Grindstone River Dam

Public Informational Meeting

Hinckley Community Center

September 26, 2017

DEPARTMENT OF NATURAL RESOURCES

Tonight's Agenda

Addressing issues surrounding the Grindstone River dam

7:00 – 7:05	Welcome, tonight's purpose, agenda, facilitator
7:05 – 7:10	Communication guidelines
7:10 – 7:20	History of project, background
7:20 – 7:30	Dam status, current situation and costs
7:30 – 8:00	Dam related issues and alternatives
8:00 – 8:10	Preliminary assessment of alternatives and challenges
8:10 – 8:30	Questions and discussion with the audience
8:30 – 8:55	Small group discussions
8:55 – 9:00	Closing – thank you and next steps

Dam's purpose

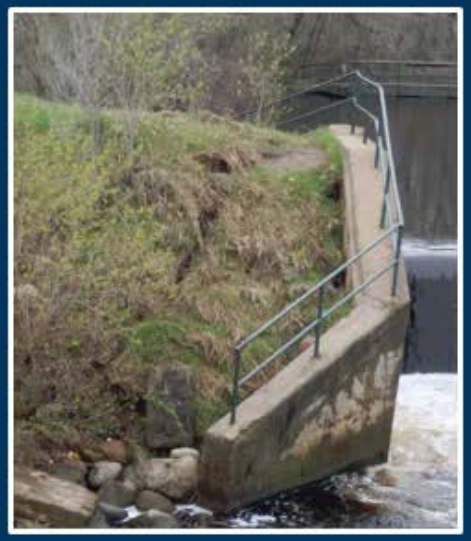
The dam was constructed by the Department in 1931.

The reservoir provides a water source for the fish rearing ponds.

Considerations:

Repairs of varying magnitude have been made over the years.
Recent inspection results give the dam a 'poor' rating.
Two documented fatalities have occurred thus far at the dam site.
Since something must be done, internal discussions have taken place in recent years.
A critical piece of funding was secured via the latest legislative bonding bill.

Some of the structural deficiencies:



Photos over time:

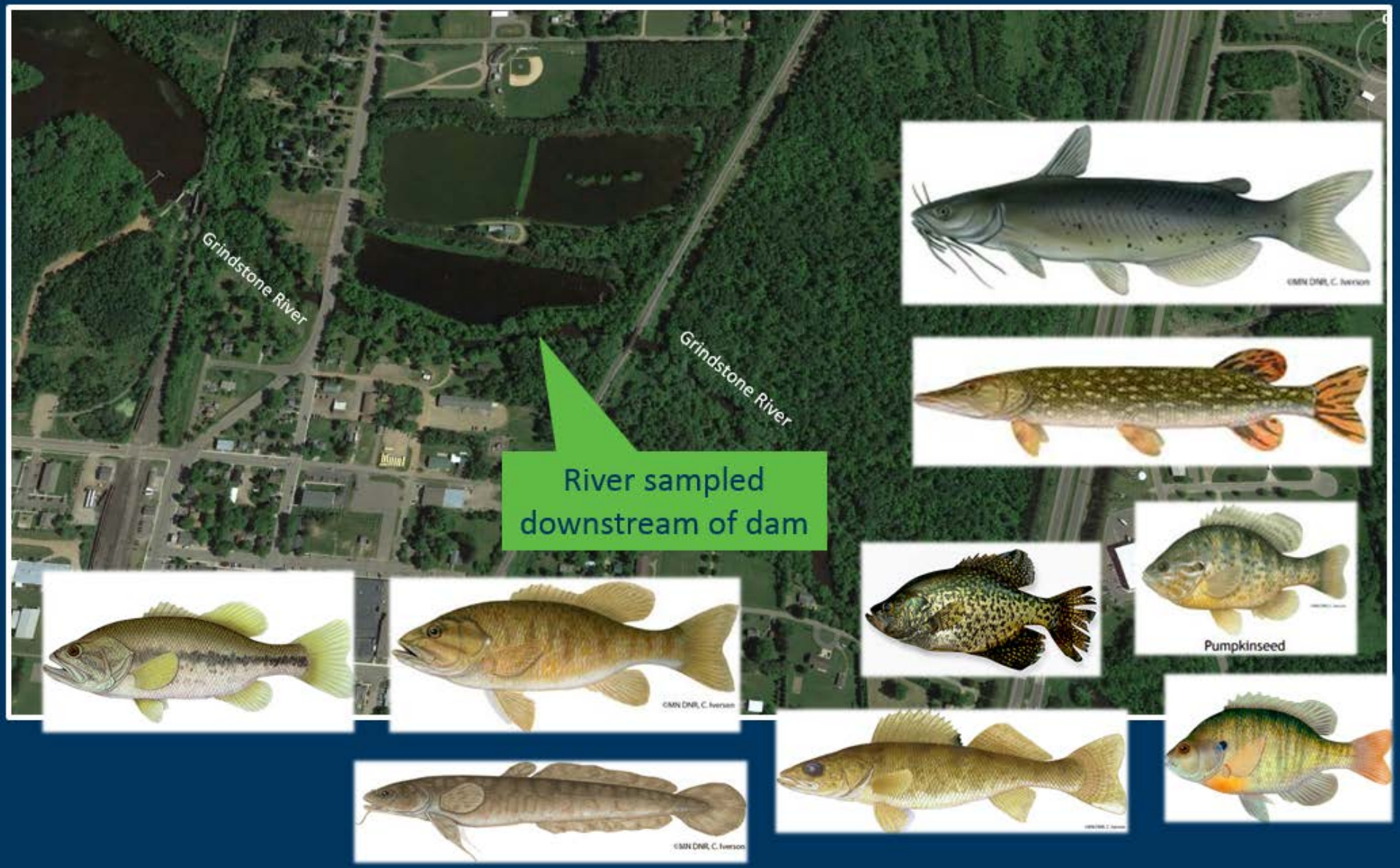
"General Use" Aquatic Management Areas (AMAs)

Managed by DNR Fisheries to provide non-boat access to water resources.

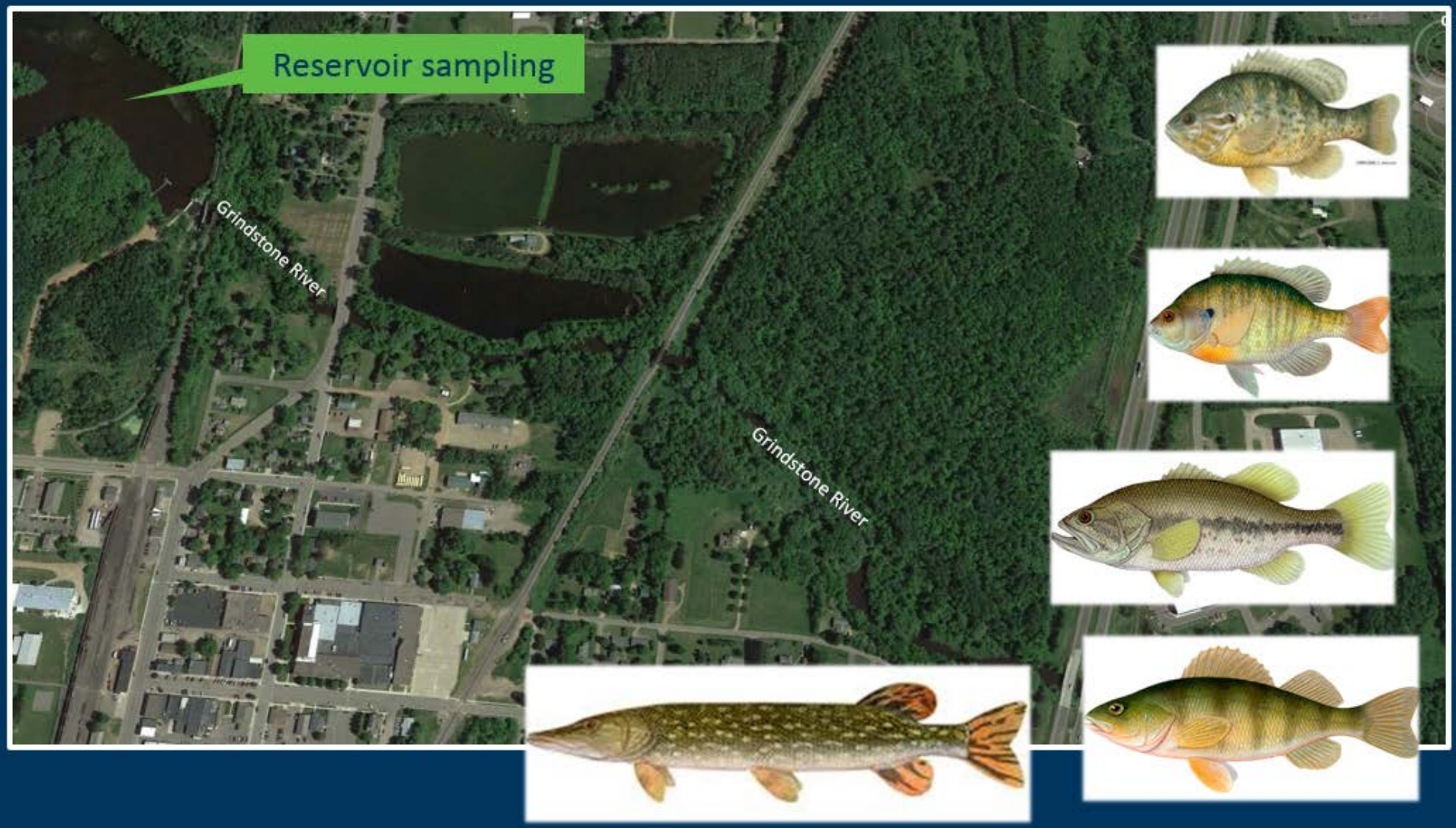
Allowable public uses - 'light, non-motorized' include:

- Hunting
- Fishing
- Trapping
- Hiking
- Wildlife observation

Fish Community Assessment



Fish Community Assessment



Grindstone River Dam - Structural Status and Costs

By Jason Boyle

Dam Safety Engineer

DNR Ecological and Water Resources Division

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Dam History

- Two failures and rebuilds
  - 1944 and 1954
- Four major repairs
  - 1976, 1985, 1993, and 2014
- Two drownings
  - 1953 and 2002


View looking north. Note marking of dyke section on back of end wall before failure.


Grindstone River Dam Pine Co. 42-58-1-72-6-1
Nr. Hinckley pool drained - looking downstrea

Current Status

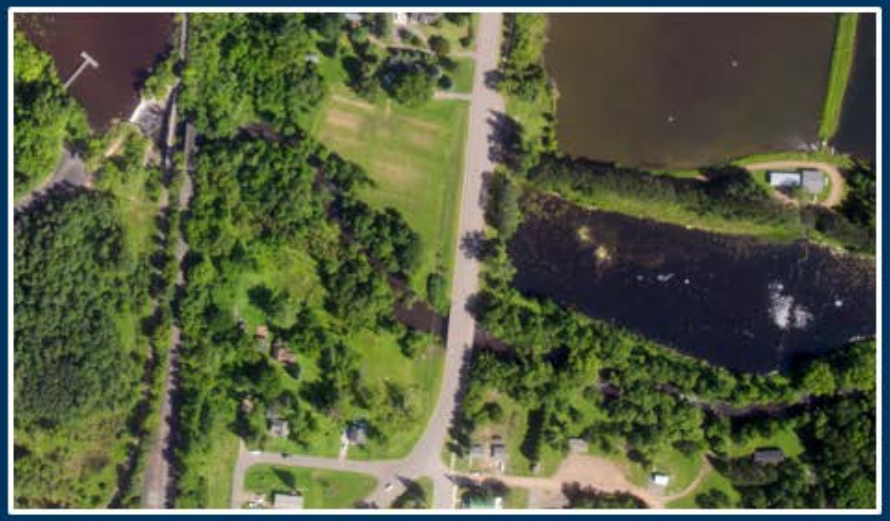
- Built in 1931
- 18 feet high
- Inspected every four years by engineer
- Class II Hazard
  - Was formerly Class I, i.e. high hazard
  - Consequences if dam fails
- “Drowning Machine” hydraulic roller

Current Status

- Stability
  - Right wall cracking and movement
  - Spillway and left wall
- Ability to pass flood
  - Unable to pass design flood
  - Overtopping protection
- Rating: Poor condition

Costs

- 1981 Report
  - Alternatives
  - Costs in equivalent 2017 dollars
  - Replace = $1,200,000
  - Repair = $650,000
  - Remove = $500,000 to $700,000



Contact Information:

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Rivers, Dams, and Ecosystems

Luther Aadland, Ph.D.
River Ecologist, River Ecology Unit
Department of Natural Resources

- River functions and processes
- Historical changes to rivers
- Dam related issues, problems, and implications
- Solutions and case examples

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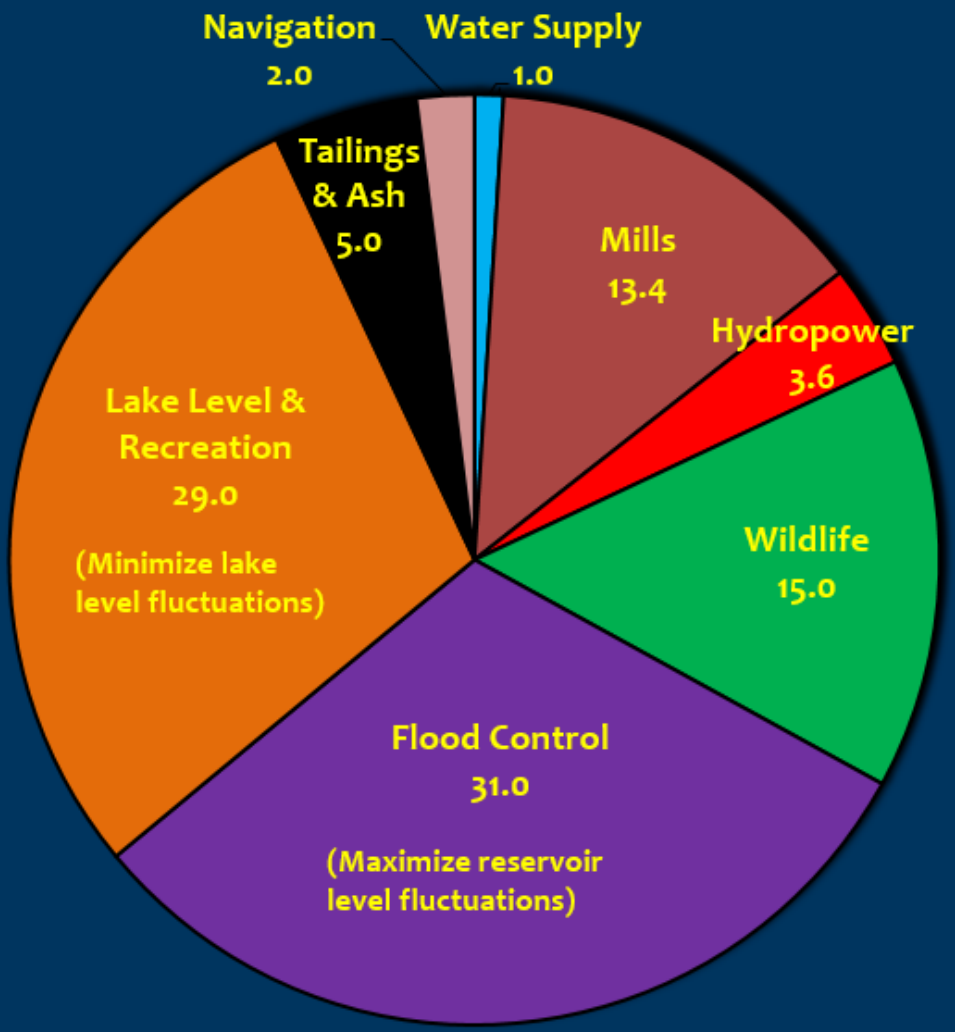
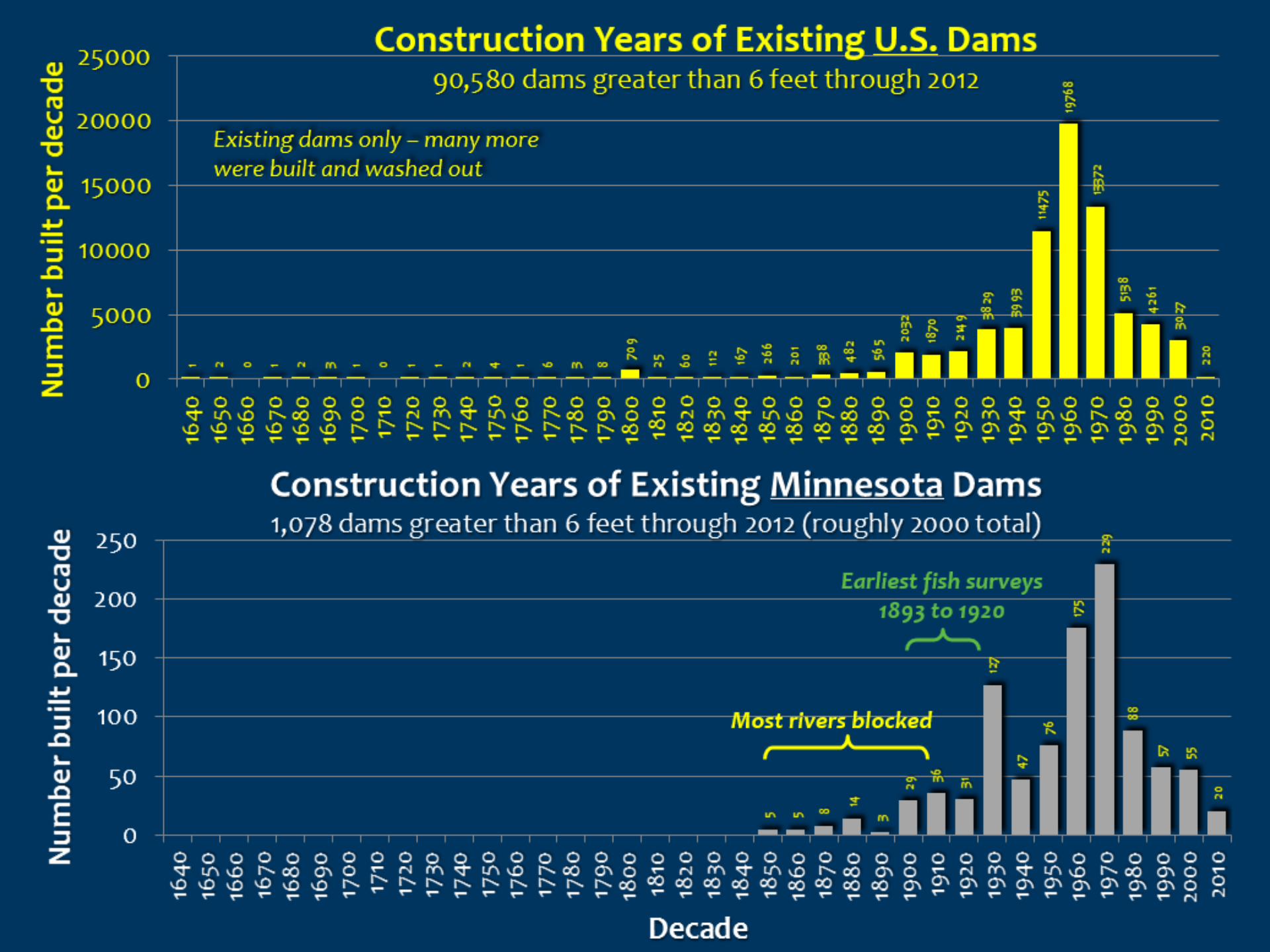
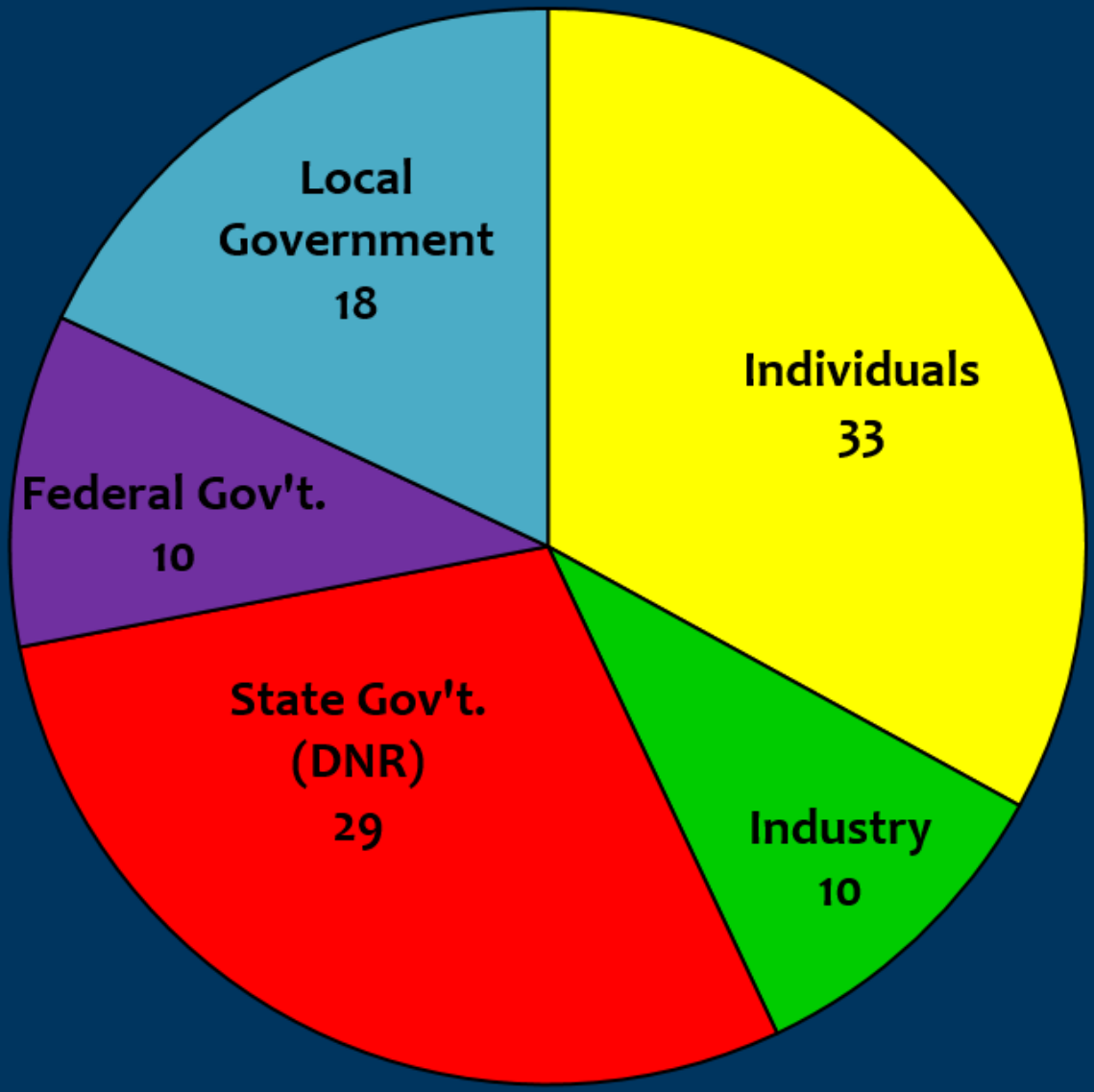
Dam Purposes in Minnesota



Source: MN DNR 1995


Construction Years of Existing U.S. Dams
90,580 dams greater than 6 feet through 2012
Existing dams only – many more were built and washed out
Number built per decade
25000
20000
15000
10000
5000
0
1 2 0 1 2 3 1 0 1 1 2 4 1 6 3 8 709 25 60 112 167 266 201 358 482 565 2032 1870 2149 3829 3993 11475 19768 13372 5138 4261 3027 220
1640 1650 1660 1670 1680 1690 1700 1710 1720 1730 1740 1750 1760 1770 1780 1790 1800 1810 1820 1830 1840 1850 1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
Construction Years of Existing Minnesota Dams
1,078 dams greater than 6 feet through 2012 (roughly 2000 total)
Earliest fish surveys
1893 to 1920
Most rivers blocked
Number built per decade
250
200
150
100
50
0
5 5 8 14 3 29 36 31 127 47 76 175 229 88 57 55 20
1640 1650 1660 1670 1680 1690 1700 1710 1720 1730 1740 1750 1760 1770 1780 1790 1800 1810 1820 1830 1840 1850 1860 1870 1880 1890 1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010
Decade

Dam Ownership



Dam Effects

- Migration Blockage
- Inundation of Critical Habitat
- Altered Flow Regimes
- Propagation of Invasive Species
- Loss of Native Species
- Reservoir Sedimentation
- Tailwater incision and erosion
- Dam Failure
- Dangerous tailwater hydraulics
- Altered Nutrient Processes
  - cyanobacteria blooms

Rapidan Reservoir Sediment 60 feet deep

Silver Lake Dam Failure $102 million damages

Bullsby Reservoir algal bloom

Hydraulic Roller

Aging Dams

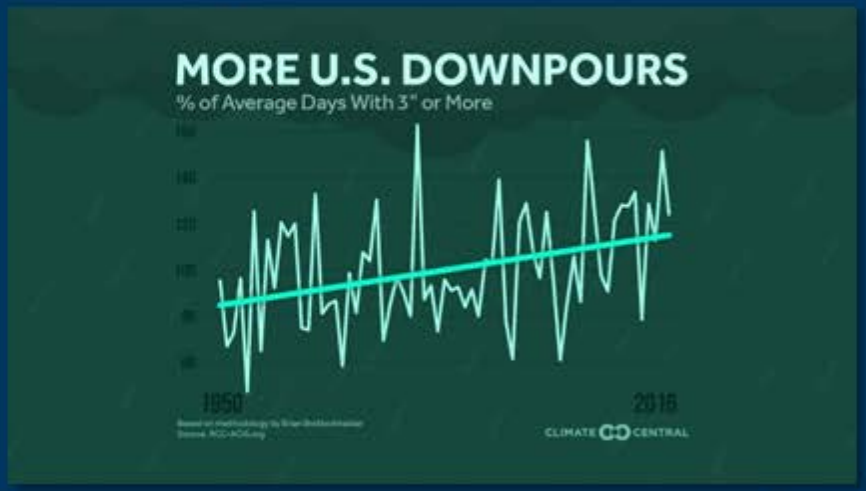
- About 85% of U.S. Dams will have exceeded their design life by 2020 (FEMA 1999).
- An estimated 4000 dams are deficient, 2170 of these are high hazard (ASCE 2017). The American Society of Civil Engineers gave the U.S. a "D" grade for dams. Repairs of deficient high hazard dams would cost $45 billion.
- There were over 400 dam failures in the U.S. from 1985 to 1994 (NRCS 2000).
- Dams can fail even when well maintained.

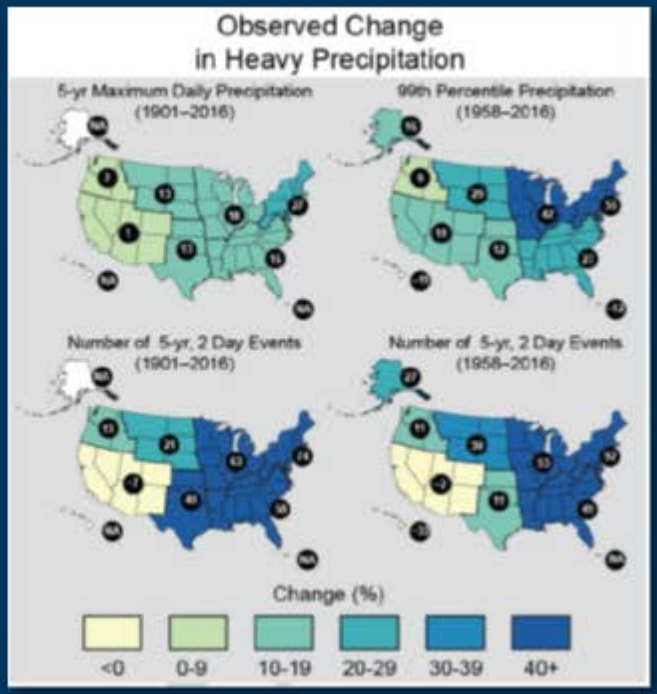
Oroville Dam
Tallest Dam in U.S. at 770 feet
Spillway erosion- Feb. 2017
188,000 evacuated

Silver Lake Dam Failure in 2003
(shortly after PMF upgrade)
$102 million damages

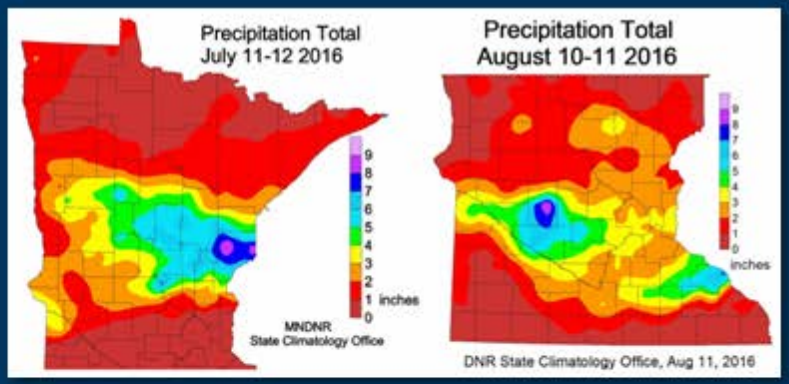
Heavy Precipitation Events

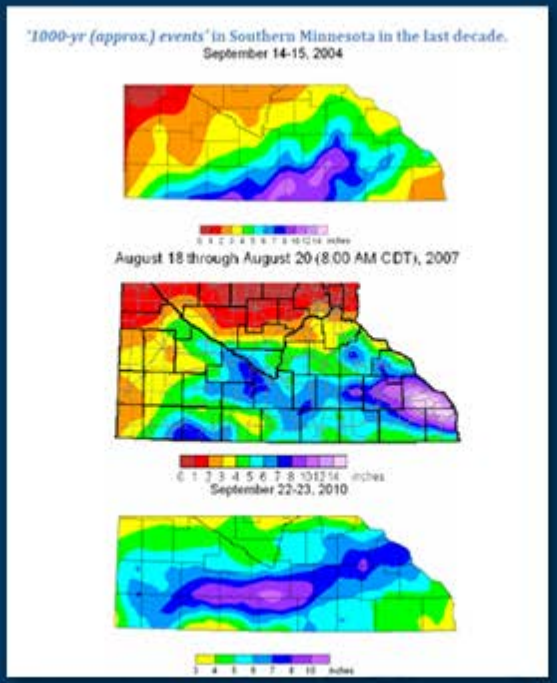
Heavy precipitation events are more frequent across the U.S.

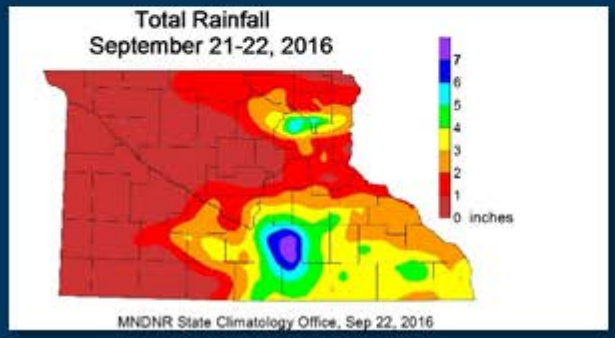


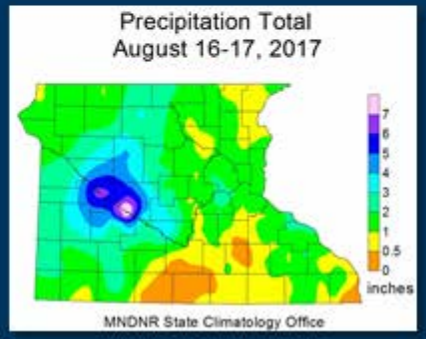


Heavy precipitation events in MN.









Recent Dam Failures in Minnesota

- ✓ Willow River Dam failure - 2016
  - 5 to 8 inch rain event
- ✓ South Mound Creek Dam failure - 2014
  - 7 inch rain, no major dam deficiencies
- ✓ High Island Creek Carp Dam failure - 2014
  - 25-year flood, no major dam deficiencies
- ✓ Thomson Forebay failure -2012
  - St. Louis River
  - 500-year flood (50,000 cfs), no major dam deficiencies
  - Costs: $90 million (forebay) + $21.3 million (hwy 210) + more
- ✓ Lake Shady Dam failure – 2010
  - Zumbro River
  - 500-year flood, no major dam deficiencies
- ✓ Heiberg Dam failure – 2002
  - Wild Rice River,
  - No major dam deficiencies
  - 500-year flood (June 9) then a 2000-year flood (June 24)
- ✓ Appleton Dam failure – 1997
  - Pomme de Terre River
  - 500-year flood
- ✓ Breckenridge Dam failure – 1997
  - Otter Tail River
  - 200-y flood , also failed in 1989, 2001, 2006, and 2007

Willow River Dam failure

Lake Shady Dam failure

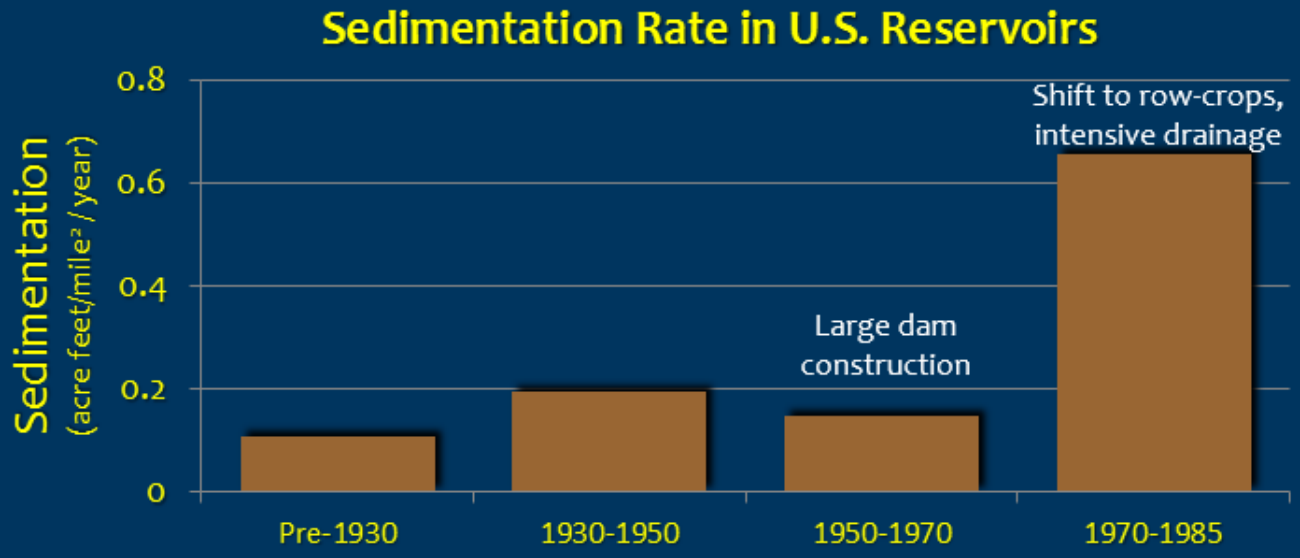
High Island Creek Dam failure

Dam Dangers – Hydraulic Undertow

Video of a miniature wooden canoe caught in the hydraulic roller.

Over 300 pelicans killed by the hydraulic undertow at Marsh Lake Dam.

Sedimentation in reservoirs



Rapidan Dam -built in 1910

1939

Reservoir 60 feet deep

1950

1991

12 million yards of sediment in 1991. Over $105 million if dredged plus $2 million/ year in maintenance.

2015

Sediment 60 feet deep

Observed Migration Distances of Minnesota Fish Species

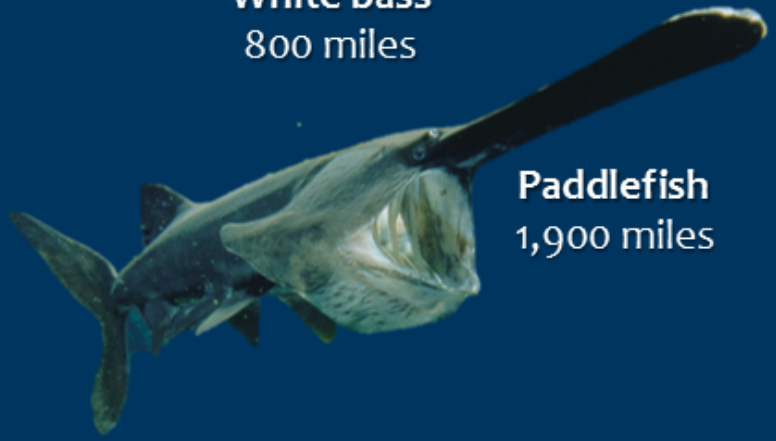
Walleye
164 miles

Channel catfish
454 miles

Lake sturgeon
682 miles

White bass
800 miles

Sauger
217 miles



Paddlefish
1,900 miles

Blue Sucker
108 miles

American Eel
3,440 miles

References: Stancille et al. 2002, Mosindy and Rusak 1991, Bellgraph 2006, Ron Bruch, news release, Mike Larson, personal communications, Jaeger 2004, Nick Schloesser, personal communication, Altena 2003, Neely et al. 2009, Finke 1966)

Why do fish need to migrate?

Reproduction

Spawning migrations can be hundreds or even thousands of miles.

Spawning lake sturgeon

Seasonal changes in habitat needs.

Winter often initiates downstream migration to deep, low velocity habitat while spring initiates upstream migrations.

Changing forage and habitat needs.

As fish grow larger they optimize feeding by migrating to habitats with abundant suitable forage.

Channel catfish fry are invertivores

Channel catfish adults are piscivores

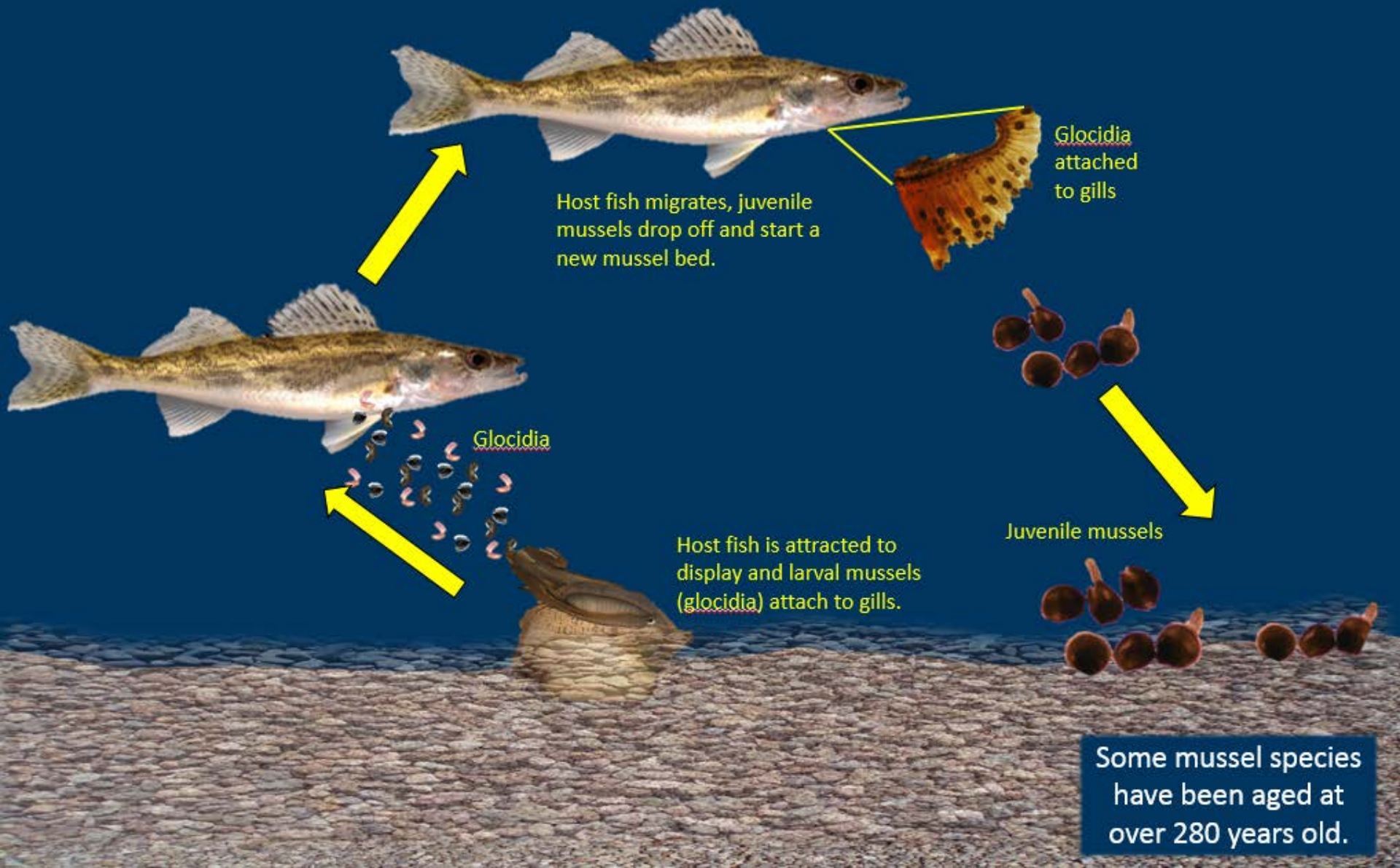
Re-colonization

Drought, low dissolved oxygen, winter stress, chemical spills, and catastrophic events can cause complete or extensive mortality. Many rivers periodically stop flowing during drought.

Drought - Minnesota River

Fish kill - S.B. Whitewater River, 2015

Native Mussel Life History



Native mussel brooding display

Pocketbook mussel
Fish hosts: sauger, white crappie
Found in Kettle River Watershed

Important Functions of Mussels

Filter Water

- Mussels of the Upper Mississippi River filter 53.1 million m^3 of water per day or 76 times the Minneapolis-St. Paul Metropolitan Wastewater Treatment Plant, one of the largest in the U.S.

Stabilize Stream Beds

- Increased steam bed shear strength by 24%.

Increase Benthic Invertebrate Abundance and Diversity

- Mussels increase the biodiversity and abundance of benthic invertebrates by increasing interstitial space in the stream bed, creating attachment surfaces, and deposition of pseudofaeces.

Reduce prevalence of cyanobacteria

- Regulate nitrogen: phosphorus ratios and alleviate nitrogen limitation shifting phytoplankton communities from cyanobacteria to diatoms.

Remove CECs (Contaminants of Emerging Concern)

- Removed 80% of some CECs within 72 hours.

Remove harmful bacteria

- Removed 98% of E-coli within 24 hours regardless of E-coli densities.

Loss of Biodiversity

Considered the most severe environmental decline facing humanity.

Freshwater extinction rates are about 5 times that of terrestrial rates and comparable to loss of tropical rainforest species.

Threatened with extinction (IUCN & other sources):

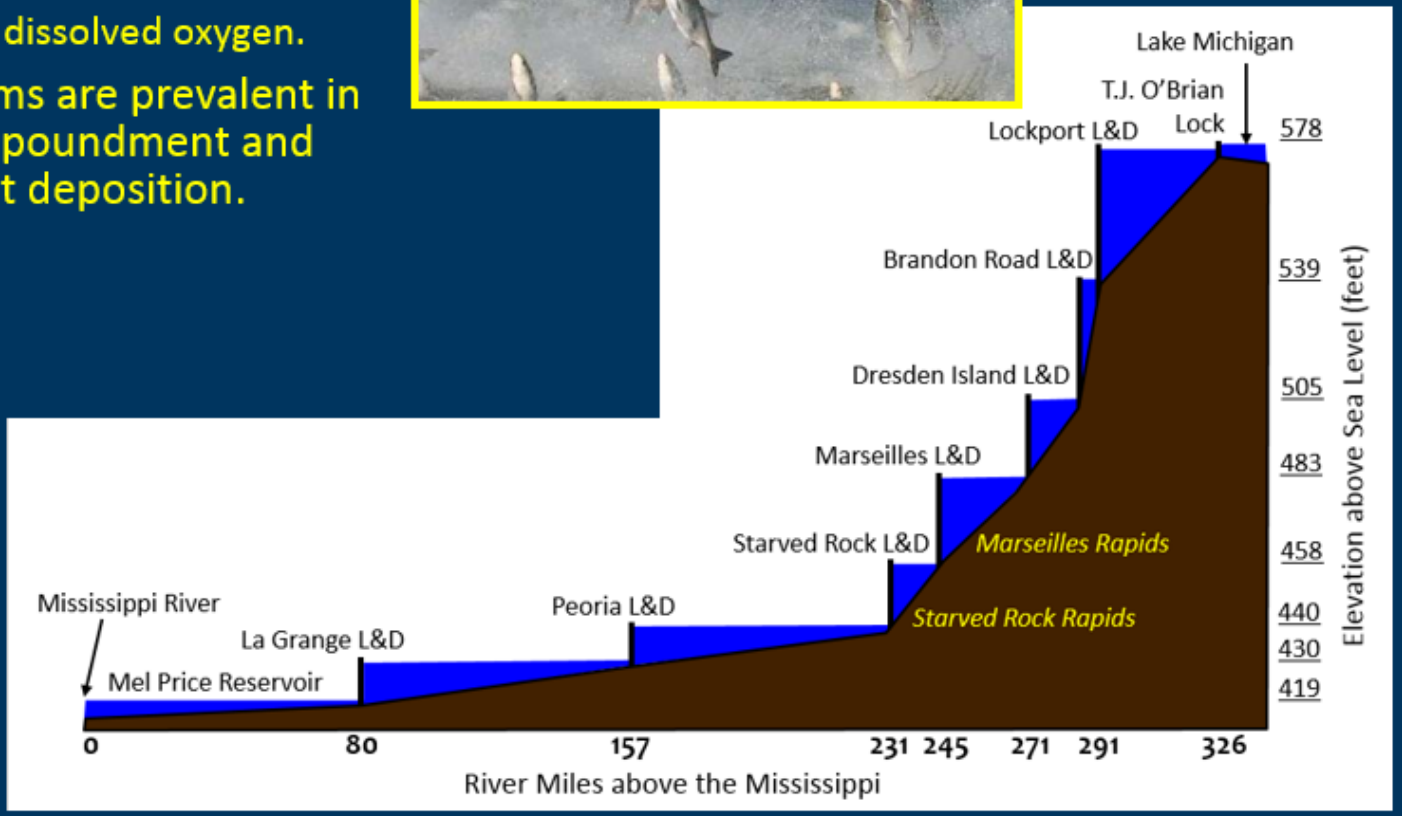
- 85% of global sturgeon species
- 72% of North American mussels listed
- 48% of U.S. & Canadian crayfishes
- 36% of global freshwater fish species
- 30% of global amphibians
- 21% global mammals
- 12% global birds
- 10% global marine fishes

Dam construction is the most definitive cause of extirpation and extinction of freshwater species.

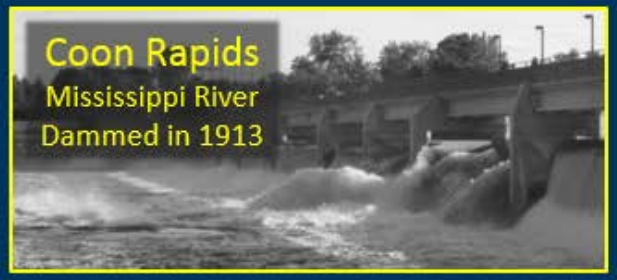
ILLINOIS RIVER

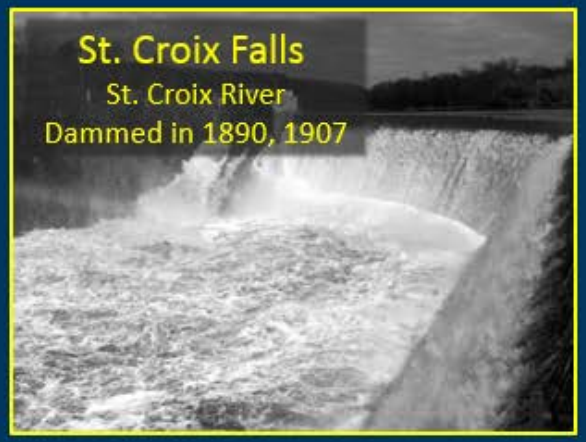
Dammed, dredged & polluted

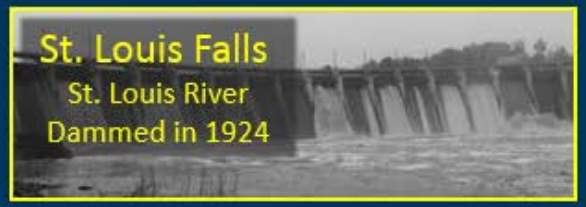
- The Illinois River may have the highest silver carp densities in the world.
- Silver carp
  a. can digest cyanobacteria including *Microcystis*, which is toxic to other species and
  b. are tolerant of low dissolved oxygen.
- Cyanobacteria blooms are prevalent in reservoirs due to impoundment and suspended sediment deposition.

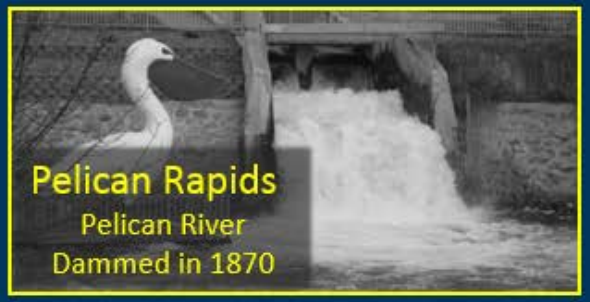


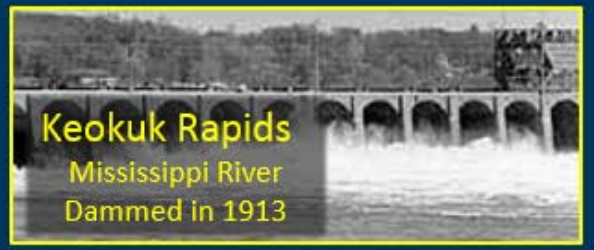
Where are the Rapids and Falls??

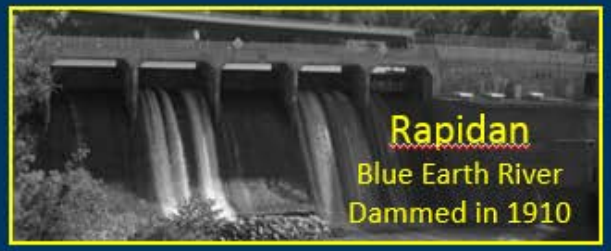


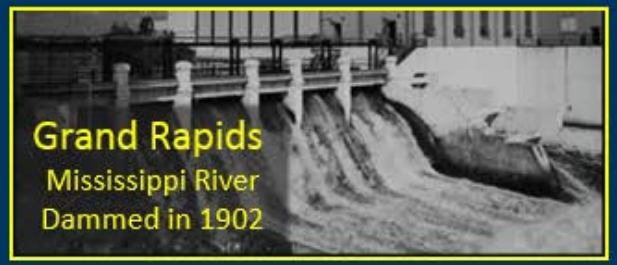










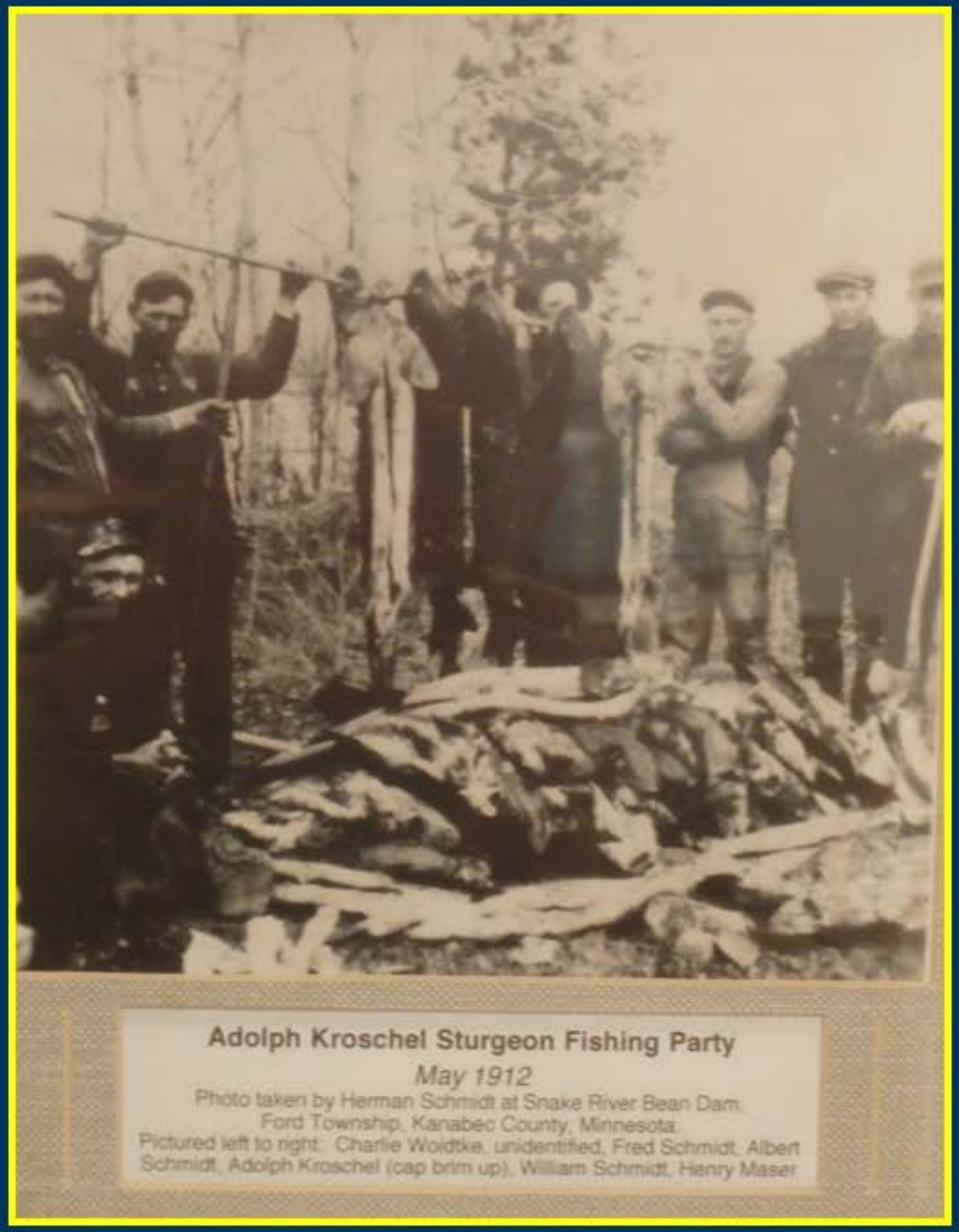


Fishes that spawn in falls, rapids, glides, and riffles

Dead Man's Rapids on Little Fork River

Video of DNR staff catching a sturgeon to collect eggs or sperm.
A tagged sturgeon traveled 135 miles from Lake of the Woods to these rapids.

Large Sturgeon eggs stick to the boulders and are well oxygenated by swift flows.



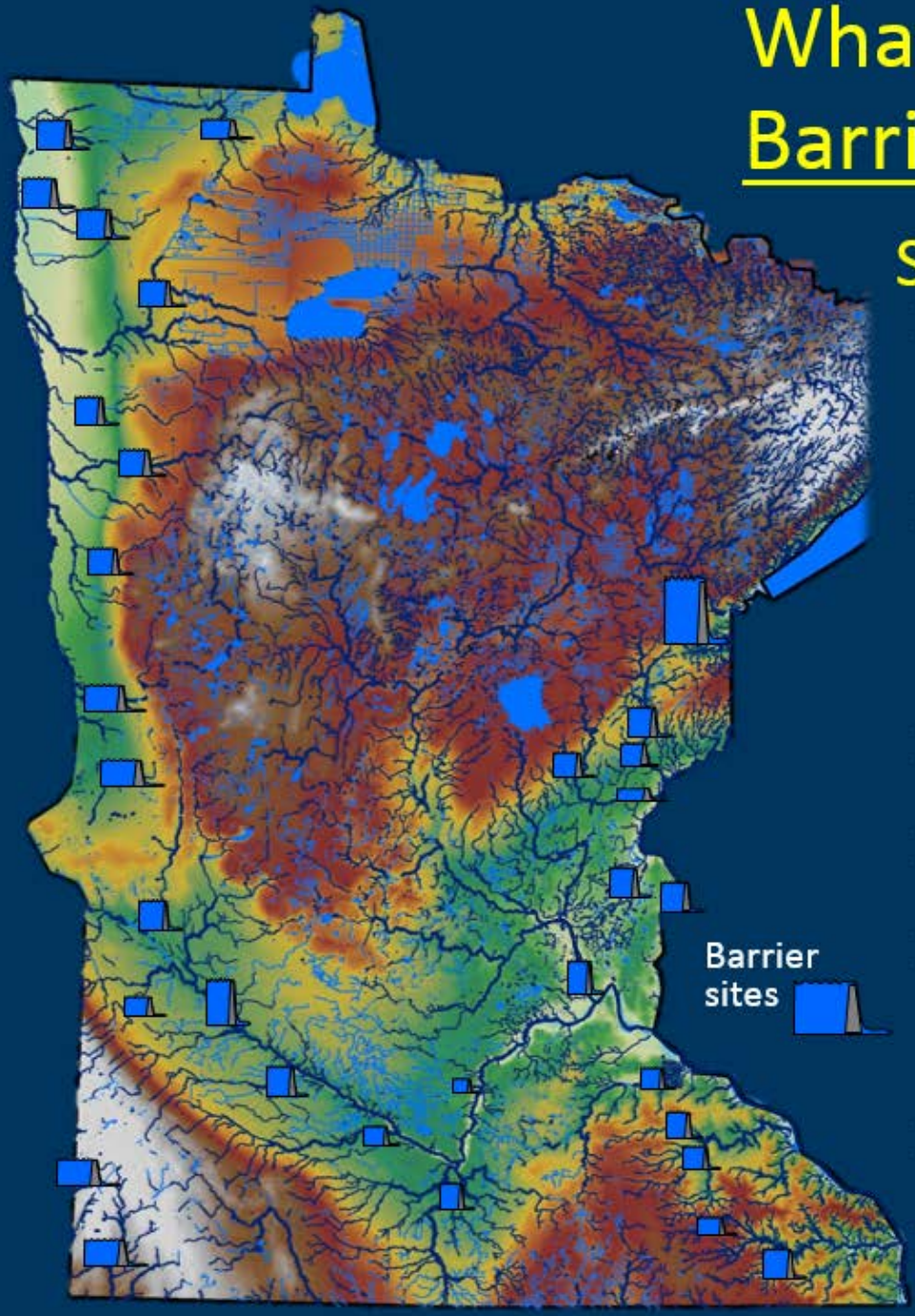
Adolph Kroschel Sturgeon Fishing Party

May 1912

Photo taken by Herman Schmidt at Snake River Bean Dam.
Ford Township, Kanabec County, Minnesota.
Pictured left to right: Charlie Woidtke, unidentified, Fred Schmidt, Albert Schmidt, Adolph Kroschel (cap brim up), William Schmidt, Henry Maser

Bountiful sturgeon catch on Snake River in 1912.

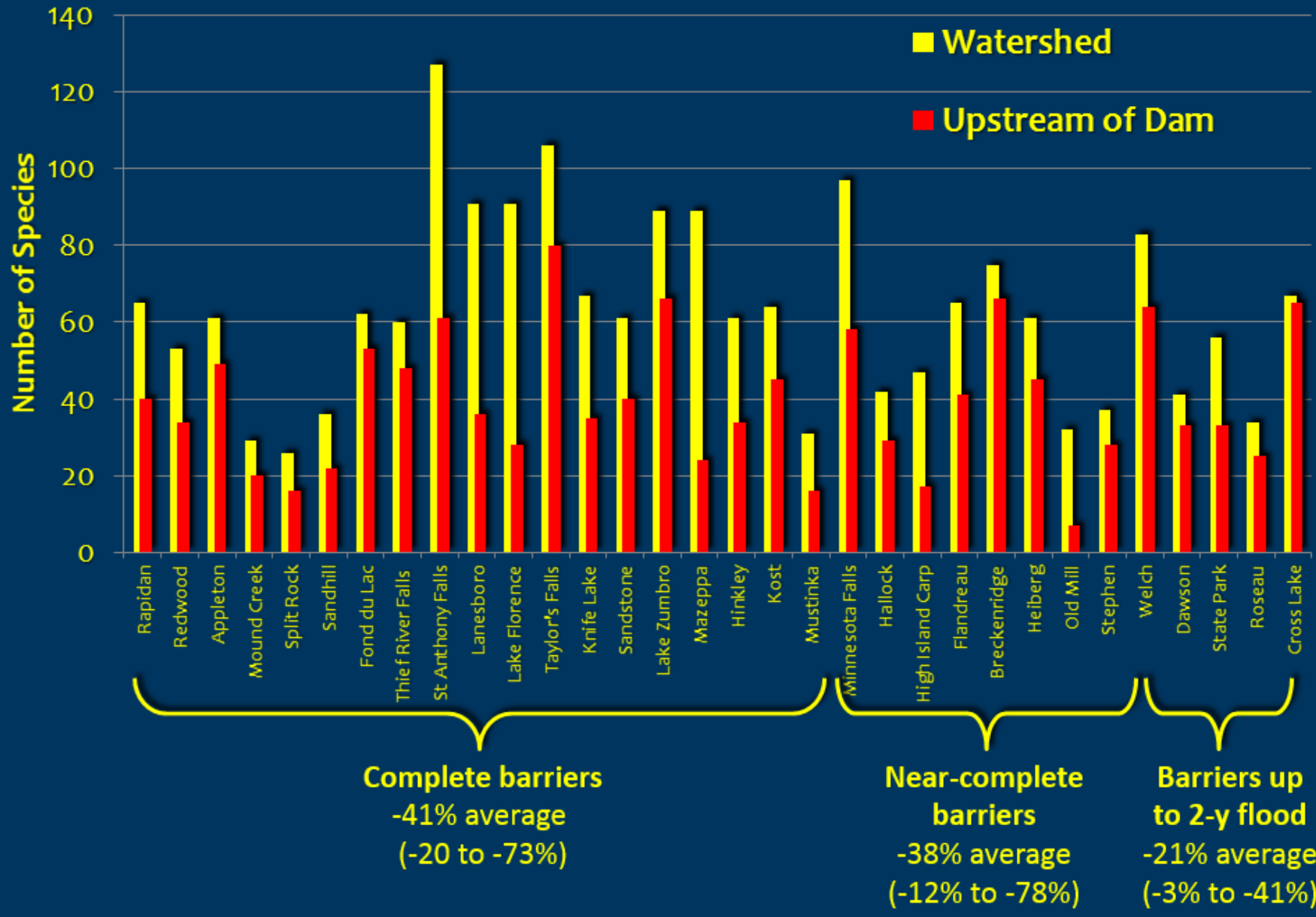
What is the Effect of Barriers on Native Species?



Study Methods

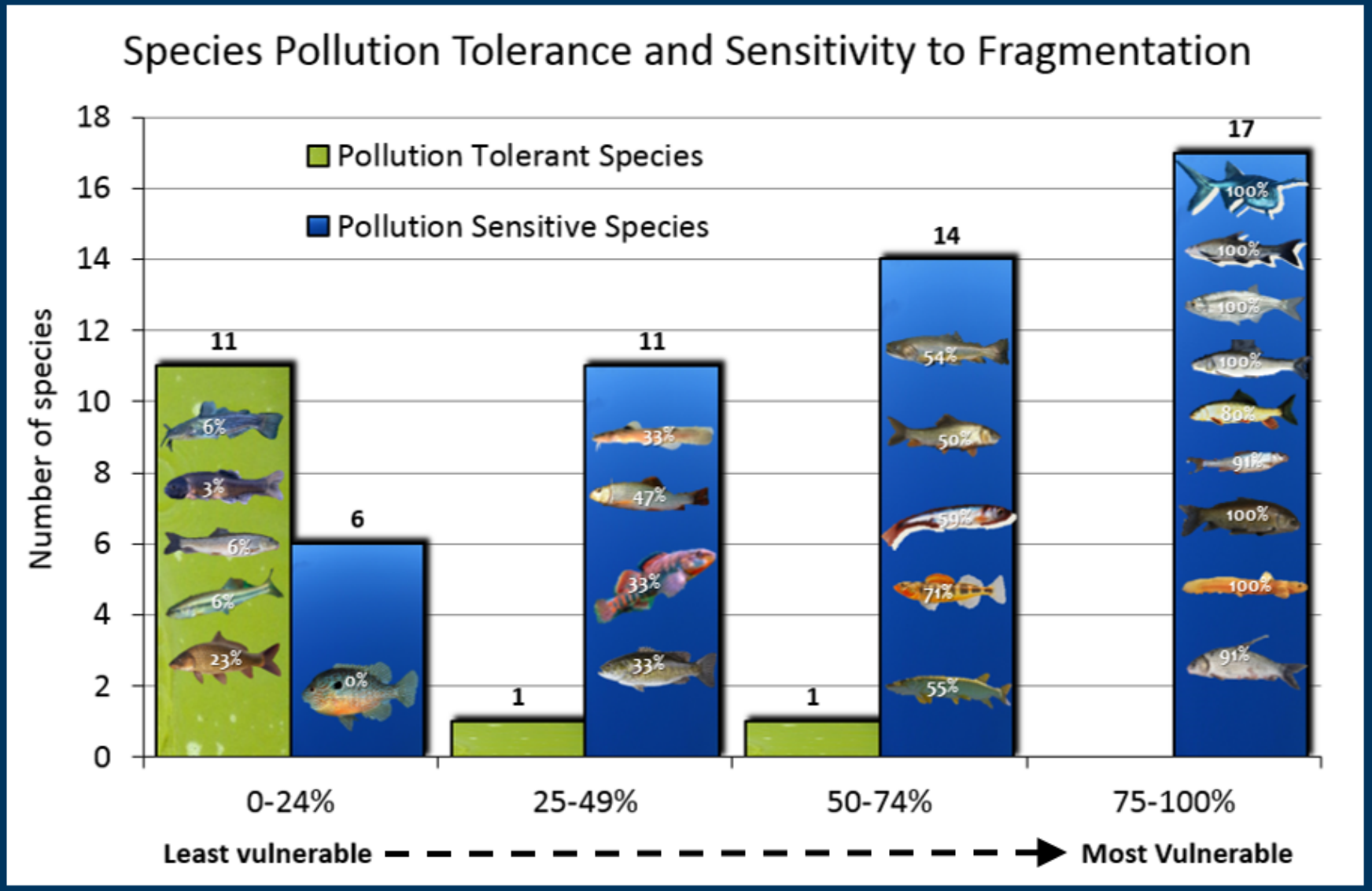
- Used FISHMAPPER and additional geo-referenced fish surveys from DNR-Fisheries, DNR-EWR, PCA, the Bell museum, university collections, and other reliable sources.
- Evaluated species diversity above and below 32 downstream-most barriers on tributaries of the Minnesota, Red, Mississippi, Rock, Big Sioux, and St. Croix Rivers, and mainstem barriers at St. Anthony Falls, Taylors Falls, and Minnesota Falls.
- Only species absent from entire upstream watershed were considered "absent".
- River watersheds ranged from to 17 to 19,100 miles^2.
- Included only species documented from the tributary being evaluated. Didn't include species in the downstream river mainstem for tributary barriers.
- Assessment included 150 species of fish; 134 native species.
- LOTS OF HELP FROM AREA FISHERIES STAFF!!!

Barrier Effects on Species Richness



Vulnerability to Barrier-Caused Extirpation

Percent absence upstream of barriers



Tolerances based on EPA designations

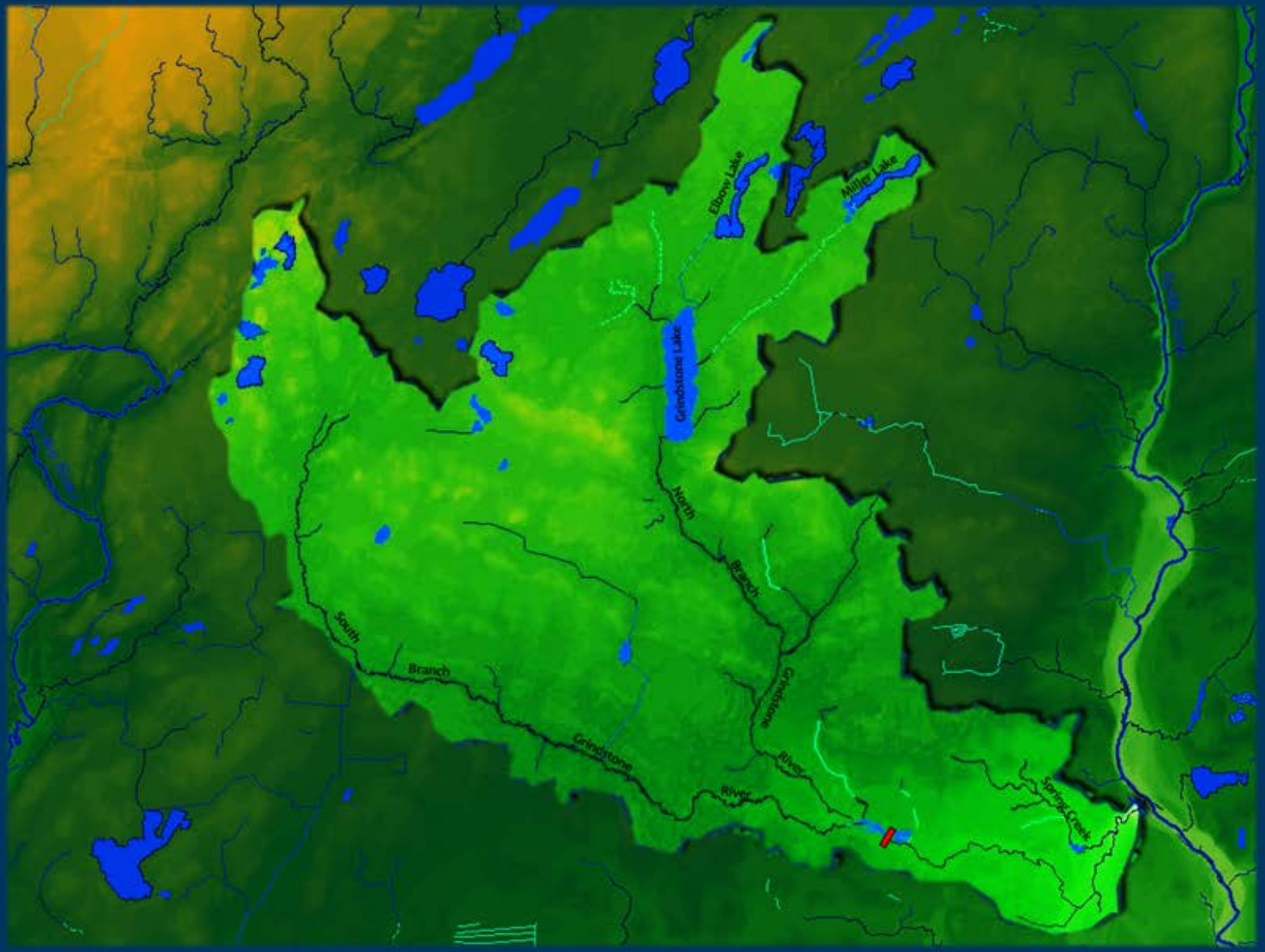
St. Croix Falls Dam

- 31 of 106 native fish species are not found upstream.
- Endangered spectaclecase mussels depend on goldeye and mooneye for reproduction (neither fish species currently exist above the dam).

Grindstone Dam

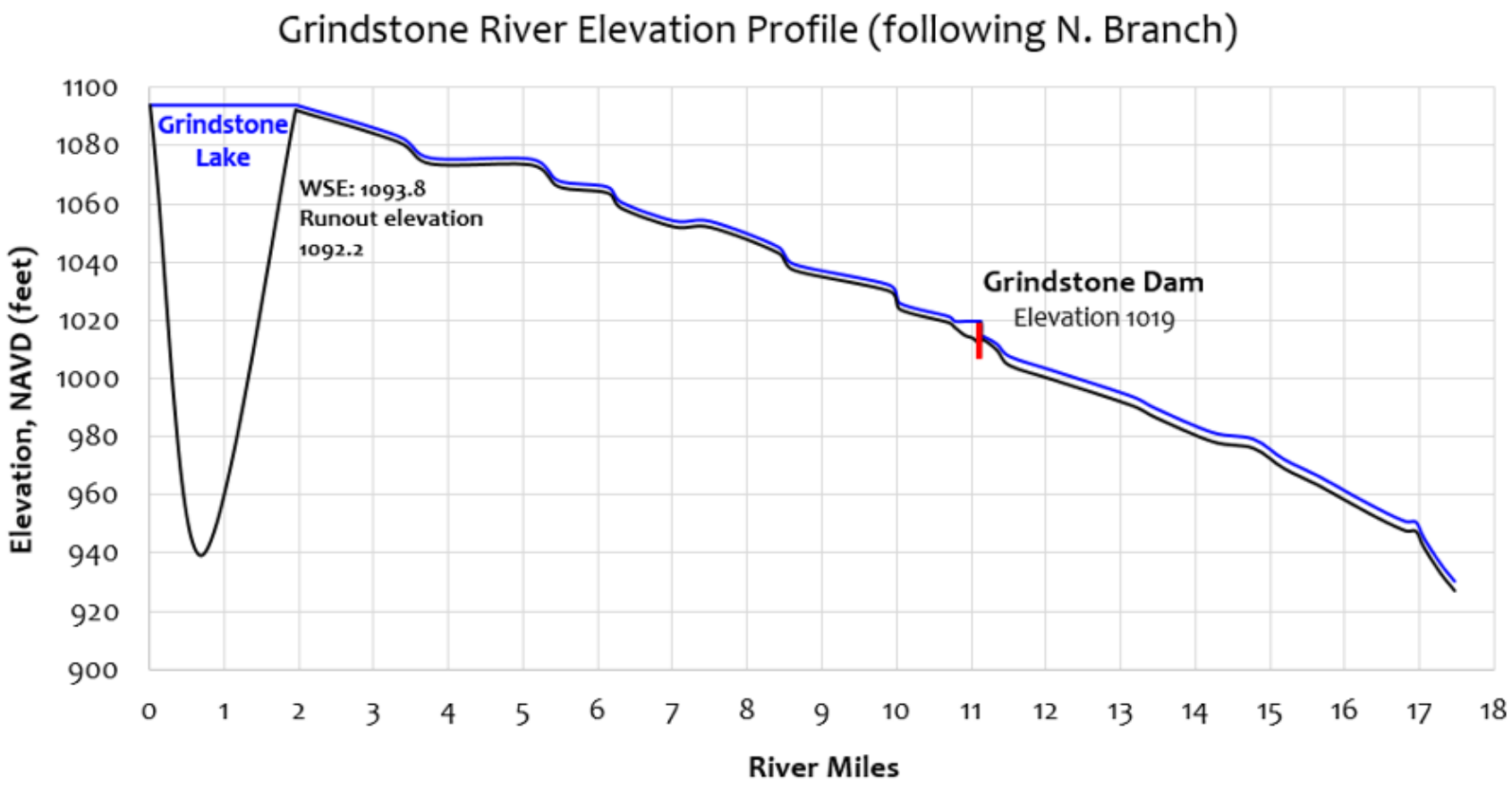
- 6 feet high
- Reservoir: 25.7 acres, median depth 3.3 feet
- Built in 1931 to supply water to musky ponds
  (a logging dam existed at the same location in the 1880s)
- Dam has deteriorated, undersized spillway
- Reservoir is filling with sediment
- 2 drowning deaths below dam (1953 and 2002)
- Complete barrier to fish passage

Grindstone River Watershed



Kettle River Watershed Native Fish Species absent upstream of the Grindstone Dam

Grindstone River Profile



Grindstone Lake outlet dam

Strategies for Reconnecting Rivers

		Nature-like Fish Passage	
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	★★★		

★★★ - Fully addresses
★★ - Partly addresses
★ - Minimally addresses
- Doesn't address

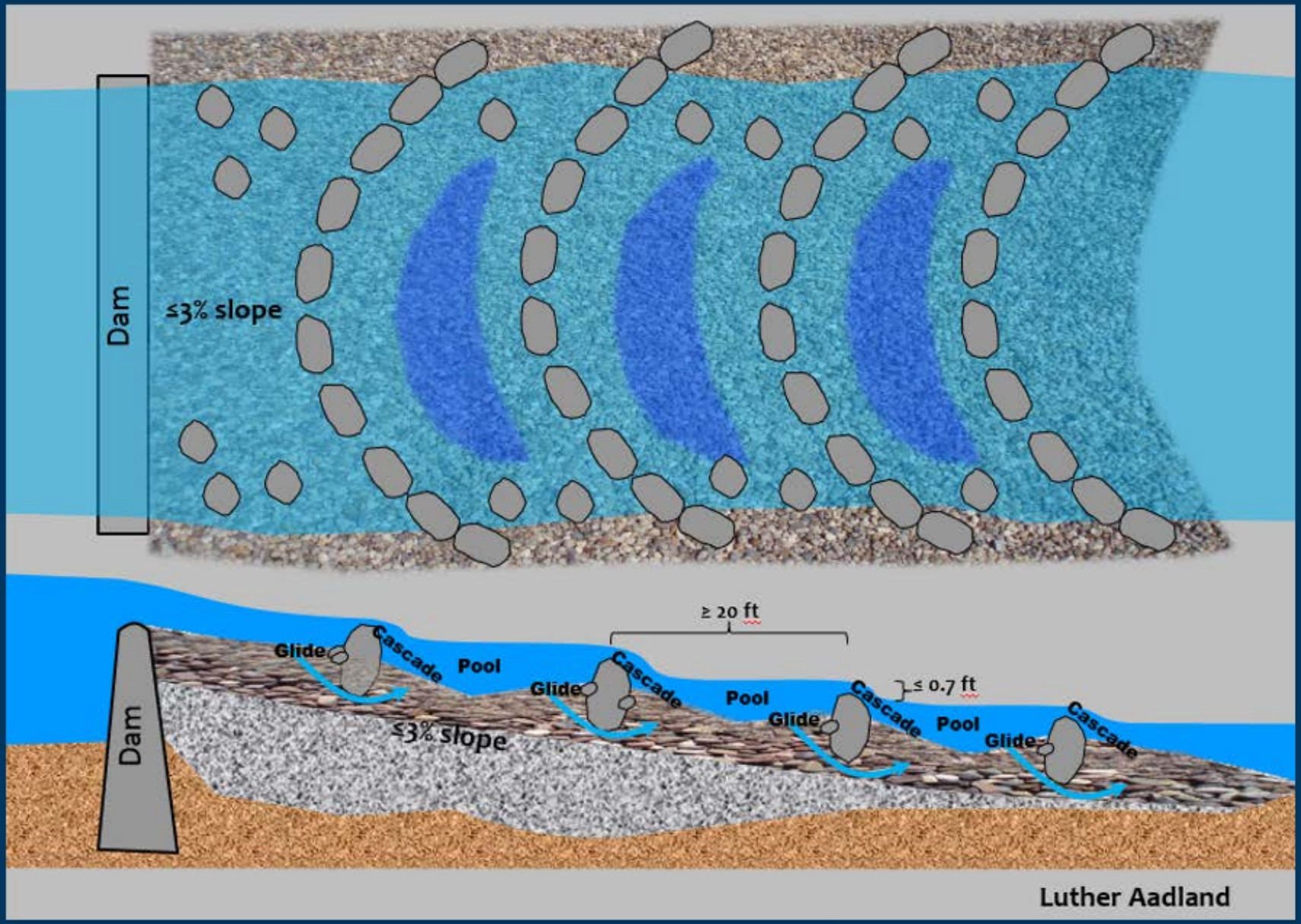
* Size dependent

Dam removal

Rock Arch Rapids

By-pass fishway

Rock Arch Rapids Concept



Cross Lake Dam Modification

Dam before:

- Hydraulic undertows - drowning hazard (1 death)
- Barrier to fish migrations

Constructed Rapids:

- ✓ Hydraulic undertow eliminated
- ✓ Fish passage restored

Crookston Dam Modification

- Hydraulic undertows - drowning hazard (9 to 27 deaths)
- Barrier to fish migrations
- Severe downstream bank erosion

Crookston Rapids

- ✓ Hydraulic undertows eliminated
- ✓ Fish passage restored
- ✓ Downstream banks stabilized
- ✓ Upstream fish community restored
- ✓ Recreational kayaking

Dunton Locks Dam Modification

- Hydraulic undertows - drowning hazard
- Barrier to fish migrations

Dunton Locks Rapids

- ✓ Hydraulic undertows eliminated
- ✓ Restored fish passage

Dam Removal

Minnesota Falls Dam - Minnesota River

- Built in 1871 & 1905, hydropower retired in 1958
- 17 feet high
- Upstream limit of 37 species of fish
- Inundated Minnesota Falls
- Worker drowned in 2011 during maintenance
- High hazard dam with significant structural deficiencies
- Repairs estimated at 5 to 7 million dollars

Dam Removed in January 2013

Removal cost $942,000

Restored Minnesota Falls

Minnesota Falls

Native species that have returned since dam removal.

American Eel
Special Concern
Over 6000 km from Sargasso Sea

Sauger

Paddlefish
Threatened

Flathead Catfish

River Carpsucker

Lake Sturgeon
Special Concern

Gizzard Shad

Highfin Carpsucker

Shovenose Sturgeon

Mooneye

Blue Sucker
Special Concern

Shortnose Gar

Silver Lamprey

Black Buffalo
Threatened

Longnose Gar

Healthier River = New Recreational Opportunities

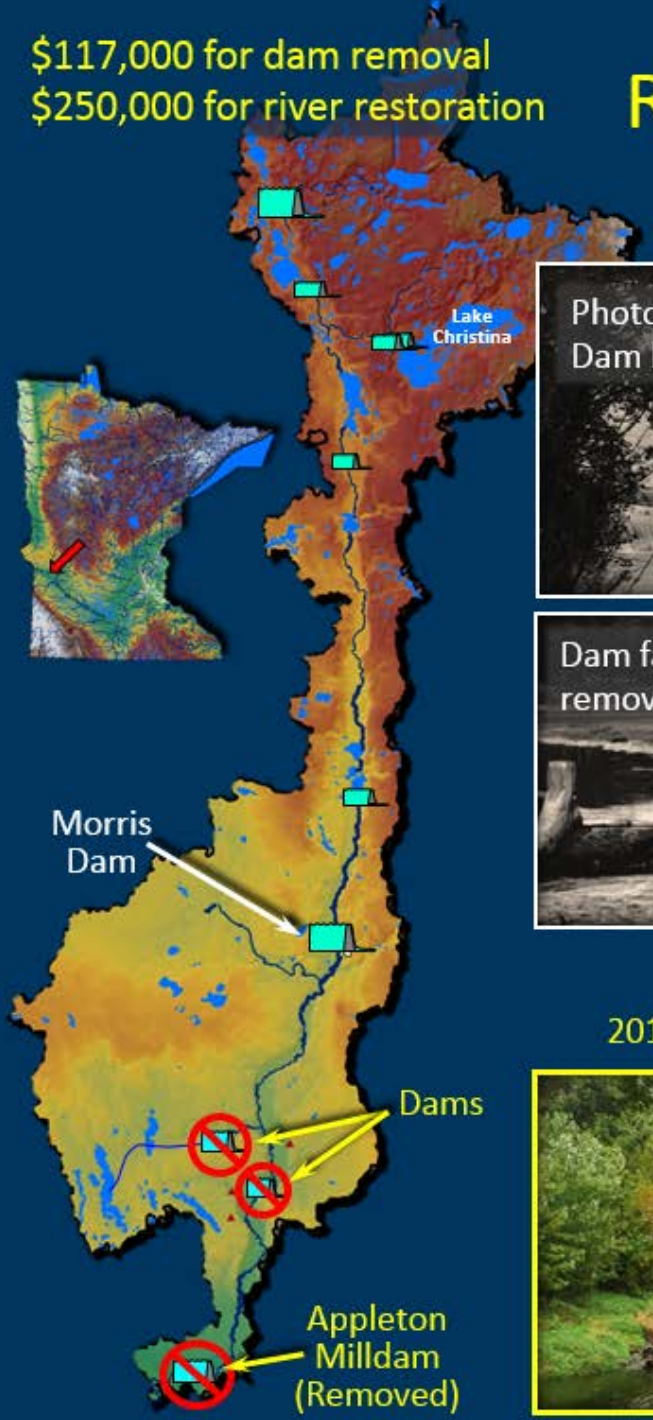
City of Granite Falls is assessing:

- Further development of paddling opportunities
- Options for fish passage through the Granite Falls Dam

$117,000 for dam removal
$250,000 for river restoration

Removal of the Appleton Milldam

Pomme de Terre River



2016 photo. Restored 1999-2001

2015- restored river channel, sediments stabilized in place

Pomme de Terre River Species absent upstream of Appleton Dam to Morris Dam

Quillback
Returned

Silver Redhorse
Returned

Greater Redhorse
Returned

Freshwater Drum
Returned

Banded Darter
Returned

Lake Sturgeon
(blocked by downstream dams but being reintroduced to Bigstone Lake)

Emerald Shiner
Returned

Northern Hogsucker

Channel Catfish
Returned

Smallmouth Buffalo
(blocked by downstream dams)

Carmine Shiner
Returned

White Bass
Returned

Central Stoneroller

77% (10 out of 13) returned after removal

Appleton Milldam Removal

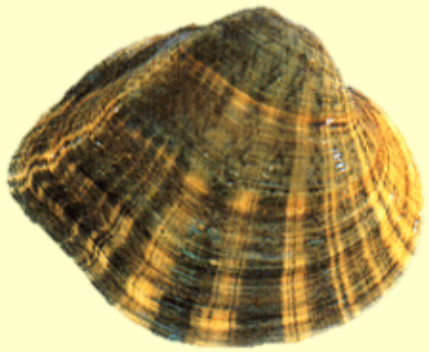
Mussels found only as dead shells prior to removal (1990 survey) that recolonized upstream of the Morris Dam following removal (2007 survey).

Elktoe Mussel
Alasmidonta marginata

Hosts:
- Rock bass NI
- Shorthead redhorse NI
- White sucker NI
- Northern hogsucker * NI
- Silver redhorse**?
- Greater redhorse**?

Pocketbook Mussel
Lampsilis cardium

Hosts:
- Walleye LT
- Sauger* NI
- Bluegill LT
- Largemouth bass LT
- Smallmouth bass LT
- White crappie NI, LT
- Green sunfish LT
- Tiger salamander LT



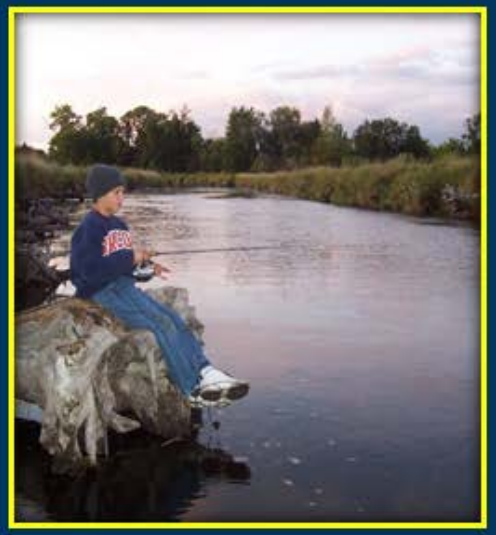
Deertoe Mussel
Truncilla truncata

Host:
Freshwater drum** NI

* Species absent upstream of dam
** Species returned after removal
NI Natural infestation
LT Laboratory transformation

Four other extirpated mussel species: round pigtoe, creek heelsplitter, mucket, and black sandshell have not yet been found upstream of the former dam site.

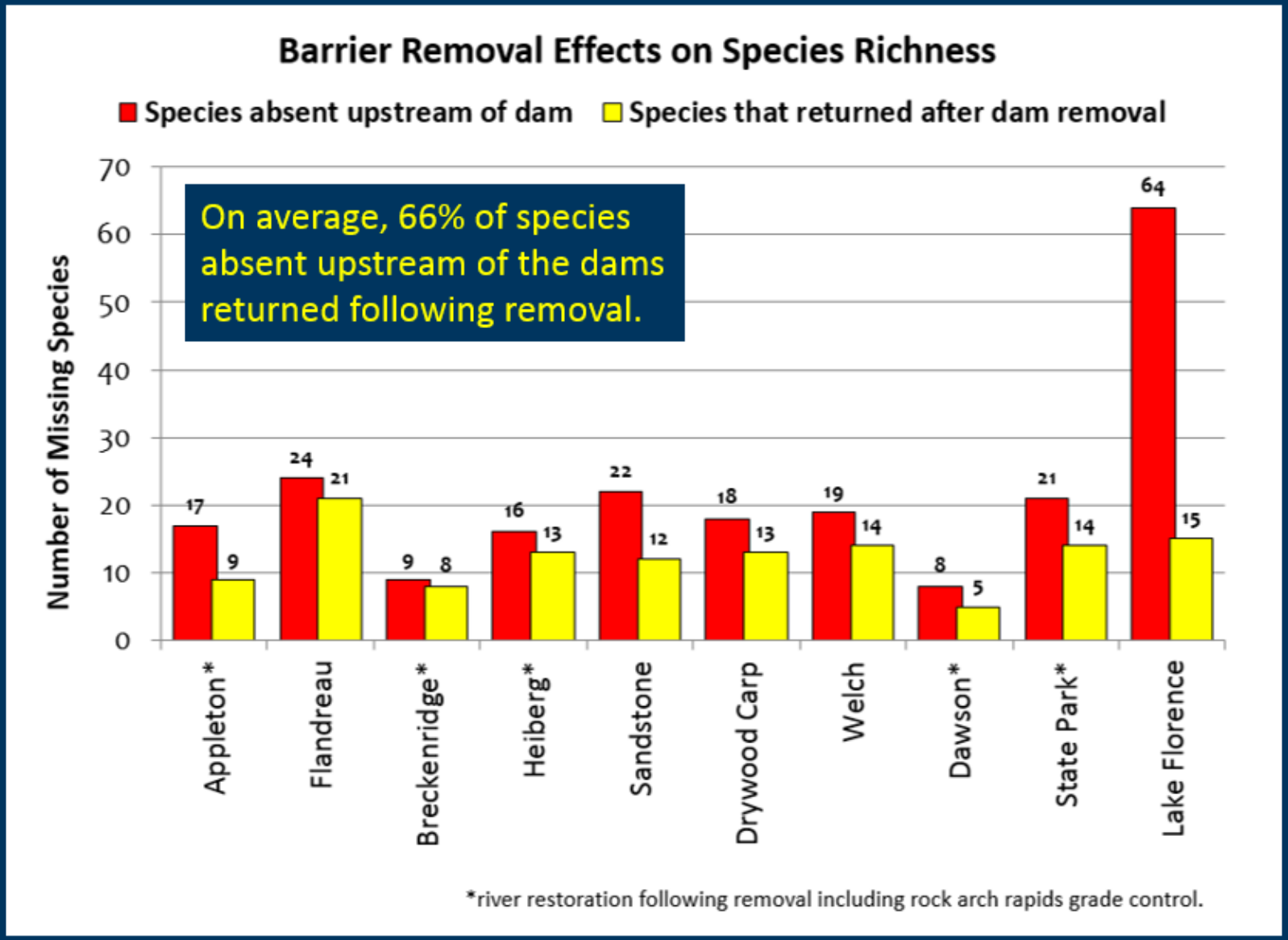
New Recreational Opportunities after Dam Removal and River Restoration



Mud River Dam Modification & Channel Restoration

Kettle River Dam Removal

Barrier Removal Effects on Species Richness



Constructed Riffles

- ✓ River restoration
- ✓ Spawning habitat
- ✓ Deep pool habitat
- ✓ Fishing

Angler Access

Angler Access Boulder
Breckenridge Dam Removal, Otter Tail River

Handicapped Accessible Angler Access
Chamber's Grove, St. Louis River

Angler Access Boulders
Dunton Locks, Pelican River

“Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together. All things connect.”
~ Chief Seattle

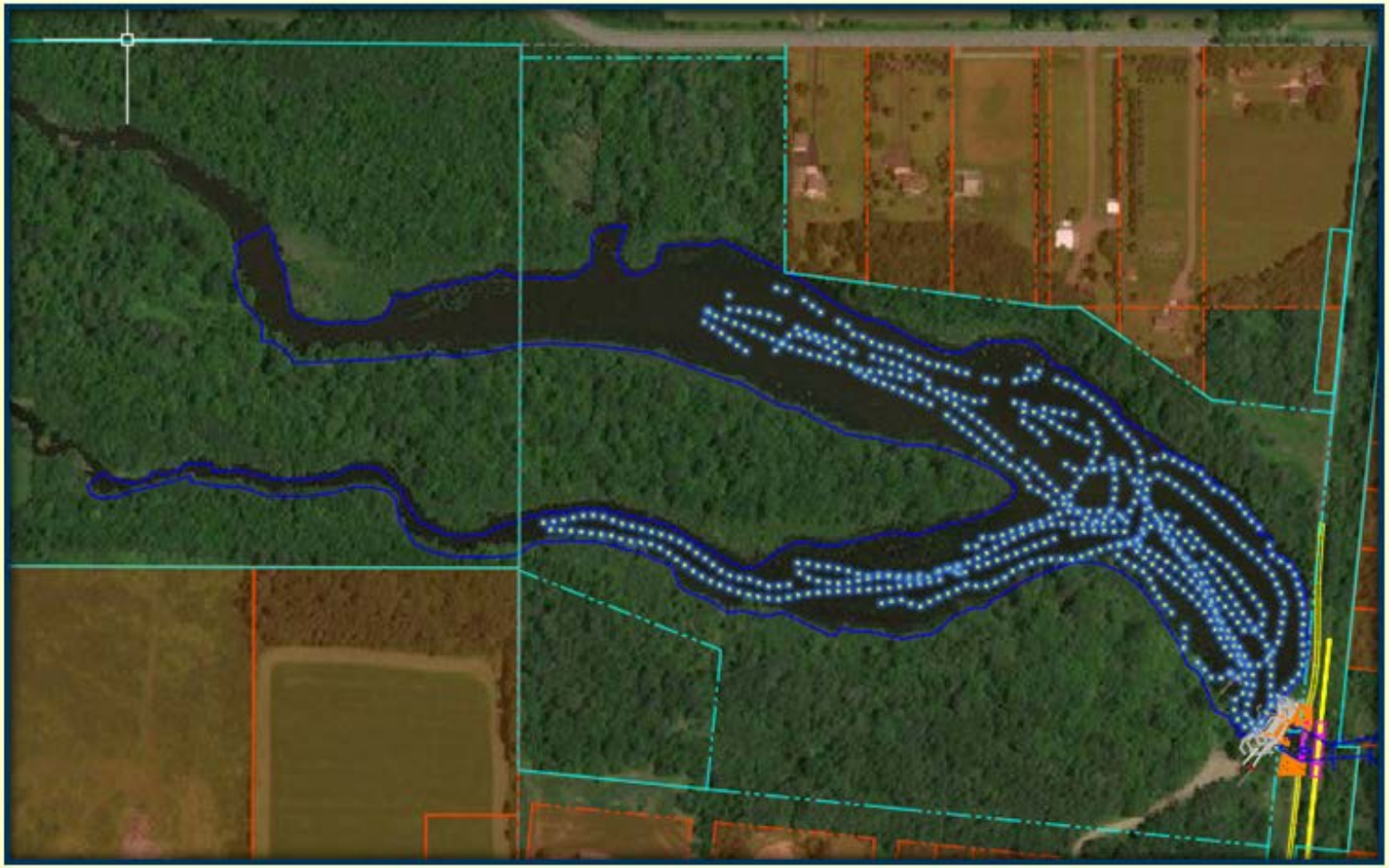
DEPARTMENT OF NATURAL RESOURCES

Concepts for the Grindstone Dam

Jon Hendrickson P.E. – NE Region Engineering

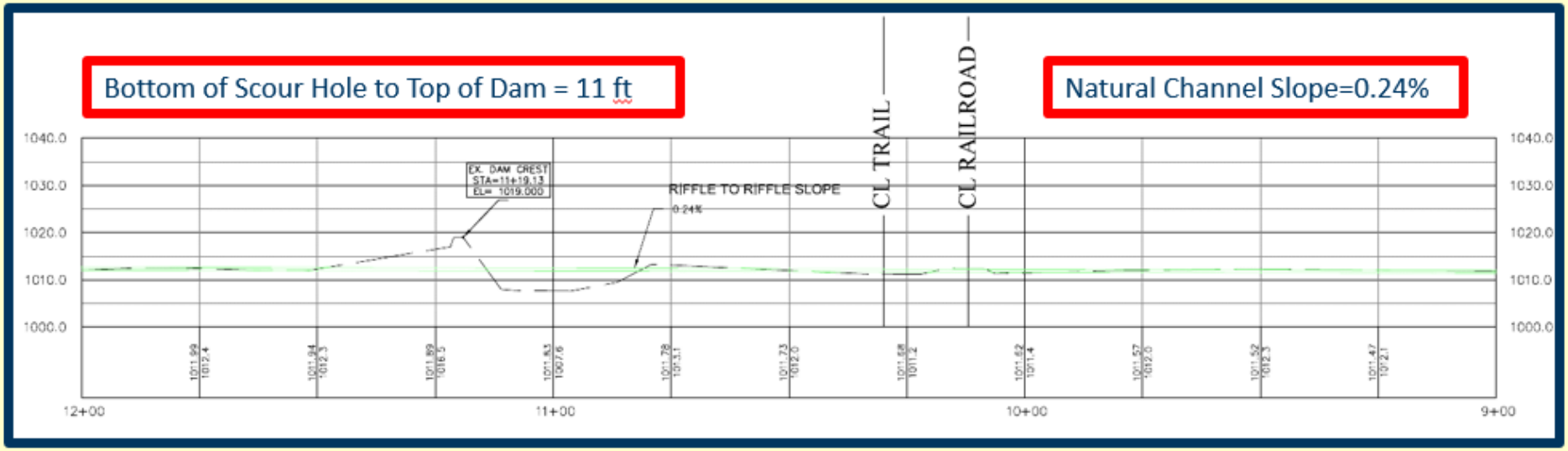
Grindstone Reservoir - Engineering Data

Bathymetric Survey of the Reservoir



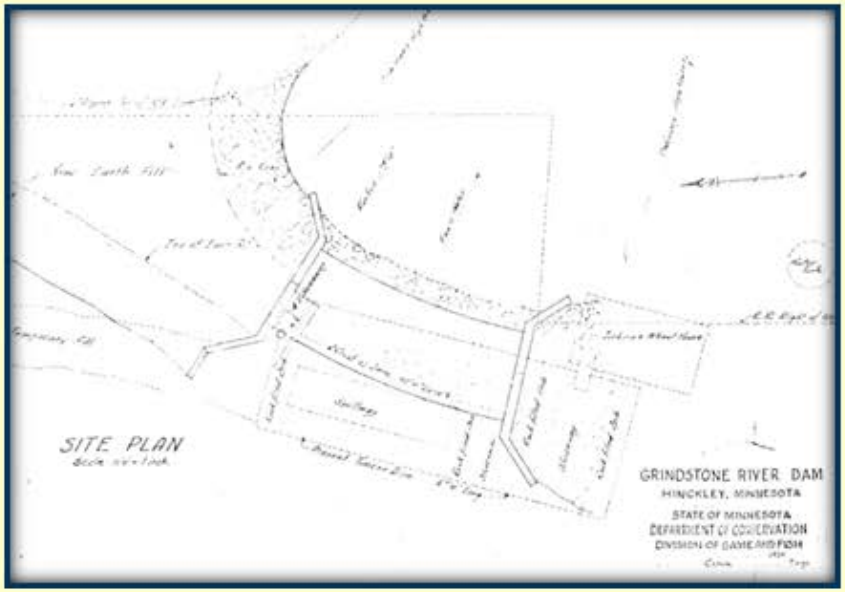
Grindstone Reservoir - Engineering Data

Downstream Channel Survey



Grindstone Reservoir - Engineering Data

Structural Components of Existing Dam



Grindstone Reservoir - Engineering Data

Property Boundary Survey

Design Guiding Principals

How do we Evaluate Success?

- Infrastructure
- Ecology
- Recreation
- Cost
- Safety
- History

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Dam Replacement

Jon Hendrickson – P.E. NE Region Principal Engineer

Dam Replacement Examples

Balsam Lake Dam Repair

New London Dam

Dam Replacement Evaluation

Conditions Supported

- **Infrastructure**
  - Design conditions for downstream infrastructure remain constant.
- **Recreation**
  - Current recreational opportunities will be maintained
- **History**
  - Current historic reservoir will be maintained

Dam Replacement Evaluation

Conditions Unsupported

- **Ecology**: The barrier in the Grindstone River will remain.
- **Cost**: Based on similar projects, the construction cost can be expected to be in excess of $1,000,000.00. This concept requires the most investment, and exceeds available funding.
- **Safety**
  - Hydraulic Roller may be maintained due to dam height.
  - Dams are vulnerable at flood events.
- **History**: Historical view of Pre-European Grindstone River remains unseen.
- **Infrastructure**: Dam replacement places infrastructure on the landscape which must be monitored, maintained, and eventually replaced.

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Rock Arch Rapids

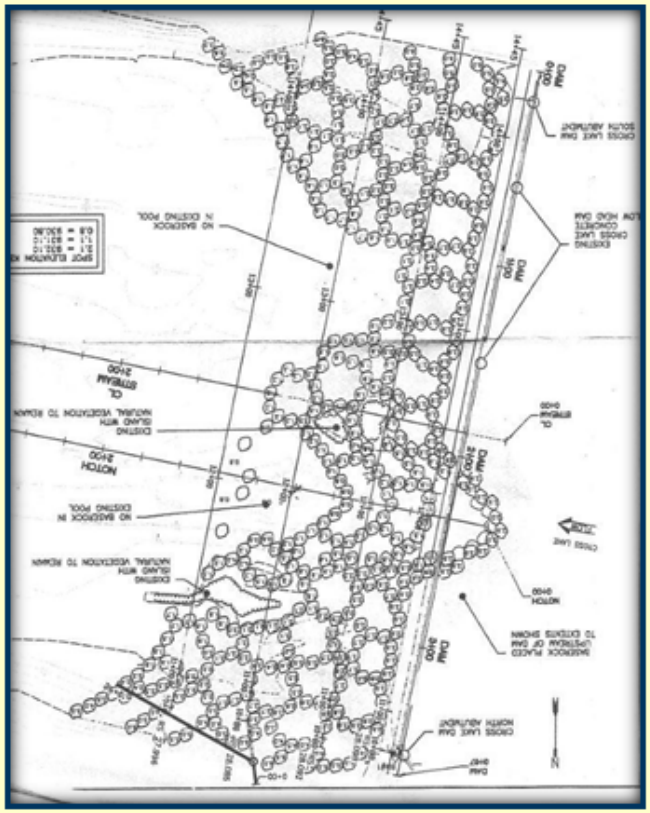
Jon Hendrickson – P.E. NE Region Principal Engineer

Rock Arch Rapids Example

Rock Arch Rapids Evaluation

Conditions Supported

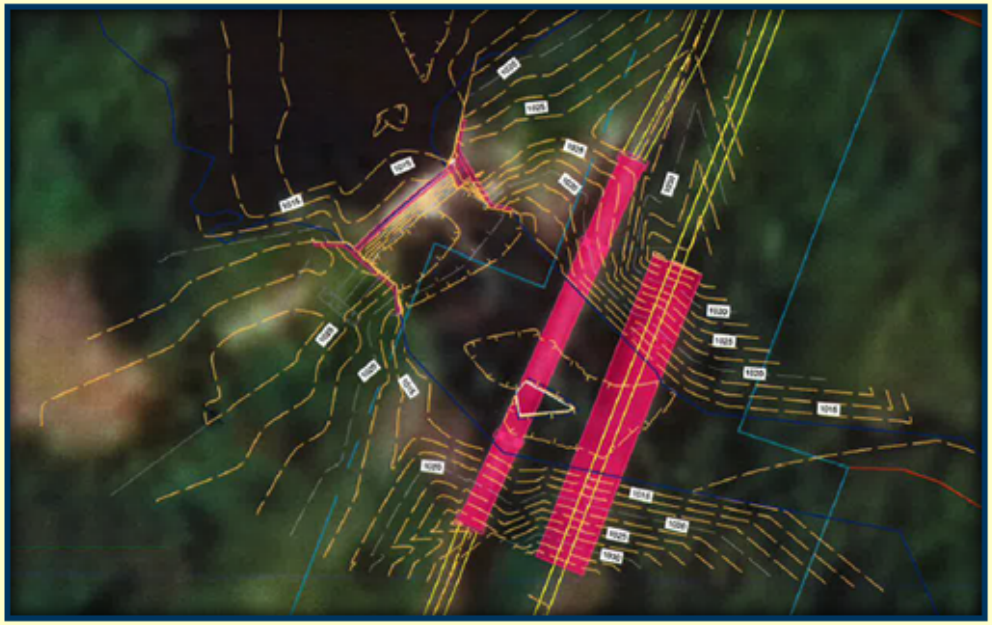
- **Ecology**: Rock Arch Rapids permit aquatic passage.
- **Safety**: Hydraulic roller is eliminated.
- **Recreation**: Current recreational opportunities in the reservoir will be maintained.
- **History**: Current historic reservoir will be maintained.



Rock Arch Rapids Evaluation

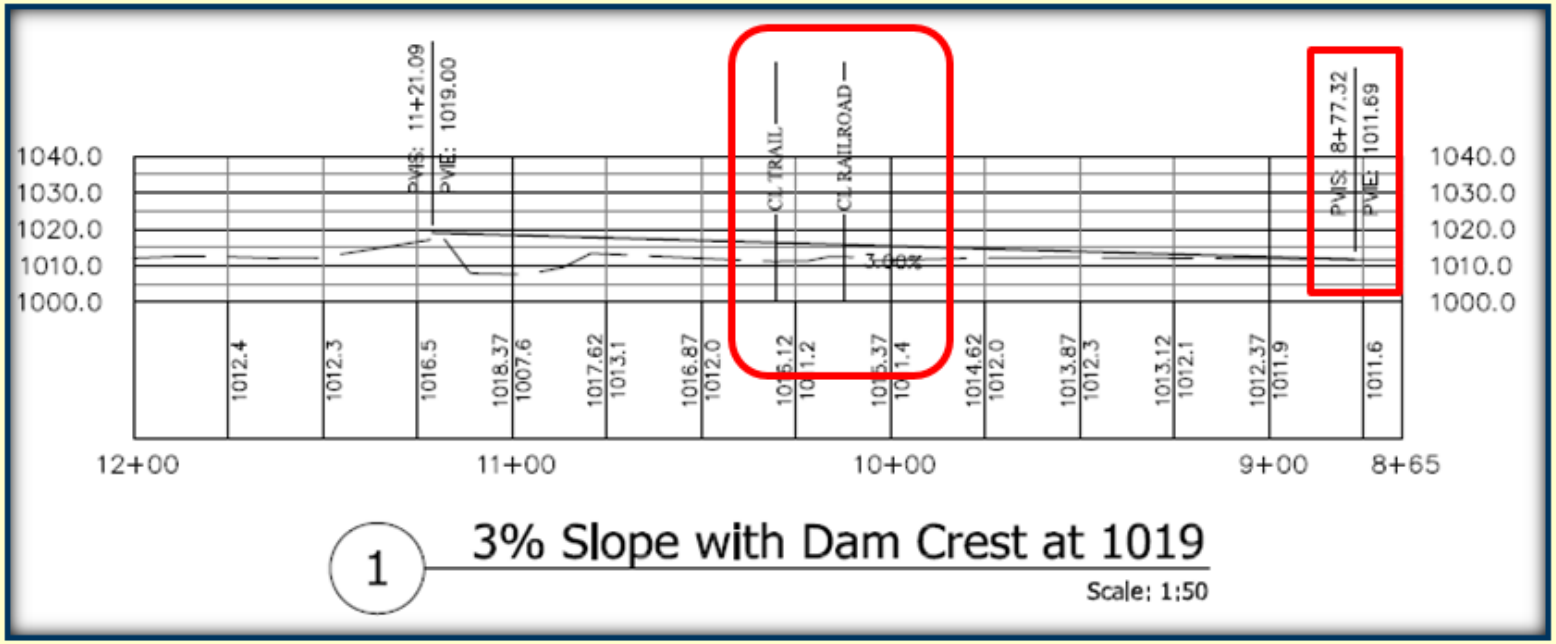
Conditions Unsupported

- **Infrastructure**: Rock Arch Rapids Geometry will impact downstream bridges, increasing velocity, and changing design conditions on downstream infrastructure.
- **Cost**: With an estimated $500,000.00 to $600,000.00 Construction Cost, this concept requires more investment than dam removal.
- **Ecology**: Natural stream geometry is not maintained.
- **History**: Historical view of Pre-European Grindstone River remains unseen.



Infrastructure Challenges with Rock Arch Rapids

Impact on Downstream Infrastructure

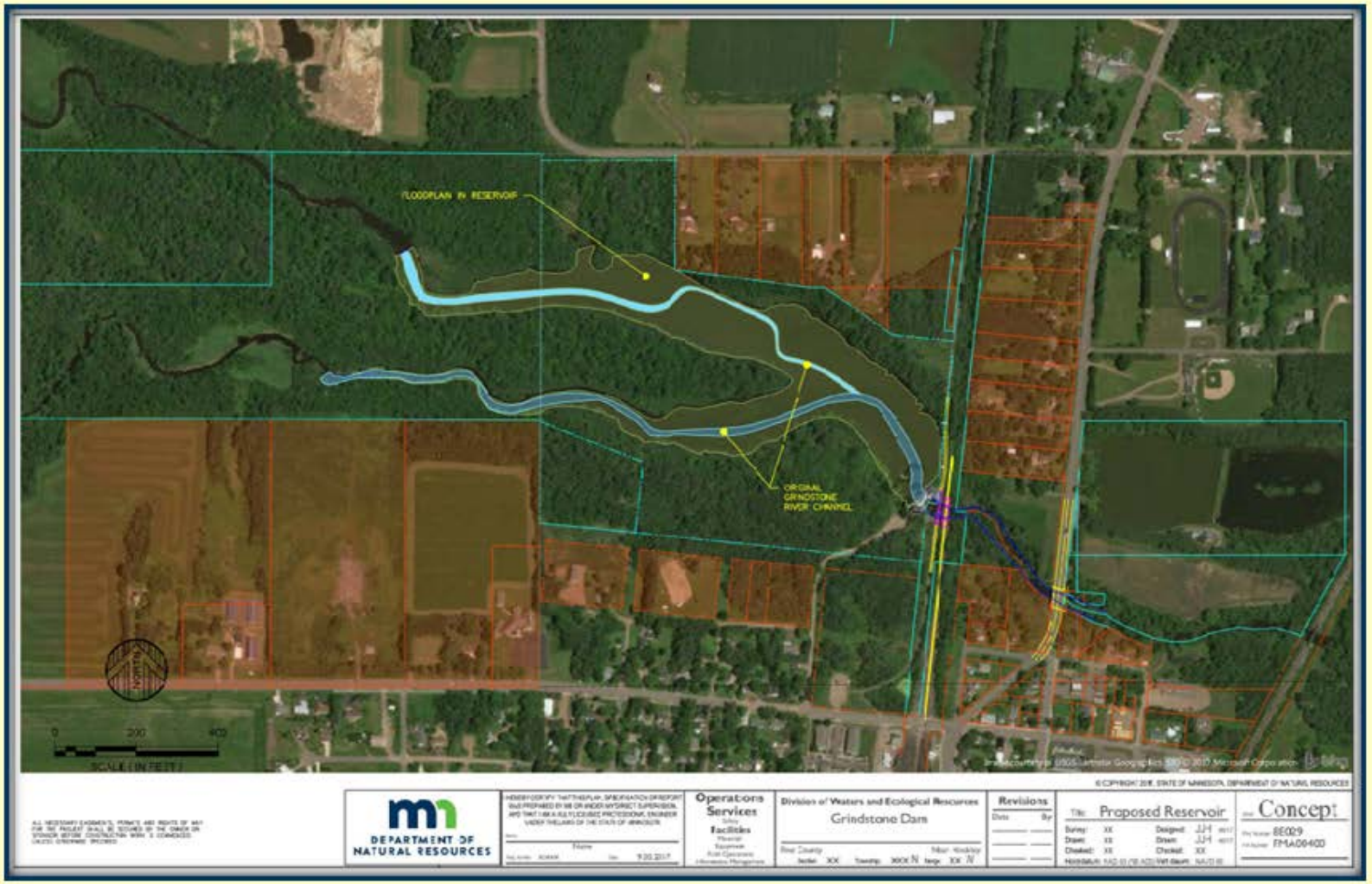


DEPARTMENT OF NATURAL RESOURCES

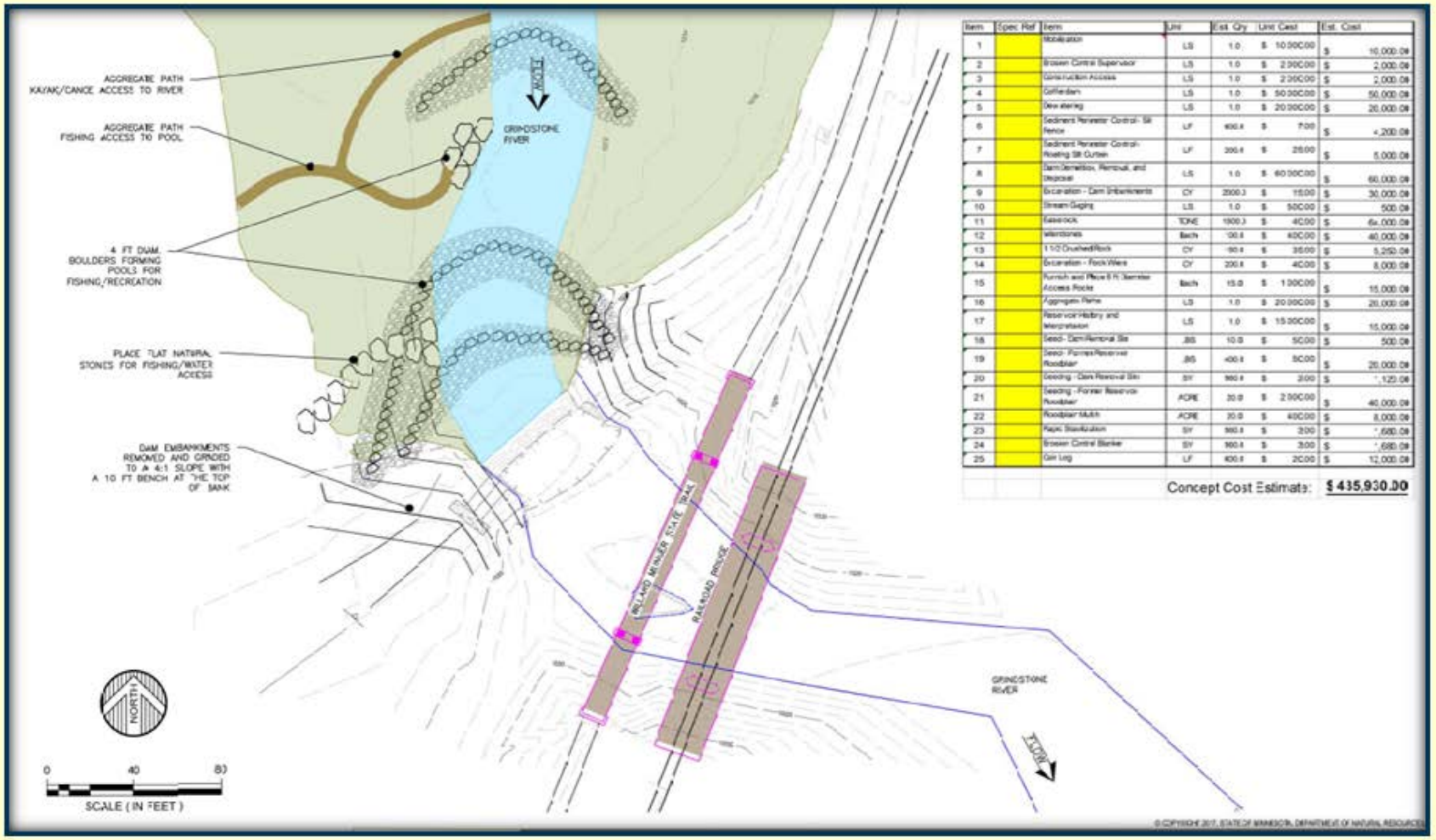
Dam Removal

Jon Hendrickson – P.E. NE Region Principal Engineer

Grindstone River Historical Channel



Dam Removal Site Concept



Item	Spec Ref	Item	Unit	Est. Qty	Unit Cost	Est. Cost
1		Mobilization	LS	1.0	$ 10,000.00	$ 10,000.00
2		Erosion Control Supervisor	LS	1.0	$ 2,000.00	$ 2,000.00
3		Construction Access	LS	1.0	$ 2,000.00	$ 2,000.00
4		Cofferdam	LS	1.0	$ 50,000.00	$ 50,000.00
5		Dewatering	LS	1.0	$ 20,000.00	$ 20,000.00
6		Sediment Perimeter Control- Silt Fence	LF	600.0	$ 7.00	$ 4,200.00
7		Sediment Perimeter Control- Floating Silt Curtain	LF	200.0	$ 25.00	$ 5,000.00
8		Dam Demolition, Removal, and Disposal	LS	1.0	$ 60,000.00	$ 60,000.00
9		Excavation - Dam Embankments	CY	2000.0	$ 15.00	$ 30,000.00
10		Stream Gaging	LS	1.0	$ 500.00	$ 500.00
11		Keystone	TONE	1500.0	$ 40.00	$ 60,000.00
12		Waterstones	Each	100.0	$ 400.00	$ 40,000.00
13		1 1/2 Crushed Rock	CY	150.0	$ 35.00	$ 5,250.00
14		Excavation - Rock Weir	CY	200.0	$ 40.00	$ 8,000.00
15		Furnish and Place 6 Ft Diameter Access Rocks	Each	15.0	$ 1,000.00	$ 15,000.00
16		Aggregate Path	LS	1.0	$ 20,000.00	$ 20,000.00
17		Reservoir History and Interpretation	LS	1.0	$ 15,000.00	$ 15,000.00
18		Seed- Dam Removal Site	.85	10.0	$ 50.00	$ 500.00
19		Seed- Former Reservoir Floodplain	.85	400.0	$ 50.00	$ 20,000.00
20		Seeding - Dam Removal Site	SY	980.0	$ 3.00	$ 2,940.00
21		Seeding - Former Reservoir Floodplain	ACRE	20.0	$ 2,000.00	$ 40,000.00
22		Floodplain Mulch	ACRE	20.0	$ 400.00	$ 8,000.00
23		Rapid Stabilization	SY	980.0	$ 3.00	$ 2,940.00
24		Erosion Control Blanket	SY	980.0	$ 3.00	$ 2,940.00
25		Coir Log	LF	400.0	$ 20.00	$ 12,000.00

Concept Cost Estimate: **$ 435,930.00**

Dam Removal Evaluation

Conditions Supported

- **Infrastructure**:
  - Former upstream reservoir may present overall increased flood storage, decreasing flood stage downstream in major flood events.
  - Removal of the Dam removes infrastructure that needs safety and condition inspections, and eventual replacement.
- **Ecology**: Grindstone river is returned to its natural state, barrier free.
- **Recreation**: New recreational opportunities in the native stream will be available.
- **Safety**: Hydraulic Roller is eliminated.
- **Cost**: At $435,000.00, likely the most cost effective option.
- **History**: Pre-European cultural and natural condition of the Grindstone river is restored.

Dam Removal Evaluation

Conditions Unsupported

- **Infrastructure**:

  Floodway "No-Rise" Study will need to be completed to determine if there are flood impacts to downstream infrastructure.

- **History**: Investment in interpretation and documentation of the reservoir history.
- **Recreation**: Recreational users will need to adapt to stream versus reservoir recreation.

DEPARTMENT OF NATURAL RESOURCES

Further Investigations

Jon Hendrickson – P.E. NE Region Principal Engineer

Further Investigations

- FEMA Floodplain Study
- Channel Bed Material Study
- Channel Geometry
- Refine Recreational Access Opportunities
- Public Water Impacts
- Drinking Water Supply Impacts

Thank You!

Hinckley Area Fisheries website

- Comments and input received tonight
- Project status updates
- http://www.dnr.state.mn.us/areas/fisheries/hinckley/index.html
- Office phone: 320-384-7721