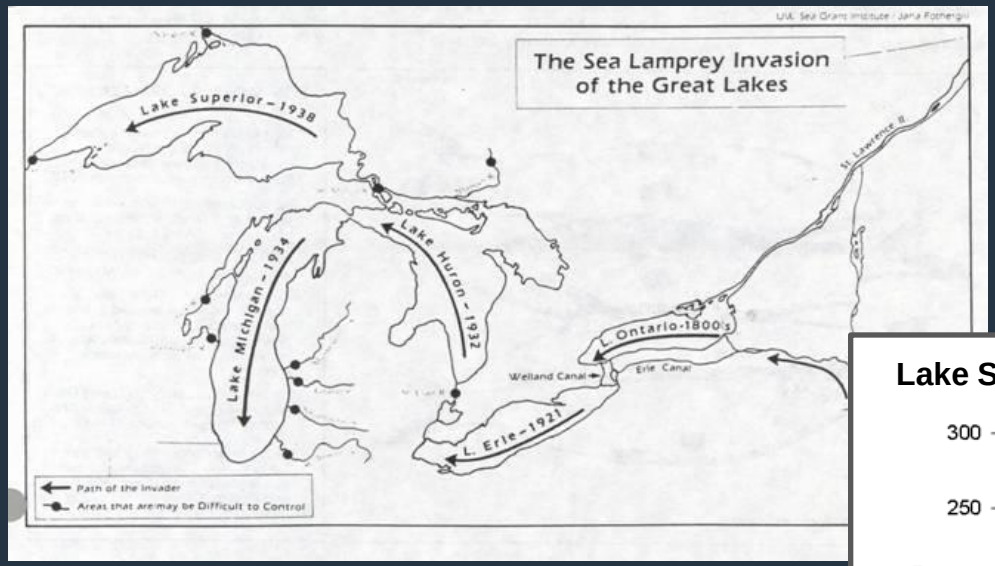
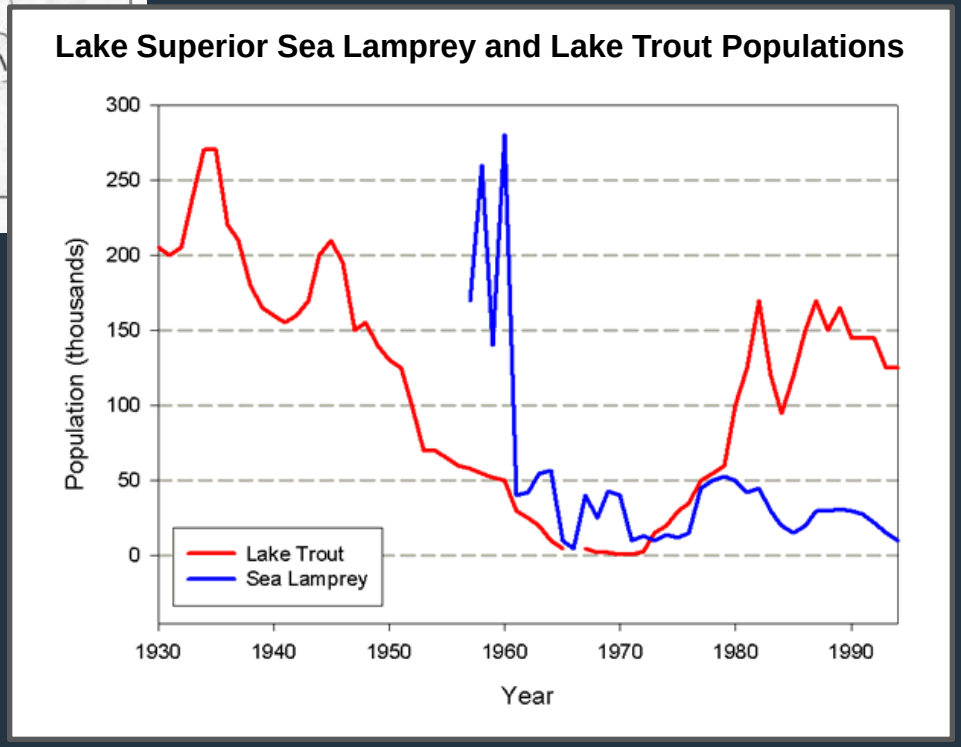
Sea Lamprey: Great Lakes Invader





- 1930's – Sea lamprey reach the upper Great Lakes
- 1950's - Collapse of lake trout population
- 1960's – Effective sea lamprey control measures instituted

Source: USGS

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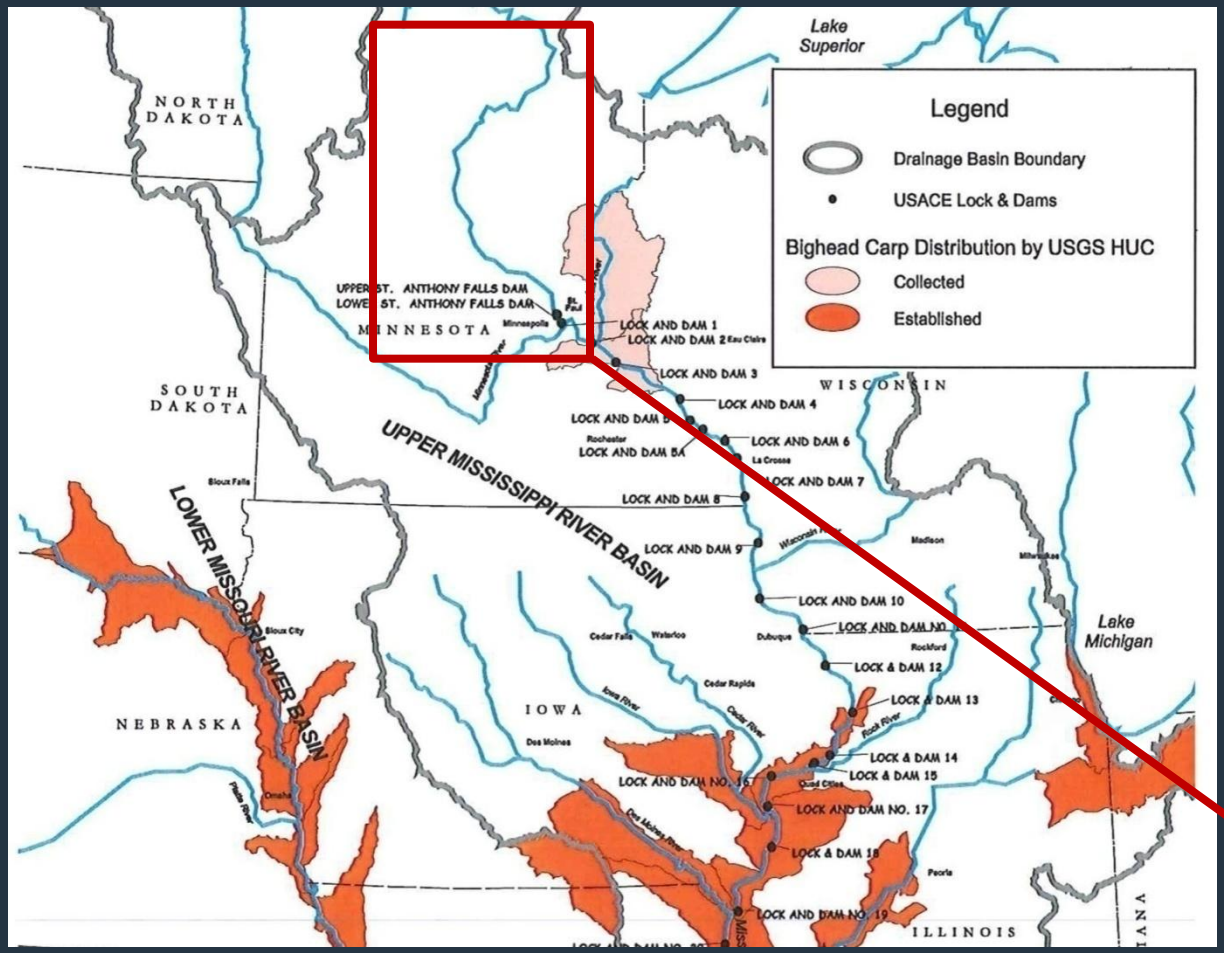
Asian Carp: Upper Mississippi Invader



- 1990's – Mississippi River flooding allows Asian carp to escape from aquaculture ponds to river
- 2006- Asian carp found 50 miles away from Lake Michigan
- 2011 – Asian carp caught at confluence of St. Croix and Mississippi River
- 2 regions of concern
  - Lake Michigan
  - Mississippi River Headwaters

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Methods of Control

Chemical

Mechanical

Electrical

Physical

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Barrier Project Development

PHASE	STAGE	TASKS	PURPOSE
I	Investigation	Site Visit/Inspection Discussion of Issues/Alternatives Estimate Conceptual Quantity/Cost Quantify Project Needs/Issues Concept Analysis/Design	Define Future Project Stages
II	Data Collection	Topographic and Structure Survey Soil Borings and Testing Design Parameter Analysis	Basis of Design
III	Final Design	Detailed Analysis/Design Develop Drawings Estimate Quantities/Cost Develop Construction Documents Refine Design	Construction

Scientists

- Define problem
- Establish objectives
- Characterize species behavior
- Provide feedback

Engineers

- Define design parameters
- Evaluate feasibility
- Layout structure
- Detailed design
- Develop construction documents

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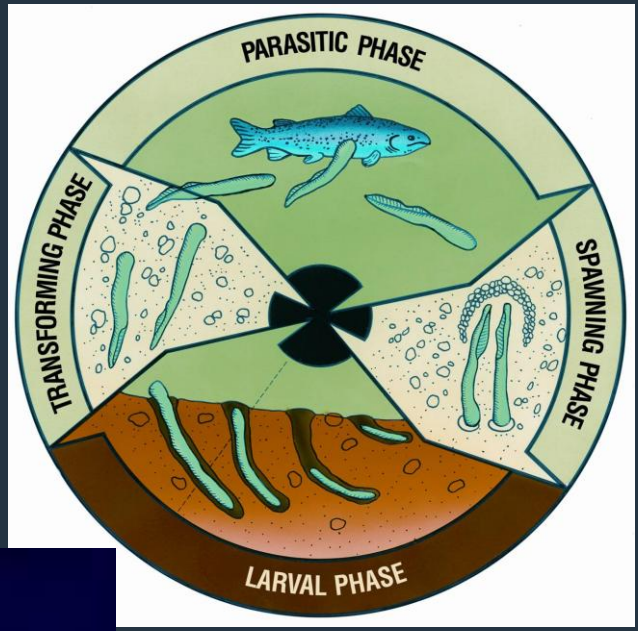
Sea Lamprey

Tendencies

- Live in Great Lakes
- Ascend gravelly streams and rivers to spawn in spring
- Stream flows are typically highest in spring

Capabilities

- Low swimming speed but can attach to rocks/objects
- Cannot ascend vertical drops greater than 18”



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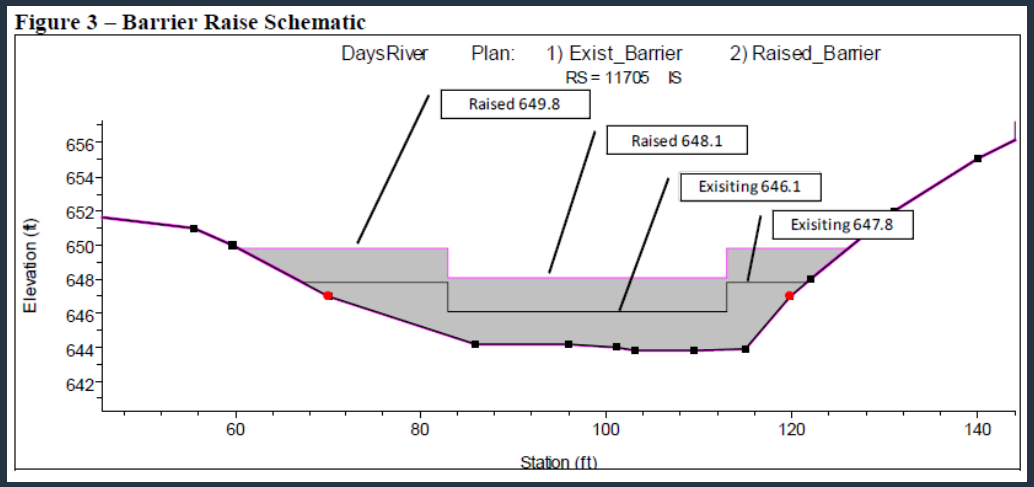
Sea Lamprey Barriers

Days River

- Existing barrier in U.P. of MI constructed in mid-80's
- No longer effective
- Project findings
  - 2' raise could improve effectiveness by 87%
  - Removing ATV trail lowers tailwater
  - Minimal upstream flooding impacts



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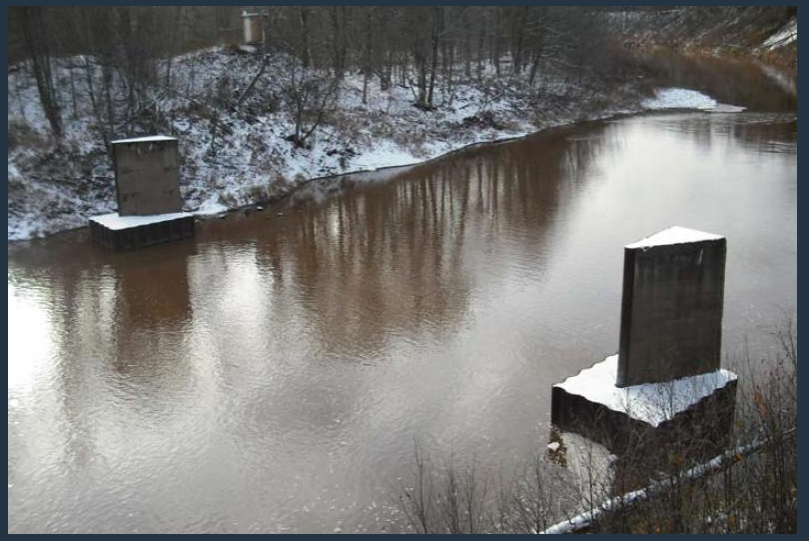
Sea Lamprey Barriers

Ontonagon River

- Most productive sea lamprey stream
- Use abandoned bridge
- Use skewed weir to control velocity
- Project findings
  - Highly variable flow regime
  - Spring water levels could be up to 10’ higher than shown in photo
  - Use sheet pile weir
  - Construction difficult (i.e. $$) but possible in 2 stages
  - Difficult to control velocity during normal spring flows



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Sea Lamprey Barriers

<u>Manistique River Barrier</u>

- Existing dam
- Significant concrete deterioration
- Void and crevice filled bedrock
- Flood impacts
- Environmental concerns

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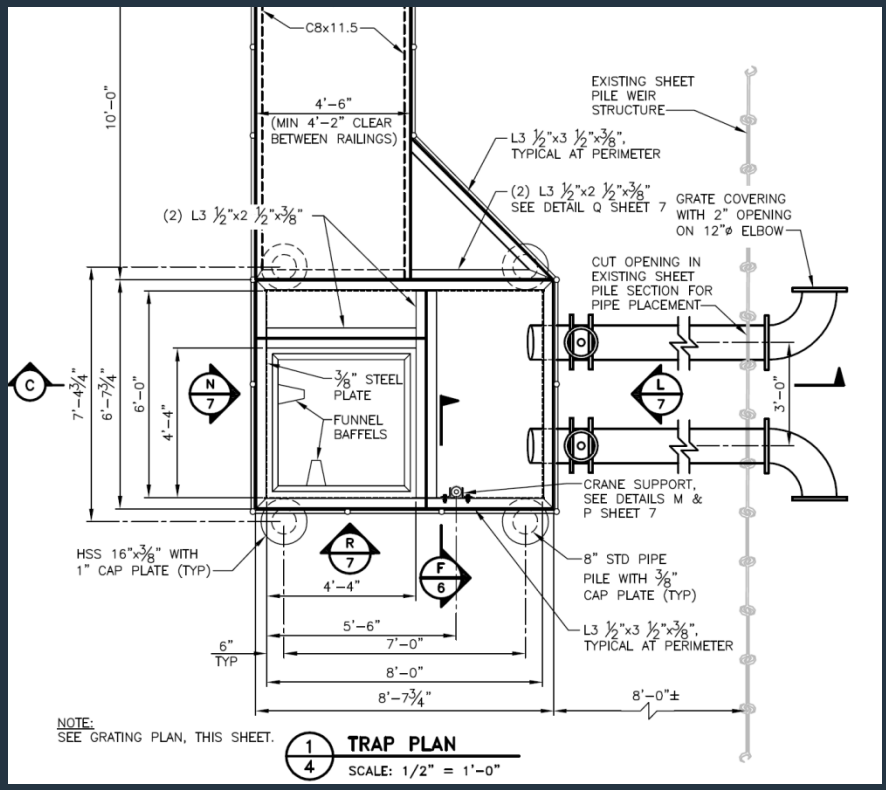
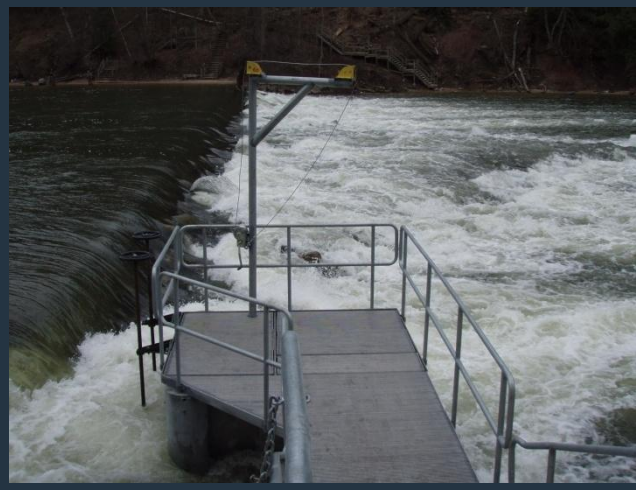
Sea Lamprey Traps

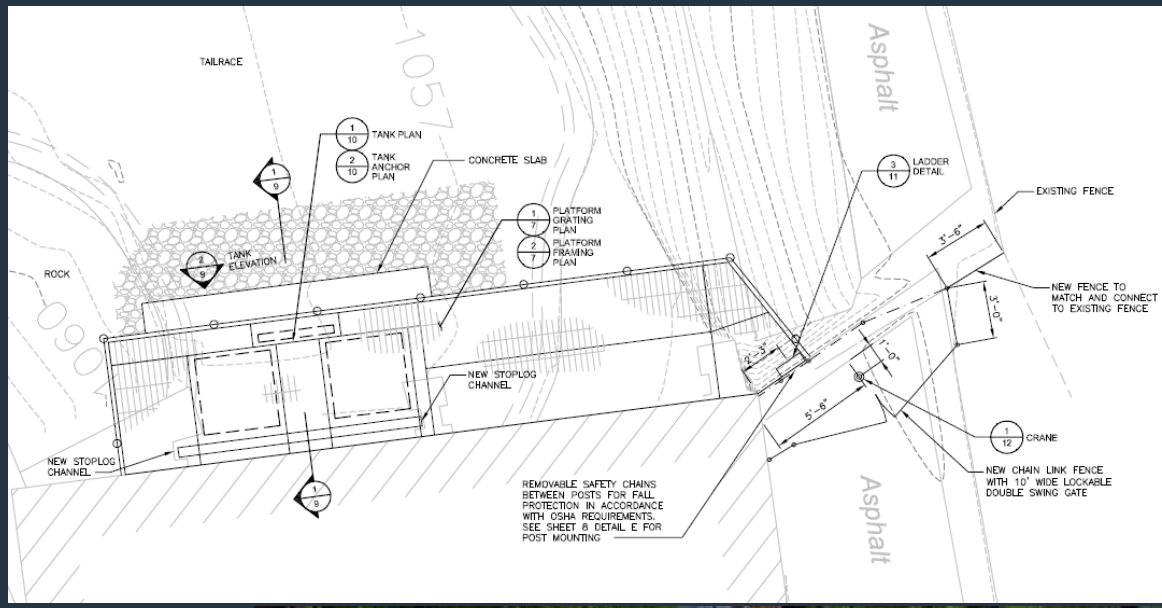
Manistee River

- Existing dam provides barrier
- Design trap box to be removable
- Valved pipes (2) to provide flows
- Removable grated panels and crane for trap lifting
- Switch from deep pipe pile to hybrid shallow pile/slab foundation
- 2010 Construction





Sea Lamprey Traps



Cattaraugus Creek

- Existing dam provides barrier
- Historic structure
- No attachment to powerhouse
- Remove turbine runner
- Remove 14’ of sediment in forebay
- Concrete slab foundation
- Stoplog adjustable openings
- Provide 2 cranes for lifting trap up to parking area
- Construction 2011

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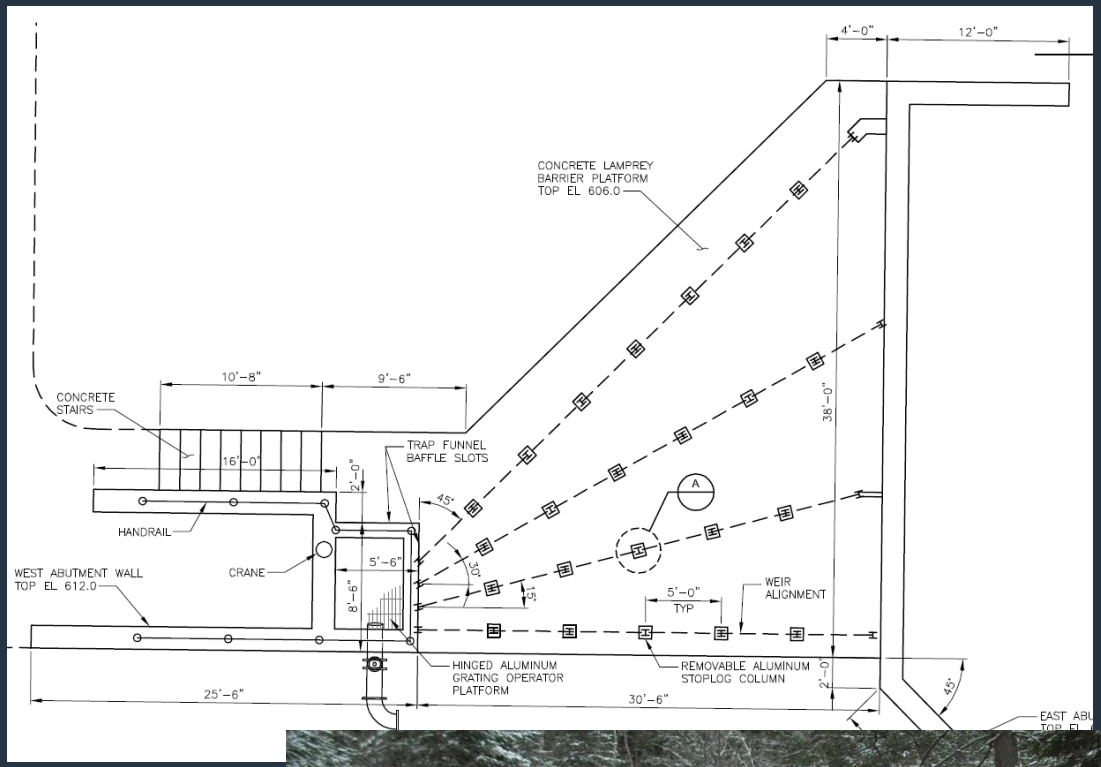
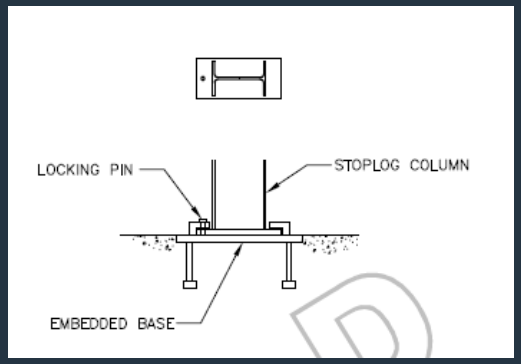
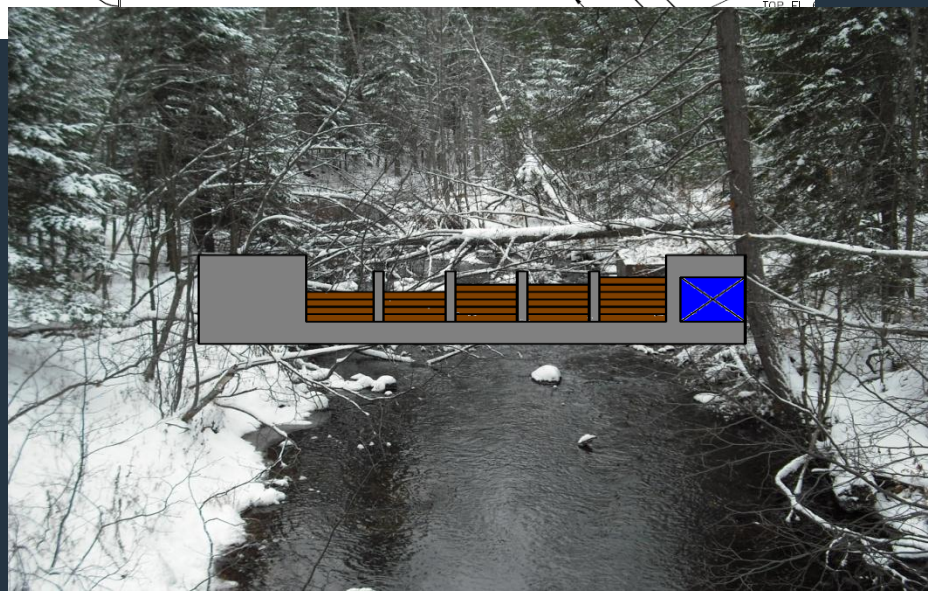
Sea Lamprey Trap Testing Facility

Harlow Creek

- Proposed facility on small creek in U.P. MI
- Adjustable angle and weir heights
- Removable posts with stoplogs
- Test variations to improve trapping effectiveness







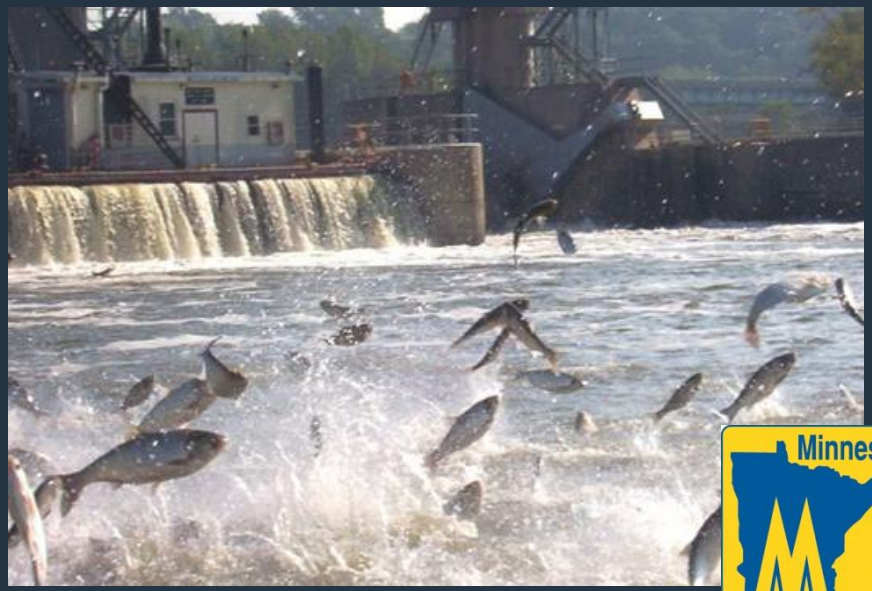
Asian Carp

Capabilities:
- 25 feet per second burst velocity
- 10-foot leaping ability

Tendencies:
- No seasonal migration habits
- Migrate during high river flows

Potential Affected Waters:
- Upper Mississippi
- Lake Mille Lacs

Detrimental Effects:
- Jeopardize native fish species
- Hazard to boaters/water skiers
- Fishing contributes $2 billion/year to the Minnesota economy



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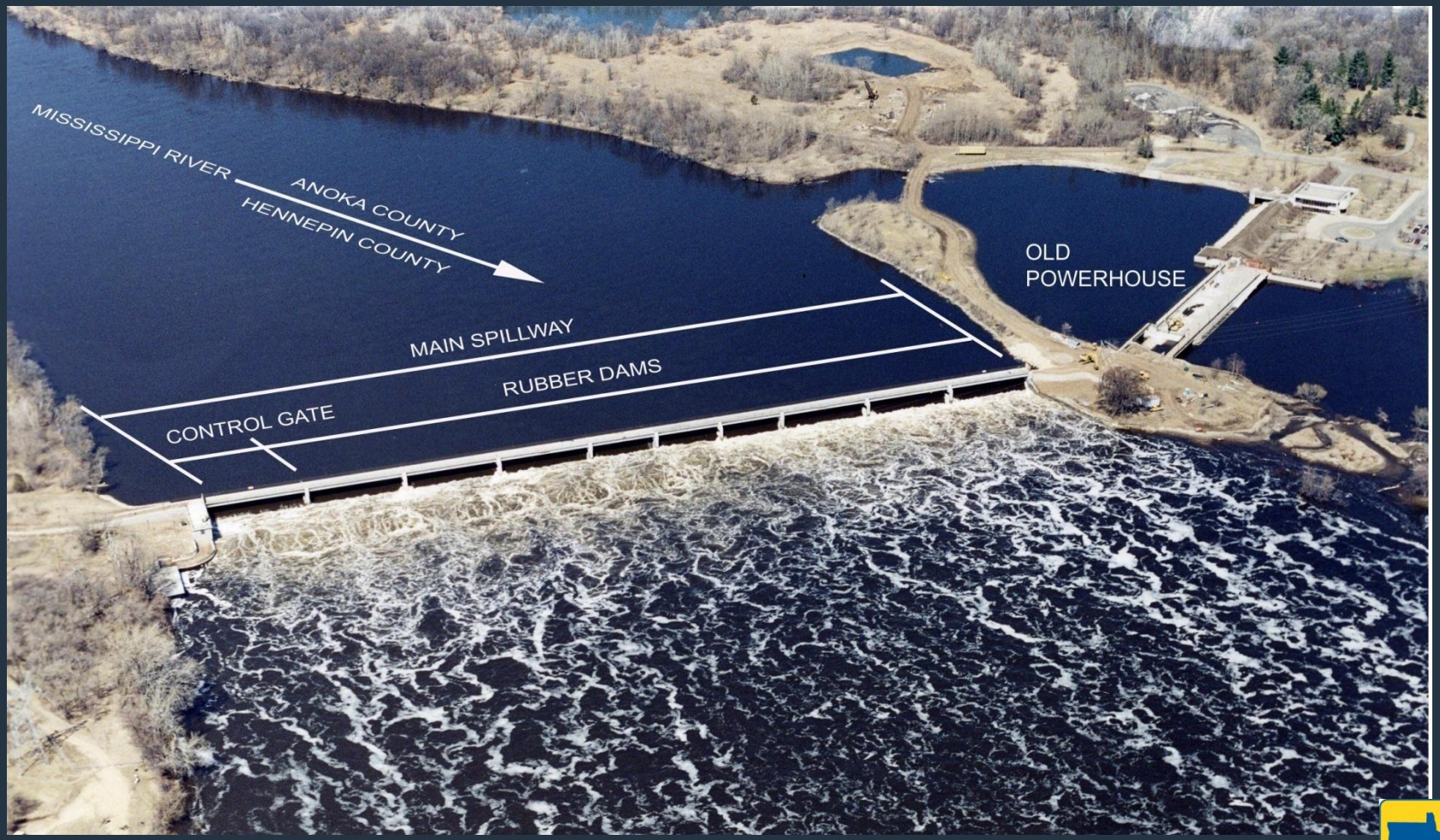
Coon Rapids Dam



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Spillway Gates

Inflatable Crest Gate

Hydraulic Crest Gate

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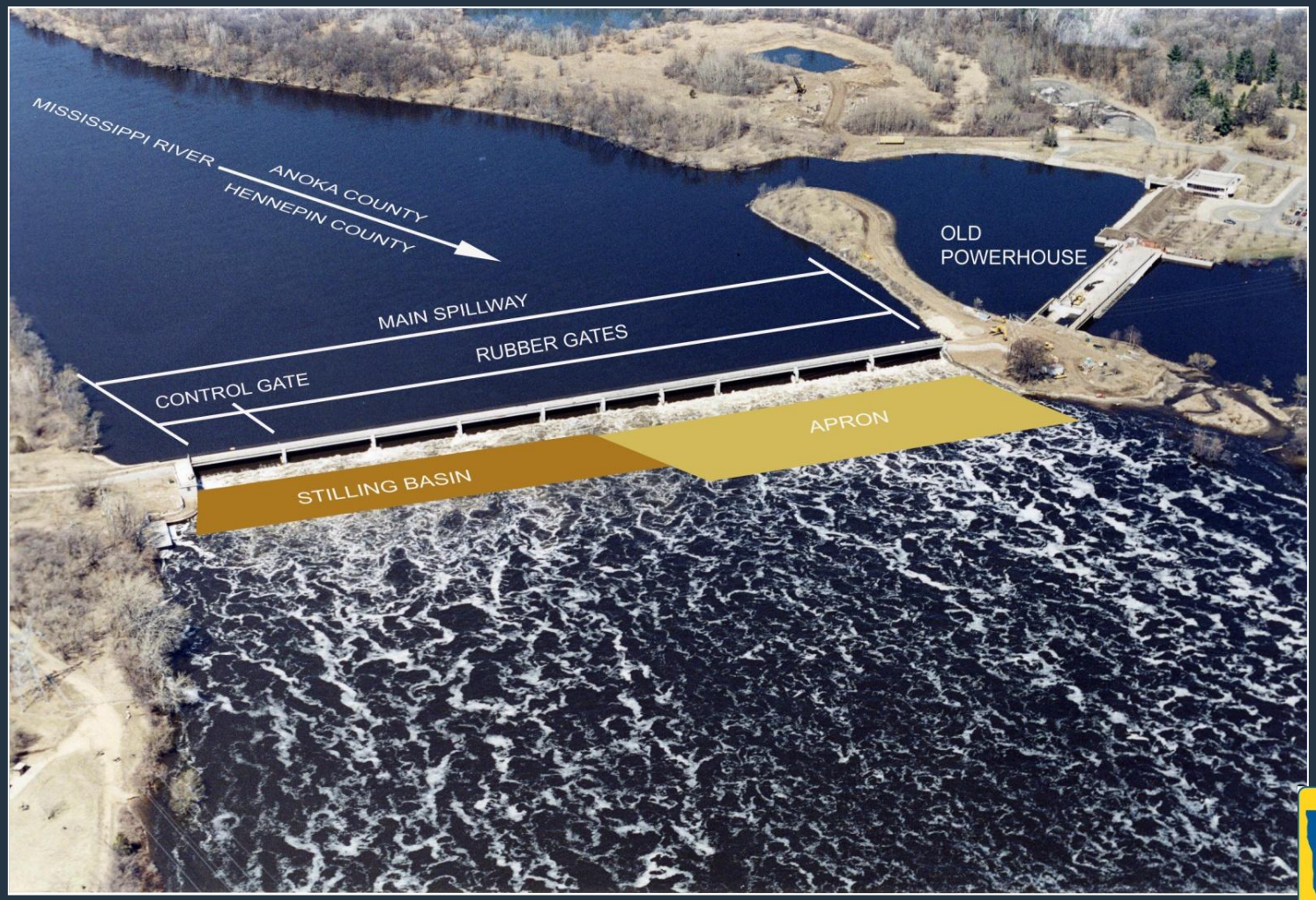

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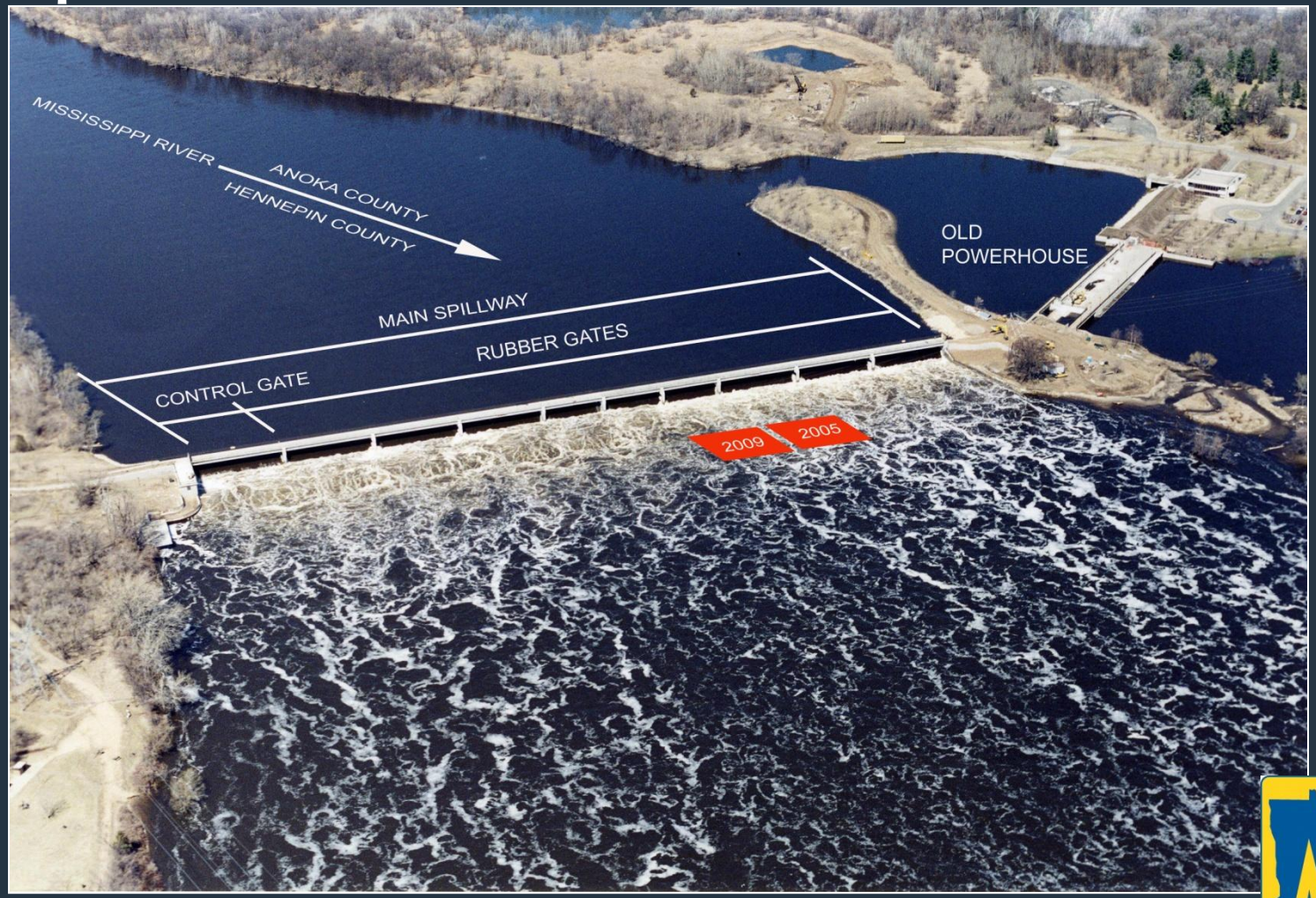
Apron Scour



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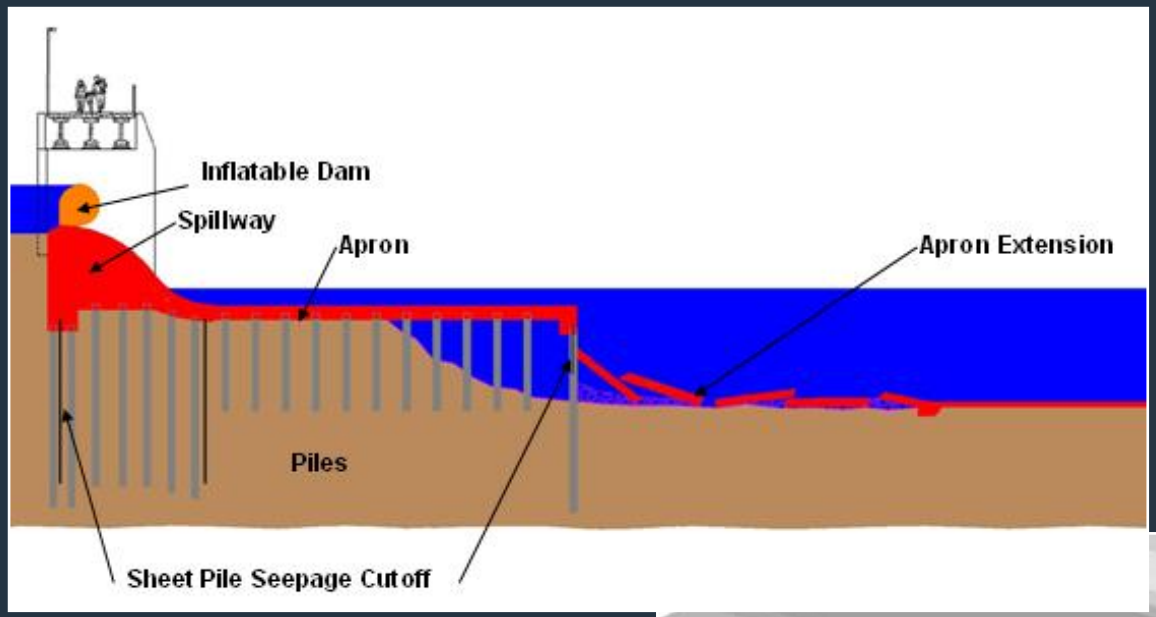
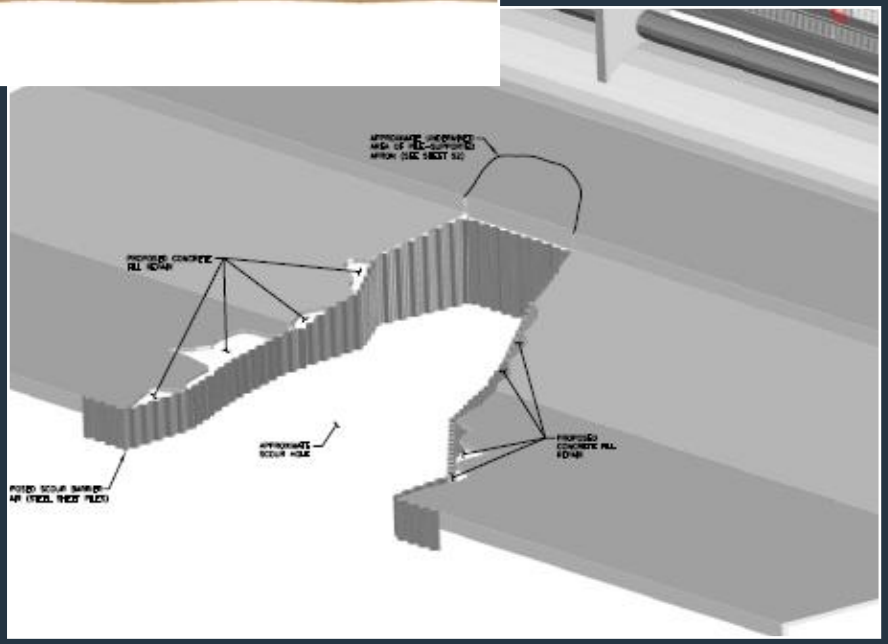
Apron Scour Damage





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Asian Carp Passage

Barrier & Deterrent Alternatives

Behavioral

- Strobe lights
- Air bubble curtains
- Acoustics
- Electrical barriers
- Hydrodynamic Louvers

Physical

- Screens
- Curtains
- **Vertical drops***
- **Water velocity barriers***

* **Deemed practical & feasible at Coon Rapids Dam - other alternatives dismissed due to width of waterway, high river flows, water level fluctuations, & climate/ice.**

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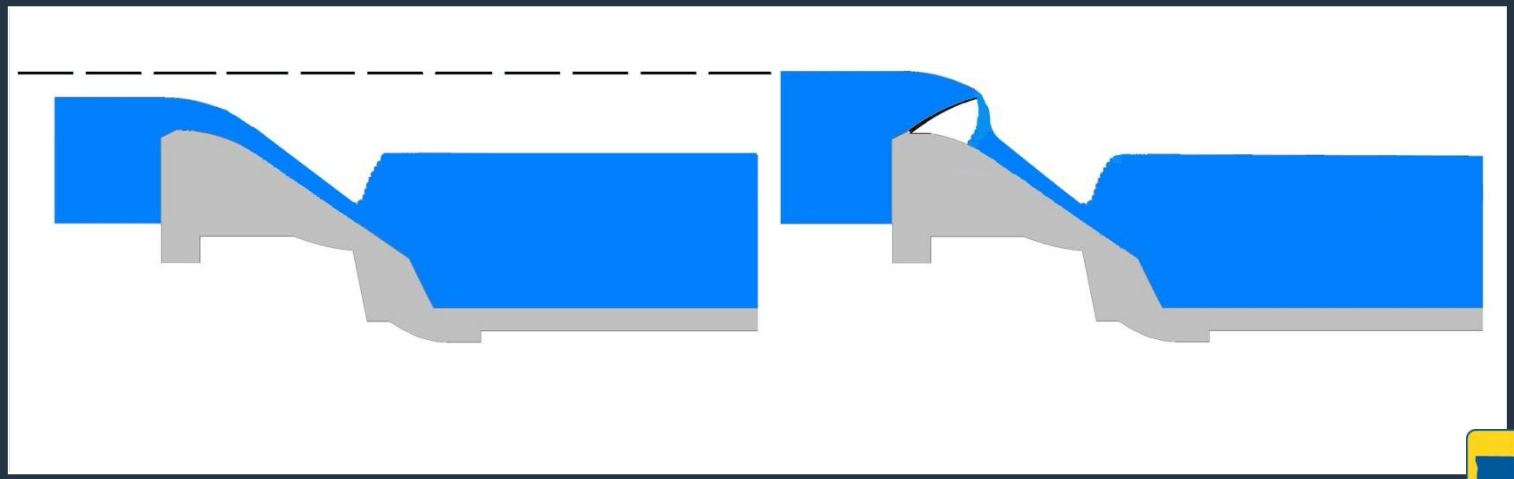
Evaluation of Coon Rapids Dam

- Spillway hydraulics (vertical drop & water velocity)
- Historic river flows (79 years)
- Existing gates & operation
- New gates & modified operation*



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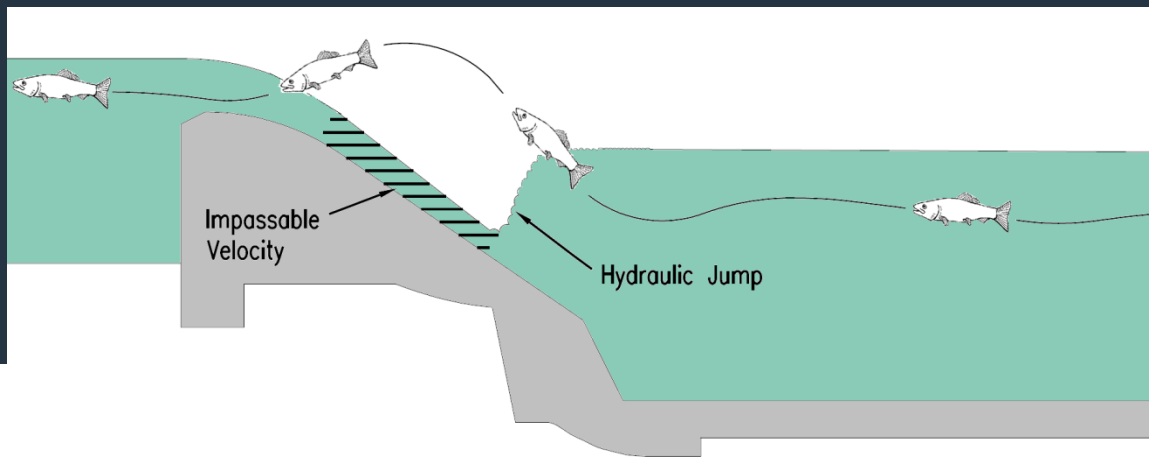
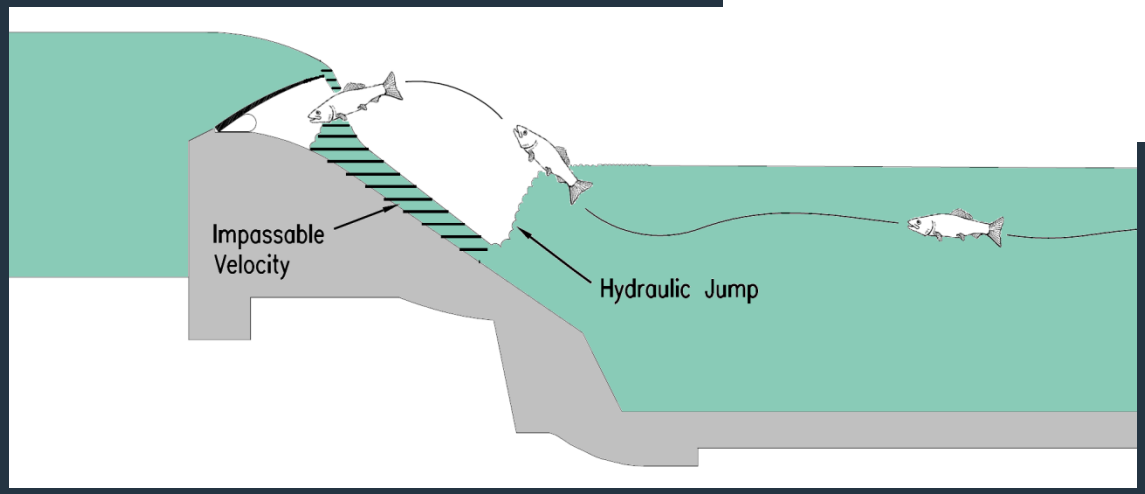
Asian Carp Passage

Evaluation of Coon Rapids Dam:

- Behavioral type barriers not practical for CRD
- Utilize natural water head and velocity as barrier (fish must swim and/or leap from tailwater to pool)





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Future of Coon Rapids Dam

Conclusions: With improvements and operational changes, dam would be effective barrier ~99% of the time.

Status: Minnesota State Government recently passed bonding bill including $16 million for Coon Rapids Dam renovation.

Acknowledgements

Greg Klingler
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Minnesota Department of Natural Resources

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Principal Water Resources Engineer
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Questions?