

Reconnecting Rivers with Rock Arch Rapids Dam Modifications

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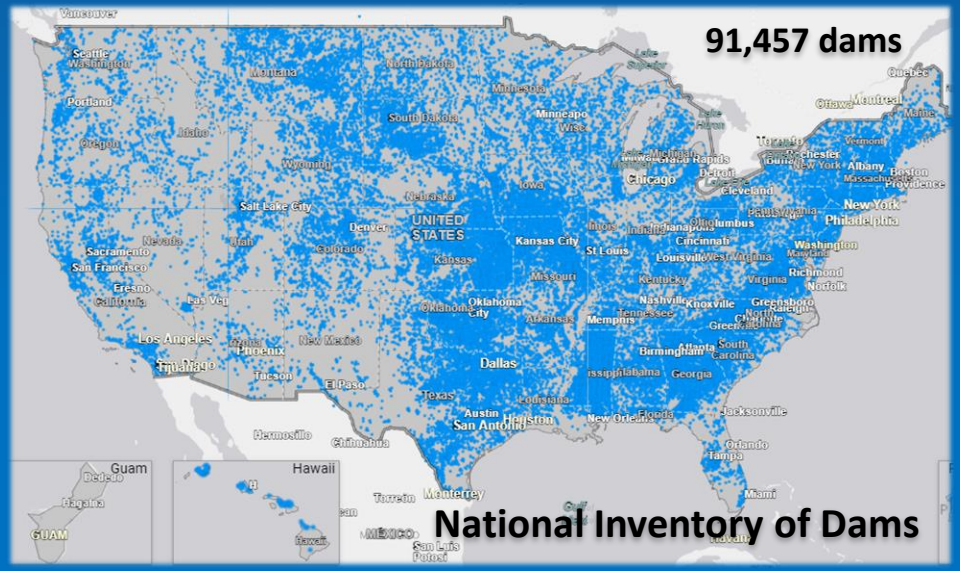
DEPARTMENT OF NATURAL RESOURCES

DAMS

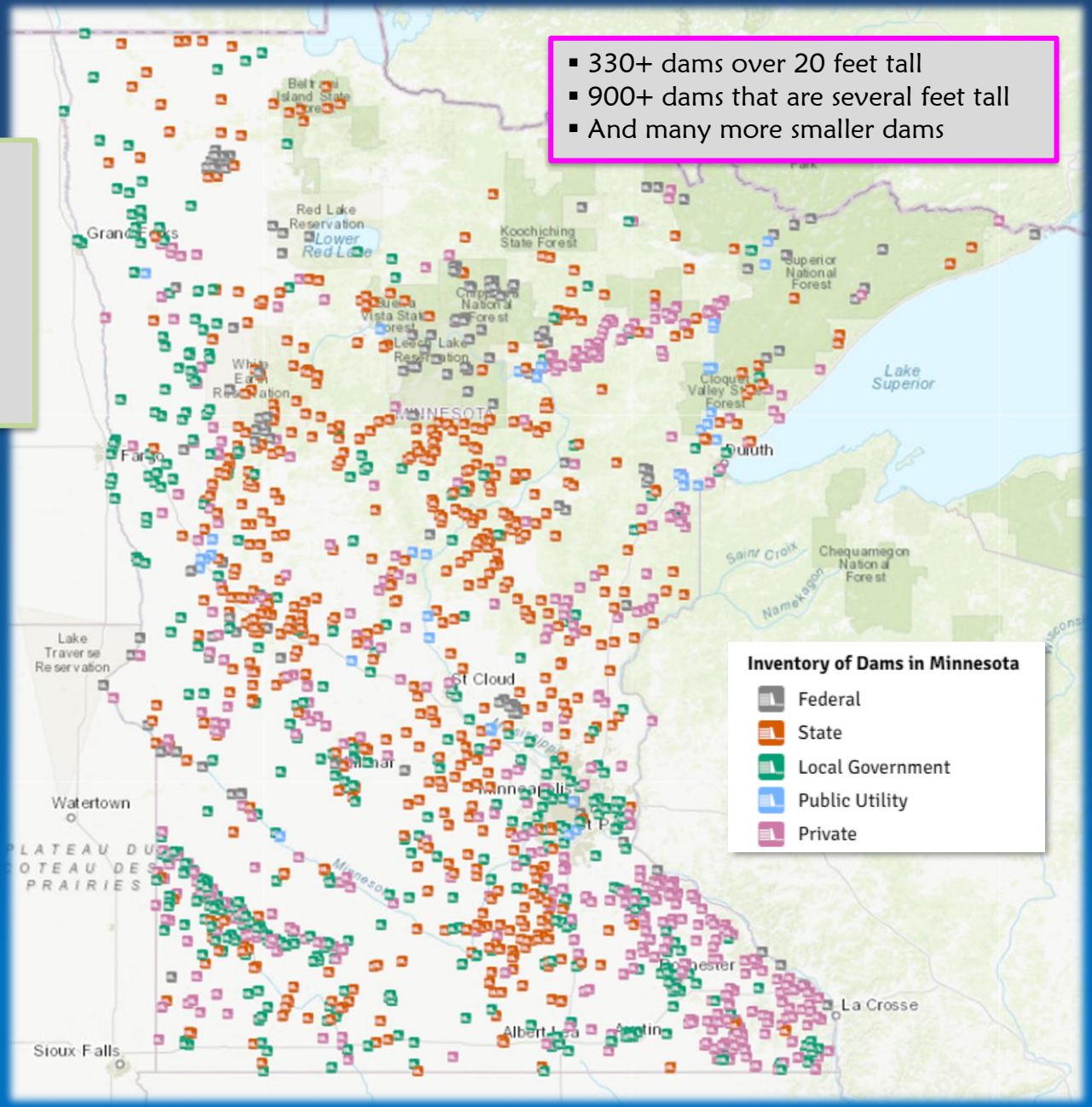
- Water supply
- Lake level control
- Mills
- Power generation
- Recreation
- Floodwater retention
- Diversion

In the United States:

- There are 6,575 dams at least 49 ft high
- over 75,000 dams at least 6 feet high
- And many more smaller dams



- 330+ dams over 20 feet tall
- 900+ dams that are several feet tall
- And many more smaller dams



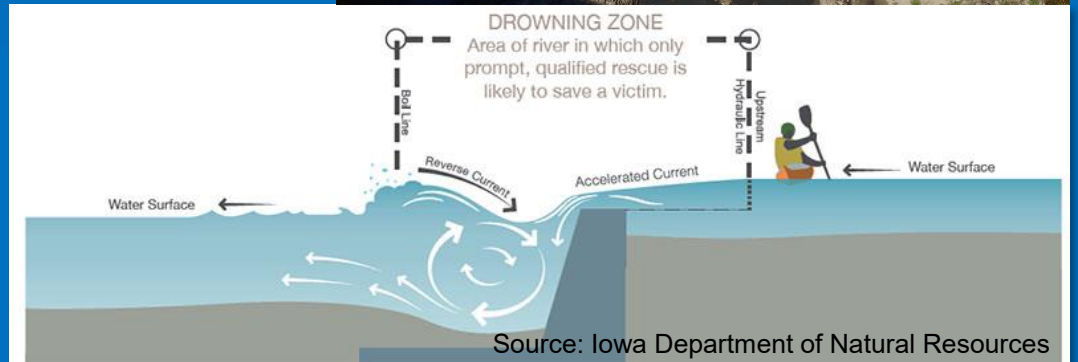
Dam Finder: https://arcgis.dnr.state.mn.us/ewr/dam_finder/

Concerns with dams

- Aging structures:
  - About 85% of U.S. dams have exceeded their design life (typically 50 years) in 2020 (FEMA 1999). The average age of the 94,000 dams in America is 59 years old (FEMA 2022).
- Hydraulic Roller
  - Water flowing over low-head dams create a dangerous roller that can trap and drown swimmers, boaters, and kayakers.
- Fish Passage
  - Are barriers or partial barriers to fish passage.
    (Avg. 36% of native species are lost above a barrier dam)
- Maintenance
  - As dam structures age, maintenance increases. Debris and blockages are also common.
- Water Quality Issues
  - Sediment erosion downstream due to hungry water
  - Nutrient releases as a sediment accumulates behind the dam







Source: Iowa Department of Natural Resources

Strategies for Reconnecting Rivers

Nature-like Fish Passage

Dam Removal

Rock Arch Rapids

By-pass Fishway







Problem Corrected / Restored	Dam Removal	Rock Arch Rapids	By-pass Fishway
Stream Habitat	★★★	★½	★ *
Safety – dam failure risk	★★★	★	
Safety – hydraulic undertows	★★★	★★½	
Fish & Wildlife Passage	★★★	★★½	★★ *
Canoe passage, recreational boating	★★★	★★	★ *
Geomorphic and ecological processes (sedimentation, incision, nutrient processes, etc.)	★★★		

* Size dependent

Applications of Rock Ramps

- Dam Modification
  - Full Pool- (original height of the dam retained)
  - Reduced height
  - Stabilization of the reservoir sediment with restoration
- Lake outlets
- Grade stabilization/ incision correction







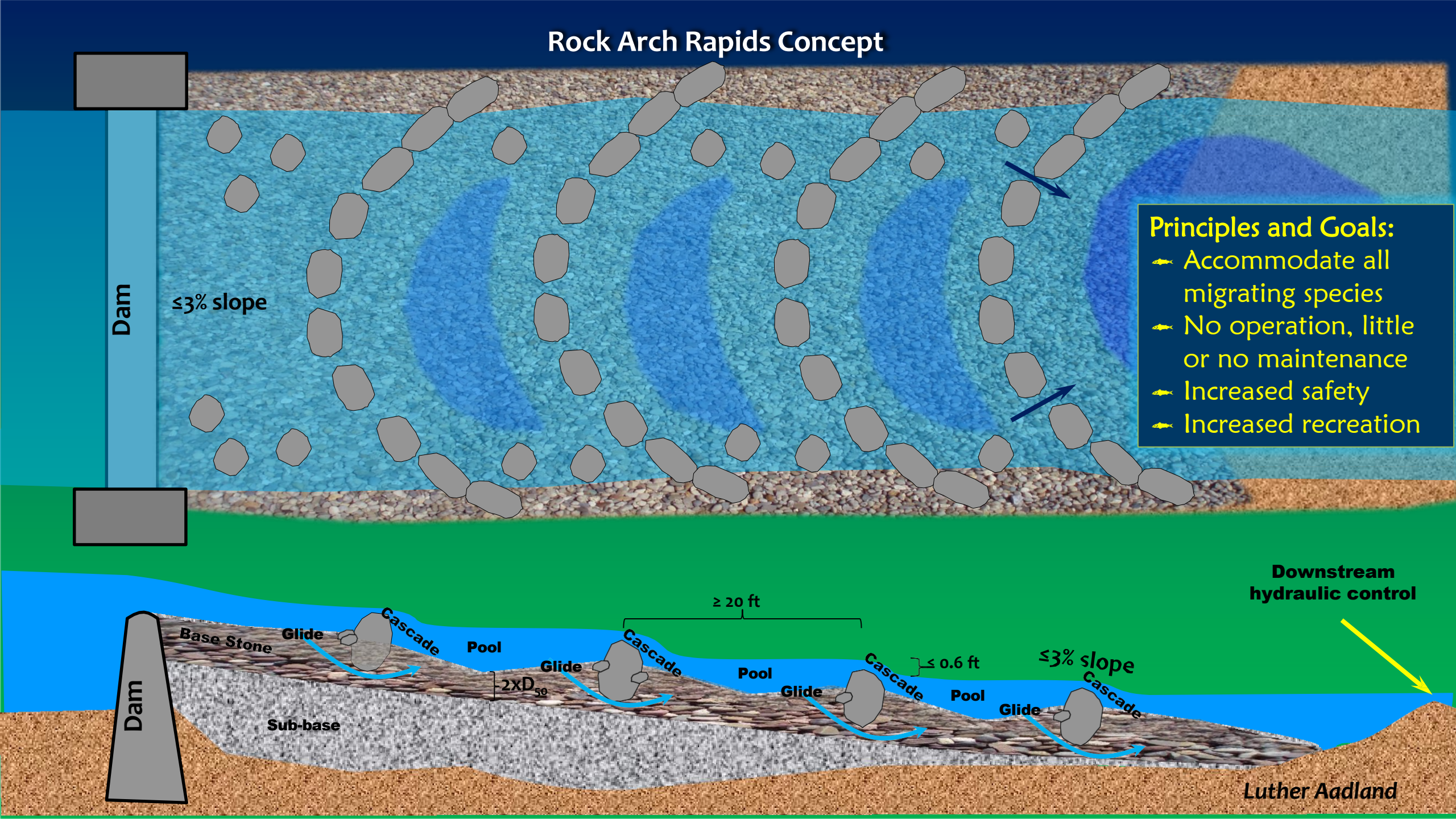
Rock Arch Rapids

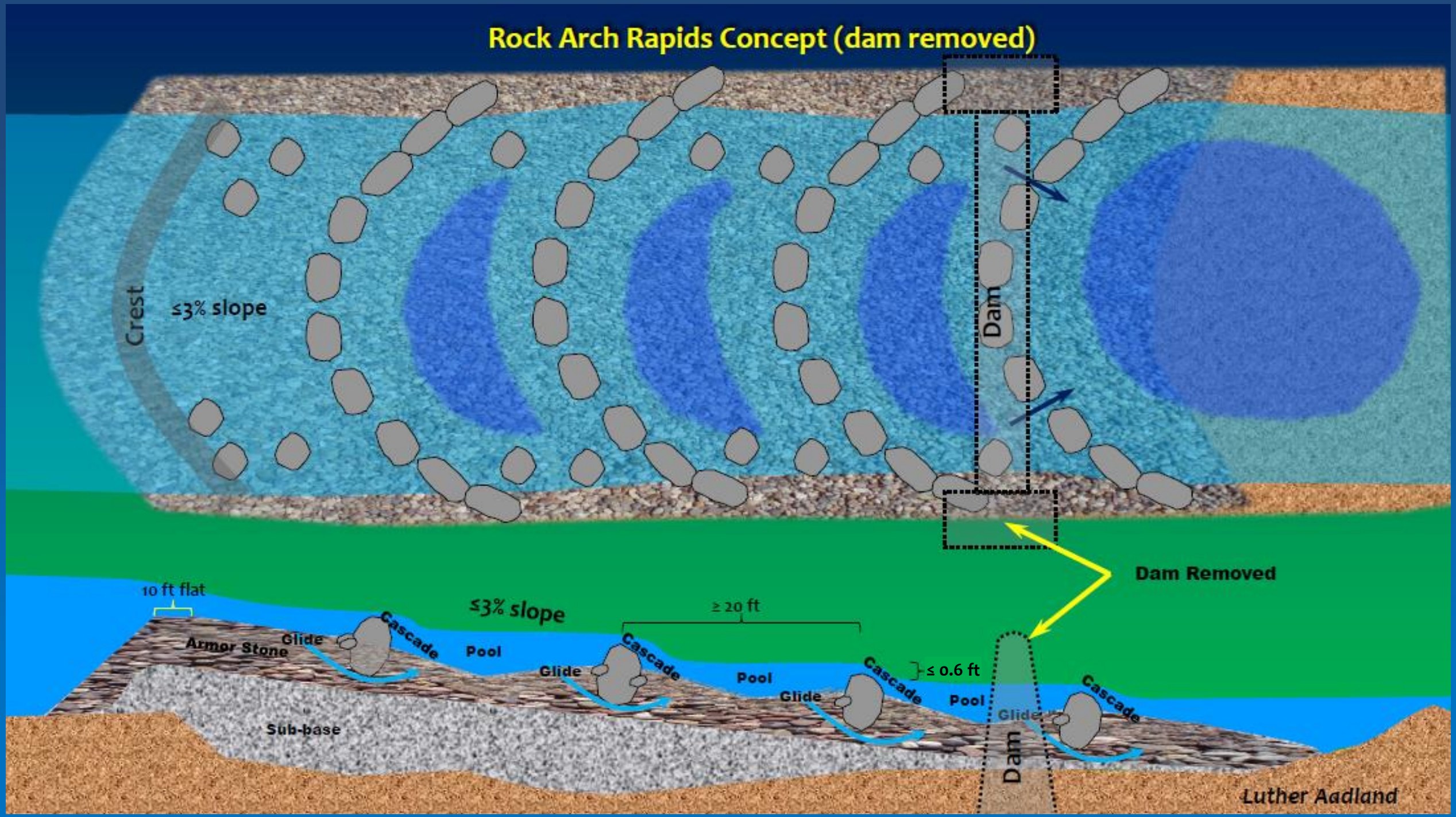
- Advantages:
  - Full width for fish passage
  - Eliminate hydraulic roller (drowning machine)
  - Provide high gradient habitat
  - Can provide canoe and kayak passage

- Disadvantage:
  - Have practical limits on dam size and height
  - Need to withstand the largest flood if the structure does not flood out.



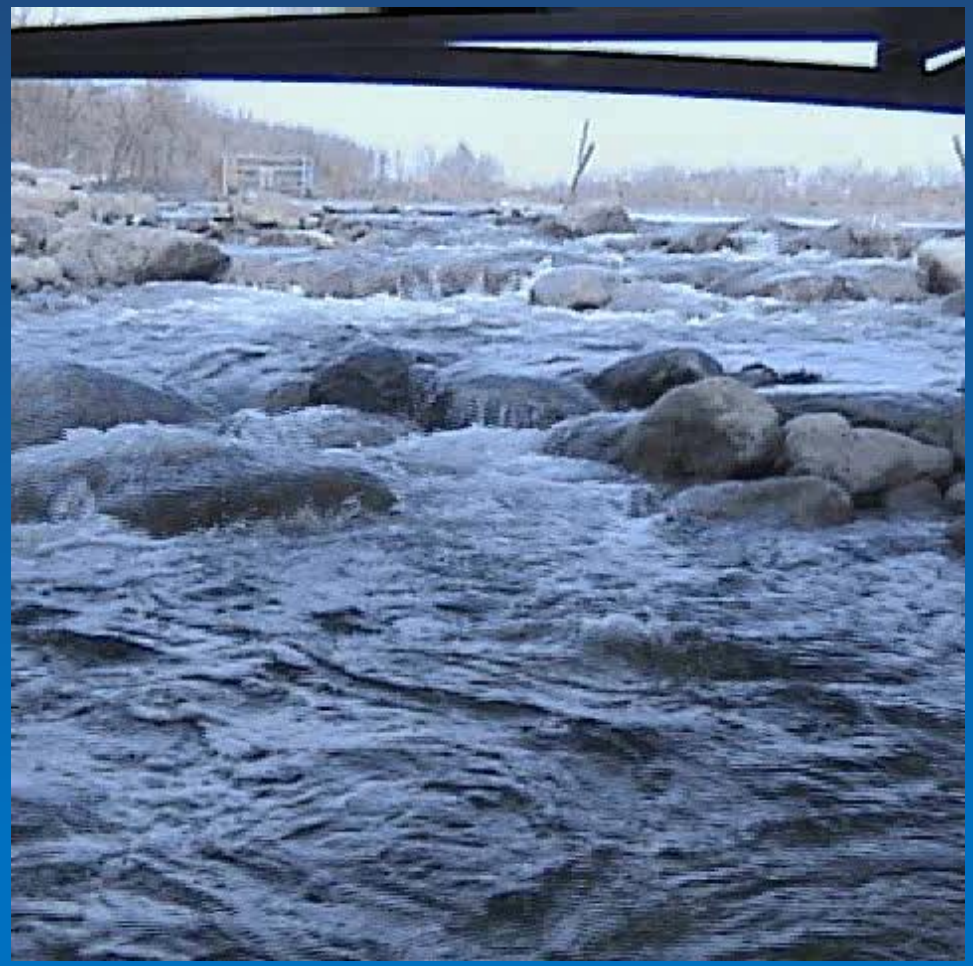
Rock Arch Rapids Concept




Rock Arch Rapids Concept (dam removed)
Crest
≤3% slope
Dam
Dam Removed
10 ft flat
≤3% slope
≥ 20 ft
Armor Stone
Glide
Cascade
Pool
Glide
Cascade
Pool
Glide
Cascade
≤ 0.6 ft
Pool
Glide
Cascade
Sub-base
Dam
Luther Aadland

Fish passage



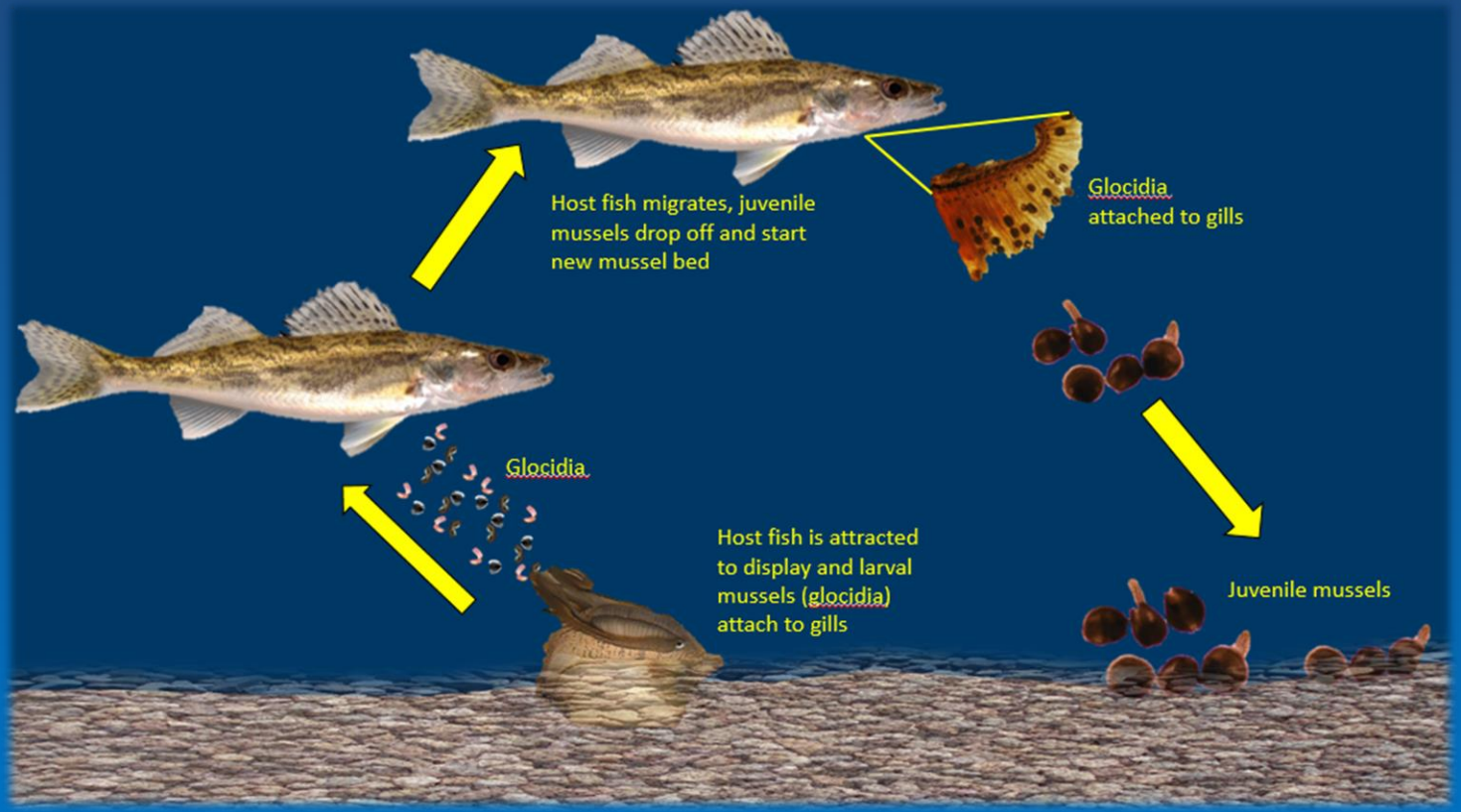


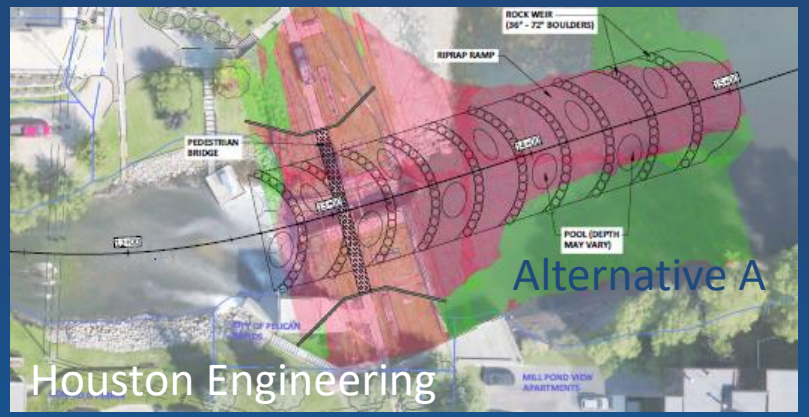
An average of 67% of the missing species return after removal, failure or fish passage modification.

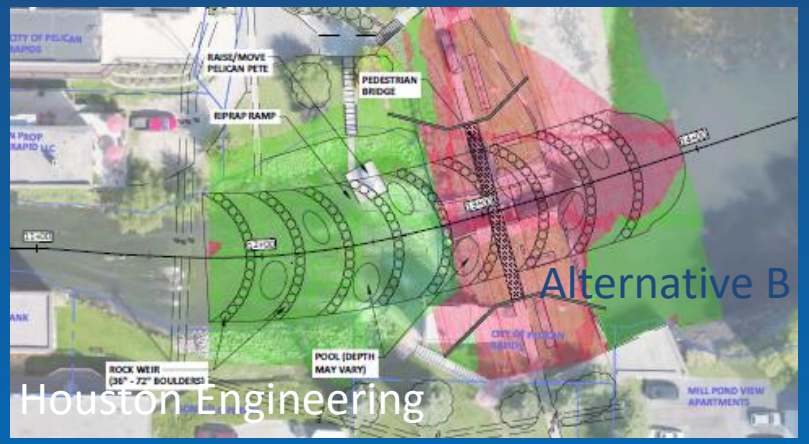
Linked to Mussel Populations

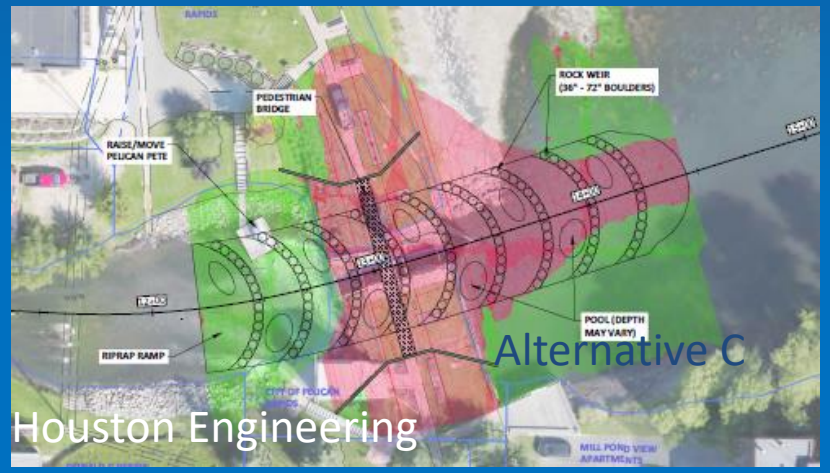


A female Plain pocketbook mantle display - Sturgeon River.
Fish hosts include bluegill, smallmouth bass, sauger and walleye.









- The design process is typically iterative.
- Each project is different and careful consideration is necessary to get the structure to fit.
- Consideration of the sidewalks, utilities, fishing pier, walking bridge and storm sewers were necessary in this example.



Construction

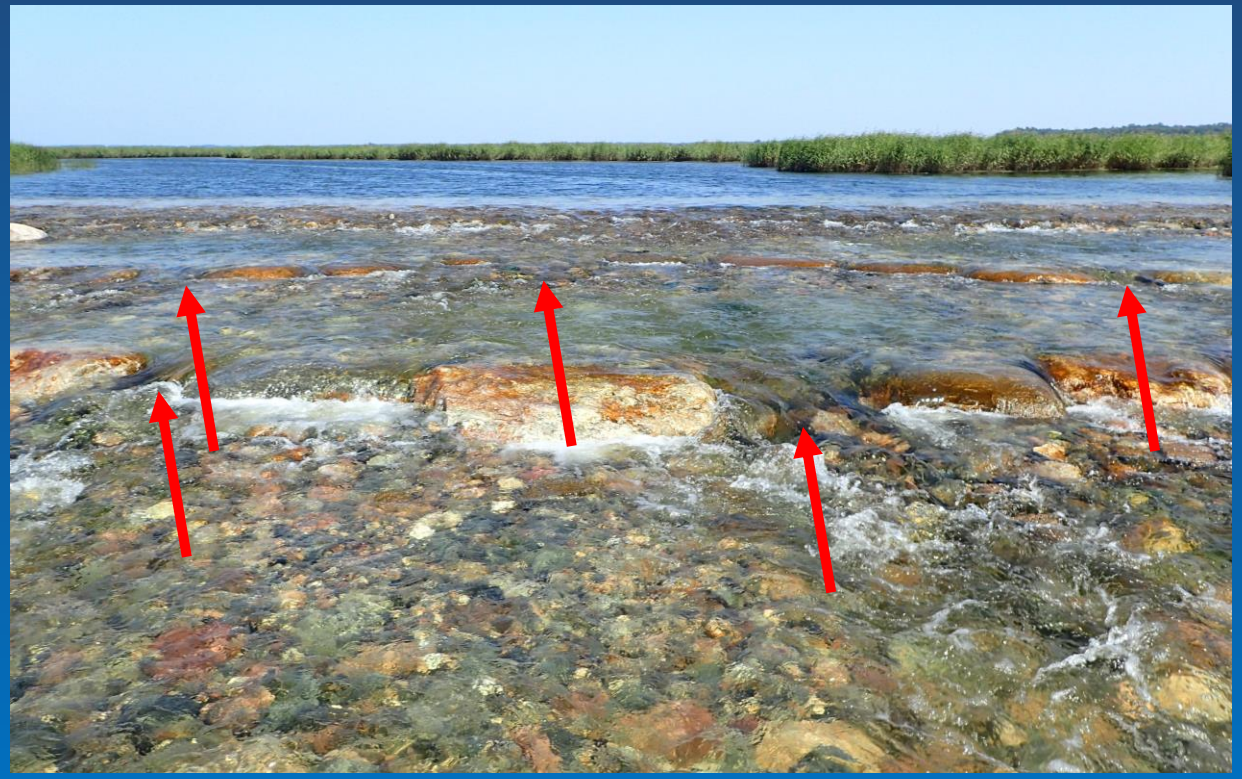




- Typically done in the winter.
- Minimizes the damage to surrounding ground.
- Flows tend to be low facilititating work in the water.
- Less likely to have a flood pulse occur during construction.

Key Feature: Weir Gaps and Resting Pools for Fish Passage

- Each weir has strategically placed gaps to allow for fish passage.
- Most Minnesota fish species do not jump but rather burst within the water column to pass high velocity areas.
- Resting pools between the weirs allow for recovery.



Flat Stone Features for Fishing and Recreation





Additional recreation and community opportunities

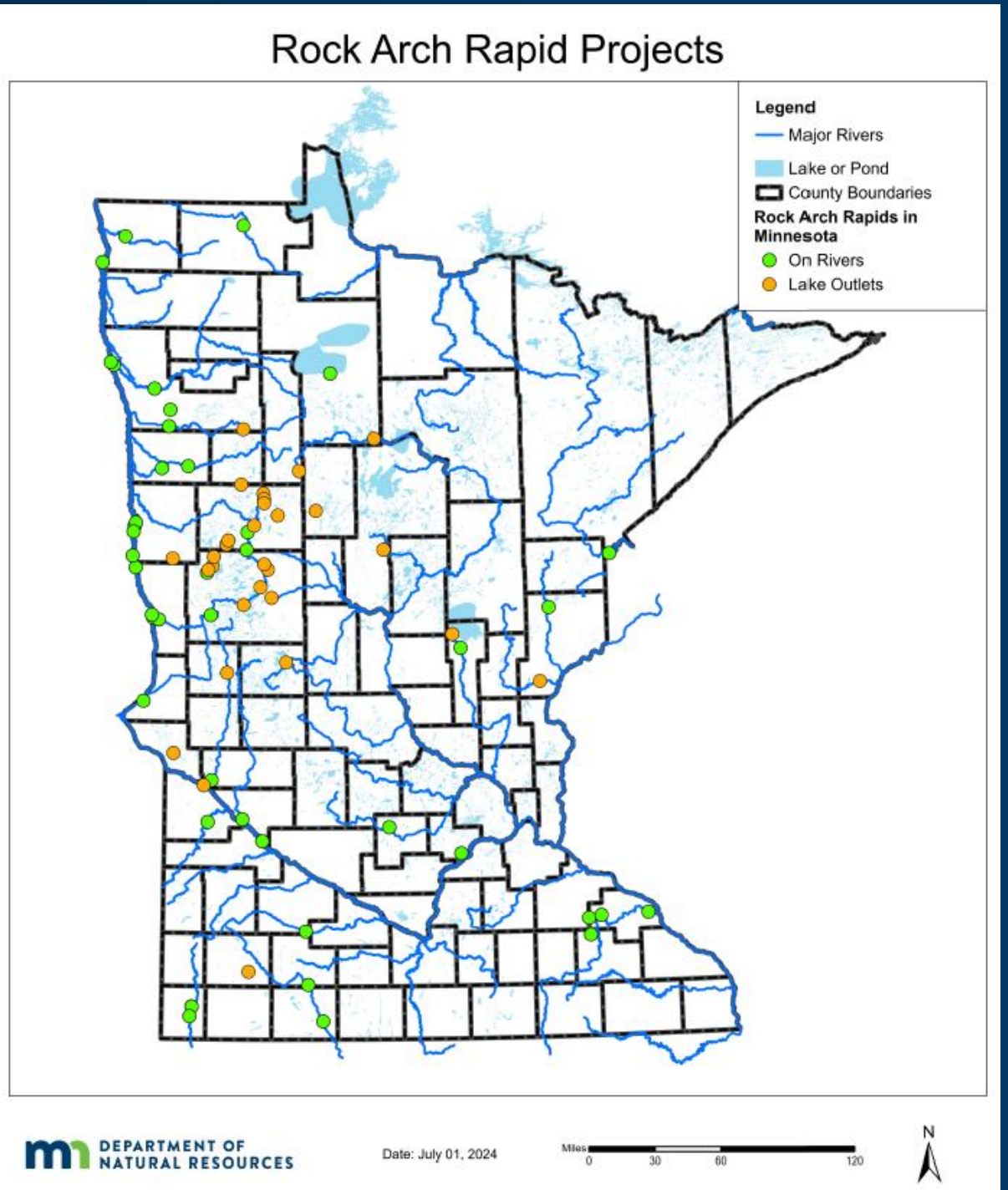


Pelican Rapids





- Final cost of the restoration portion was $2.9 million.
- Park features were added or reconfigured by the city with additional funds.
- The walking bridge replaced the walkway that the dam once provided.



- 72 Rock Arch Rapids
  - 48 Full pool or lake level
  - 8 Lowered pool
  - 14 Stabilized reservoir sediments for channel restoration
  - 1st one built in 1994 Otter Tail River in Fergus Falls
  - 3 Largest Drayton, Grand Forks (Riverside) and Oronoco

Willow River Dam, Willow River





Dam Modification





- Failed in 2016 after 5-8” rain event
- 1 drowning death in 2011
- Full pool Rock-Arch-Rapids built in 2021
- $1.8 million

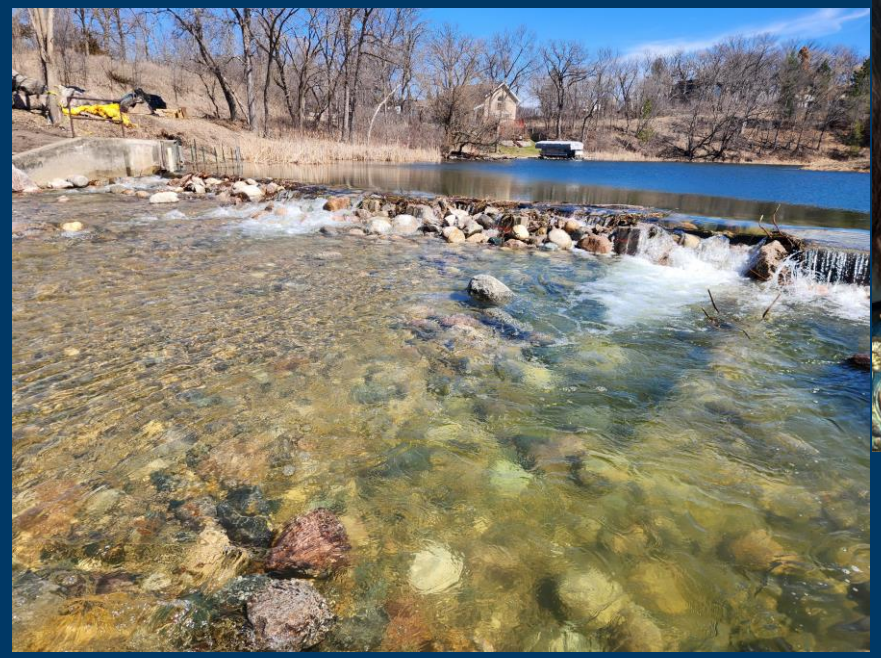




Bucks Mill Dam, Pelican River – Detroit Lakes, MN

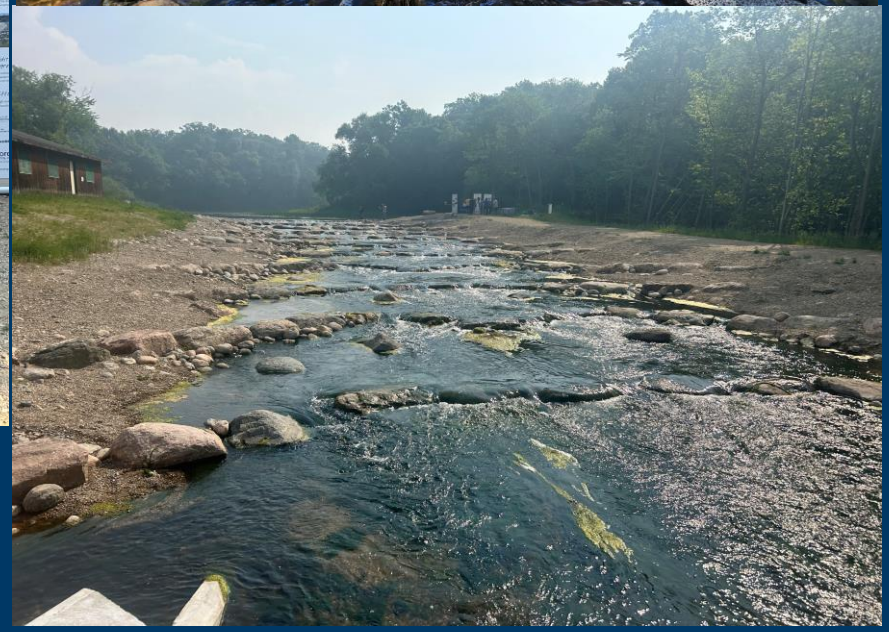
- Rock Arch Rapids built to set runout elevation
- Constructed in 2026
- Projected cost - $3.5 million











Mill Dam
10/2/2026
Feb 16, 2026
Captured with
DroneDeploy


24327 Buck's Mill Dam
3/5/2026
50 ft
Captured with DroneDeploy


24327 Buck's Mill Dam
3/26/2026
50 ft
Captured with DroneDeploy

24327 Buck's Mill Dam
4/7/2026
50 ft
Captured with DroneDeploy


24327 Buck's Mill Dam
4/30/2026
50 ft
Captured with DroneDeploy






CLEAN
WATER
LAND &
LEGACY
AMENDMENT

New Project Proposals

- Request for Proposals will be issued in January 2027

- Stream Restoration Priority List
  - Capitol Bonding
  - LSOHC
  - Proposals will be due in February

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